TECHNICAL REPORT 76 2006

THE DISTRIBUTION AND STATUS OF WATERBIRDS AROUND THE COAST AND COASTAL WETLANDS OF THE NORTHERN TERRITORY

Ray Chatto

Parks and Wildlife Commission
of the Northern Territory

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Cover photograph: Magpie Goose on Mary River wetlands, Peter Whitehead.

This report is dedicated to the memory of senior traditional owner

Mr. MUNUNGURRITJ,

who died suddenly on 31/1/2004.

A gentleman and a friend, and a great help to me in the early years of this project.

Ray Chatto (Gadakaka)

PREVIOUS REPORTS IN THIS SERIES by Ray Chatto

WATERBIRD BREEDING COLONIES IN THE TOP END OF THE NORTHERN TERRITORY.

Technical Report 69/2000

http://www.nt.gov.au/nreta/wildlife/science/publications/2000/waterbird.html

THE DISTRIBUTION AND STATUS OF COLONIAL BREEDING SEABIRDS IN THE NORTHERN TERRITORY.

Technical Report 70/2001

http://www.nt.gov.au/nreta/wildlife/science/publications/2001/colonial.html

THE DISTRIBUTION AND STATUS OF SHOREBIRDS AROUND THE COAST AND COASTAL WETLANDS OF THE NORTHERN TERRITORY.

Technical Report 73/2003

http://www.nt.gov.au/nreta/wildlife/science/publications/2003/shorebird.html

NEXT REPORT IN THIS SERIES

THE DISTRIBUTION AND STATUS OF MARINE TURTLE NESTING IN THE NORTHERN TERRITORY.

EXECUTIVE SUMMARY

Prior to 1990 there had been little survey work done to assess the distribution and status (primarily their abundance, density and seasonality) of any of the Northern Territory coastal fauna. With the possible exception of some Magpie Goose aerial surveys and some work done in Kakadu National Park, there had also been very little done on assessing this for Top End wetland fauna. Locating and documenting this information for our Top End fauna, prior to instigating necessary management actions, is a vital step in ensuring the future conservation of these animals and their habitats.

Commencing in 1990 with the Parks and Wildlife Service of the Northern Territory, I began a series of extensive aerial and ground surveys to locate and document the distribution and status of selected faunal assemblages (mostly aquatic birds, marine turtles and cetaceans) along the Northern Territory coastline, on offshore islands and in Top End coastal wetlands. This is the fourth in a series of reports being written from information collected during these surveys. Individual reports are based on the different species groups surveyed. (For the purposes of these reports the aquatic birds were considered separately as shorebirds, seabirds and waterbirds, even though shorebirds are also waterbirds). The three previous reports in the series considered waterbird and seabird breeding colonies, and shorebirds. This current report summarises the distribution and status of 66 selected migratory and resident waterbird species (i.e. not including shorebirds). It covers all species of waterbirds not previously included in the earlier report dealing only with colonial breeding waterbirds. This current report also details the non-breeding distribution and status of the (13) colonial breeding species which were only discussed in terms of their breeding colony status in the earlier report. As with each of the previous reports, this current report has been produced as an overview of waterbird distribution and status, with the main aim of assisting future management and research priorities. More detailed papers on species and areas will be written at a later date following further analysis of the data.

Over the 16 year period I made nearly 70 000 separate records, totalling a cumulative 5.6 million individuals in the survey area. Of these, nearly 30 000 records, totalling a cumulative 2.6 million individuals, were of the waterbird species detailed in this report. (For the purpose of these reports a record is a single count that differs by species, location and/or time). These records and other information gathered during my aerial and ground surveys have clearly shown that the Top End floodplains and coastal wetlands of the Northern Territory support internationally important numbers of many species of waterbirds in highly favourable habitats.

Waterbirds were recorded on all parts of the Northern Territory coast, on many of the islands and throughout the vast areas of tidal and freshwater wetland. Within the survey area of the Top End, 31 separate wetland areas were documented as regionally significant for these taxa. Many of these are of national significance and at least 22 are of international importance (they would for example qualify for Ramsar listing) based solely on numbers of waterbirds. This is very much a minimum number of areas, as many of these areas could be further divided and still qualify; such are the numbers of birds present. Further, the addition of shorebird numbers to many other wetland areas would see them also elevate to Ramsar status on numbers of waterbirds and shorebirds combined. There are also many additional wetland areas that would qualify for Ramsar (or East Asian-Australasian Shorebird Network) status with shorebird numbers alone. These have been discussed in the previous report in this series (Chatto, 2003).

Waterbirds were recorded in greatest numbers in several areas. Of particular importance were the wetlands around the Keep River/Legune Station area in the far south west, and the wetlands between the Moyle and Finniss Rivers, and between the Adelaide River and Murgenella Creek in the north west of the Top End. Further important areas across the northern part of the Top End included the wetlands of the Liverpool/Tomkinson Rivers and the Glyde/Goyder Rivers (Arafura Swamps) and the southern

part of Arnhem Bay. Along the east coast of the Top End most waterbirds were recorded in wetlands associated with the northern parts of Blue Mud Bay, the Roper River area and the Port McArthur area in the south east.

Most of the species discussed in this report were found throughout the survey area, and many were found in greater numbers than previously suspected. Of the resident species, Magpie Goose, all four species of egrets and Australian White Ibis were recorded as the most abundant waterbirds. Other extremely abundant resident waterbird species included Pied Heron, Nankeen Night Heron and Masked Lapwing. Of the species that have most of their population leave the area to breed (either regularly or irregularly), many were recorded in large abundances when they were present in the survey area. These included both whistling-duck species, Grey Teal, Glossy and Straw-necked Ibis, Brolga, Black-winged Stilt and Whiskered Tern, and the migratory Gull-billed, Common and White-winged Black Tern. Species that do not normally appear in large groups, but for which the survey area was nationally important because of their high total numbers, included Green Pygmy-goose, Great-billed Heron, Black-necked Stork, Osprey, Brahminy Kite, White-bellied Sea Eagle Chestnut Rail and Comb-crested Jacana.

Many of the waterbirds discussed in this report breed in the survey area. Around 13 species breed in large mixed species breeding colonies. The breeding of these colony species is covered to a certain extent in this report, but have been discussed in much greater detail in a previous report in this series (Chatto 2000b). Magpie Goose breeding was recorded and is discussed but has been reported on in more detail by other authors. The breeding of most of the remaining resident waterbirds was not well studied in these surveys. With the exception of the large and obvious stick nests belonging to Black-necked Stork and the large coastal raptors, little emphasis was given to searching for single breeding pairs in these surveys.

Waterbirds, like most of the other fauna of the Top End of the Northern Territory, are in a unique position. Not only is there an immense amount of habitat which supports large populations of many species, but most of the area is very remote and has not been subject to many of the pressures associated with large human populations. Although this is likely to remain the case for the short term at least, it is equally likely that the pressures of human expansion within Australia, especially in coastal areas, will see some of this area targeted for development, such as broad-acre irrigation schemes, at some stage in the not too distant future. It is for this eventuality that we must be prepared. We must ensure the security of the more significant of these areas before problems arise. Locating key coastal fauna sites and documenting them in this series of reports is the first step in that process.

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF PLATES

ACKNOWLEDGMENTS

The flying skills of the many fixed wing and helicopter pilots, particularly during poor weather conditions or difficult landings, greatly increased the amount of information that could be obtained from some very remote areas. They are too many to include here, but their efforts and cooperation were greatly appreciated.

Without the ongoing funding from the Parks and Wildlife Commission of the Northern Territory and the support from some senior staff, particularly Dr. Peter Whitehead earlier and Dr. Greg Leach towards the end, such a large and demanding project would not have been possible to complete.

Aboriginal Land Councils (particularly Dhimurru), Traditional Owners and other land owners provided assistance and land access permission over the duration of the project.

The formatting and final presentation of this report is largely due to the considerable efforts of Neil Smit. For this I am particularly appreciative.

Irene Rainey and John Scott spent many hours transcribing my taped surveys on to paper, and Andrea Hope spent similar long hours entering data to databases designed by Maria Houlihan. Kerry Steele also assisted with some of the data entry. Anne Fuchs and Ryan Hudson helped with advice, and the maintenance of the databases. Charmaine Tynan assisted with many of those less interesting tasks like photocopying and also helped with some data entry.

Lisa Lemcke and Keith Saalfeld assisted with the Arc View preparations involved in this report.

Dr. Don Franklin, Roger Jaensch, Niven McCrie, Dr. Peter Whitehead and Dr. John Woinarski provided valuable comments on earlier drafts of this report.

Last but not least I would like to thank my family for putting up with the large amount of time I was away from home over the years, and then the long hours back in the office writing these reports.

BACKGROUND AND OBJECTIVES

Much of the Northern Territory's Top End (defined here as north of latitude 16^{o} 35' S, which is the southern limit of the Northern Territory coastline) is sparsely settled and relatively undisturbed. While much work has been done in recent years to survey biological values of terrestrial environments, much less has been done to locate and document the faunal values of the coast and floodplains.

In 1990, whilst conducting transect-based aerial surveys for Magpie Goose on the main Top End floodplains, I began to include additional surveys incorporating the coast and associated habitats during returns to overnight bases. These *ad hoc* surveys revealed significant aggregations of fauna that did not appear to have been previously reported. From these initial results I decided to set up a long-term project to involve three main phases. The first, and largest phase, was to broadly document the distribution and status (primarily their abundance, density and seasonality) of a number of different groups of fauna (mostly involving seabirds, waterbirds, shorebirds, coastal raptors, marine turtles, and cetaceans) from the Top End coast and wetlands. The main aim for this phase was to concentrate on locating and documenting the more significant sites for these species groups. The second phase will be to involve other people and select a series of important sites for on-going monitoring programs and the third phase will be to write and instigate management actions for sites or species where necessary.

Results from the first phase of this project are now being used to produce this series of reports. They are intended to help correct the deficiency of information about the Top End coast and major wetlands that support very large aggregations of feeding, roosting or breeding fauna. With such an immense and remote area to be covered, and with so many different species being considered, the main objectives of these reports are to provide broad scale information on the distribution and status of these species, rather than a precise quantitative assessment of fauna numbers and movements. The reports provide a robust base from which to plan more focussed studies and to develop conservation strategies, at both a regional and national level. The collection of precise quantitative data would have required a much greater survey effort. Such precision would have seriously curtailed the aim of the overall project, and yet added comparatively little to the determination of future conservation and management priorities, which are the main reasons for collecting and documenting this information. Nevertheless, there was still a large amount of data collected (over 70 000 records) and it is possible to analyse these data in greater detail than was done to produce this series of summary reports. This will be done in future papers for particular species and/or areas.

The previous three reports in the series detailed the distribution and status of waterbird breeding colonies (Chatto, 2000b), seabird breeding colonies (Chatto, 2001) and shorebirds (Chatto, 2003). This report is the fourth of the series. It focuses on both migratory and resident waterbirds that occur in the Top End of the Northern Territory (Table 1 and 2). This current report adds in all species of waterbirds not previously detailed in Chatto, 2000b. It also deals in greater detail with the non-breeding distribution and status of those colonial breeding waterbirds covered in Chatto 2000b. Even though the colonies are mentioned in this current report, all records and counts used for discussion in the relation to the colonial breeding species here are those made away from the active colonies. Obviously when the colonies are active, birds from these colonies will have been counted when feeding away from the colony sites.

The main body of this report is divided into two sections. The first section divides the surveyed area into 15 separate geographical blocks that are discussed individually with respect to location and abundance of all species of waterbirds. Much of the general description and notes on effort in each survey block is duplicated and updated from the previous report on shorebirds, but it is included again in this current report as each of the reports in this series is designed to stand alone. Unlike the shorebird report, no attempt has been made here to provide an estimate of total numbers for each

waterbird species in the Top End. This decision was taken for a number of reasons, the main one relating to time constraints in producing this report. Time did not permit the detailed piecing together of separate counts to produce total area counts, to which the individual species percentage abundance calculations could be applied to estimate total numbers of each species for the survey area. This may be done at a later date.

The second section separately summarises each of the species in terms of their distribution, numbers, seasonal variation and (to a lesser extent) breeding, over the entire survey area. This also follows the same general format as the shorebird report, but the sections within each of the species accounts is slightly different. This is further detailed in the methods section.

Plate 1. Author in a very common pose over the 16 years of this project. Photo N. Smit.

STUDY AREA AND ENVIRONMENT

The study area for this series of reports includes the coast, islands and major coastal, and near-coastal, wetlands of the Top End (Figure 1) of the Northern Territory. Although this figure also shows the main Top End rivers, these were only followed inland only so far as they had reasonably significant wetlands associated with them. Habitats in this very large survey area are both extensive and extremely varied. The surveys did not cover the entire Top End, and the actual 'survey area' (as it will be referred to in the remainder of the report) is best shown by a map depicting the records of all fauna made throughout the project (Figure 2). This figure also shows the distri bution of all records relating to waterbirds only as an overlay in red. The line of records running through the centre of the Top End (mostly down the Stuart Highway) is not part of the main survey area used for this series of reports. They are mainly associated with night fauna surveys along roads which will be written up as a separate paper in the future.

Including its many islands and estuaries, the Northern Territory coast extends for over 10 000 kilometres and spans some 9 degrees of longitude (129^{o} 00' E to 138^{o} 00' E) and 5.5 degrees of latitude (11^{o} 00' S to 16^{o} 35' S). There are three coastlines adjacent to recognised marine water masses. The western coast abuts the Timor Sea, the northern coast the Arafura Sea and the eastern coast the Gulf of Carpentaria. Although the Northern Territory coastline has a number of different environments, including small cliffs and rocky shores, and a number of different types of beaches (some with extensive dune systems), the majority of the Northern Territory coast is made up of mangrove-backed mudflats, estuaries and inlets.

In contrast, the islands are much less dominated by mangrove systems. There are some large islands such as the Tiwi Islands (consisting of Melville Island and Bathurst Island) and Groote Eylandt that have many different habitats, but most of the 800 or so islands are small and are geomorphologically and ecologically simple. Most tend to be dominated by sand, rock or coral rubble, lack permanent water and are not suitable for most species of waterbirds.

Immediately adjacent to the coastline and continuing inland for varying distances of up to approximately 80 kilometres, is a semi-continuous band of tidally inundated saline wetlands and seasonally inundated freshwater floodplains. In addition there are a number of separate wetlands, isolated from the main floodplains, which retain water for varying periods. In total, these wetland areas cover around one million hectares and have numerous drainage lines running through them. The wetlands vary from highly saline flats with little vegetation, through to well-vegetated freshwater areas.

Top End wetlands further inland from the main survey area were rarely sampled during these surveys. These consist of the middle and upstream reaches of rivers and streams, and the numerous, though mostly small, inland swamps and waterholes. Such sites were checked only if they occurred on route to recognised surveys areas, because they were not considered likely to contain significant numbers of waterbirds, and the surveying of such a large area with only scattered small wetlands was not considered cost effective. (It is nevertheless recognised that these smaller Top End wetlands are, collectively, likely to be important for many species of waterbirds, particularly breeding by ducks). Also the large areas of floodplain that are dry and often burnt during the dry season and the large areas of open dry saline flats were not given a lot of survey coverage. This meant that species such as Australian Pratincole on the burnt floodplains or Gull-billed Tern on the salt flats would have been under-recorded in terms of their total overall numbers. Similarly, the recording of species such as Pacific Heron, which often occur in small inland swamps, may also be under-recorded for the same reason.

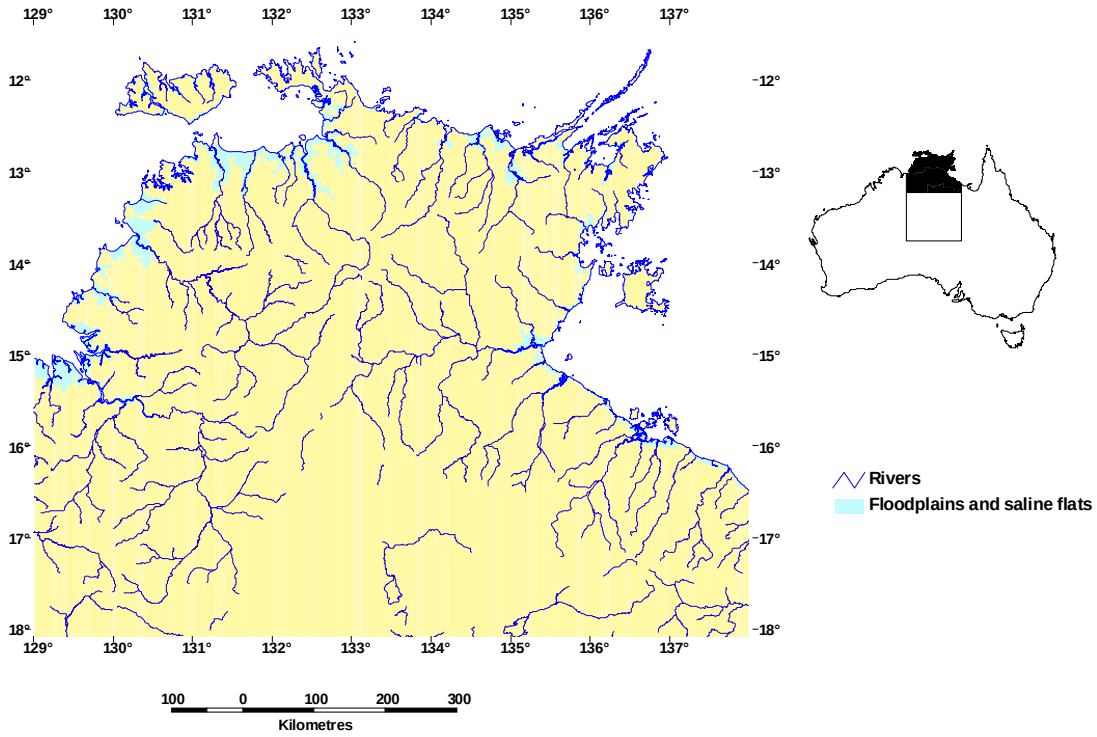

Figure 1. Northern Territory's 'Top End', showing major rivers and wetlands.

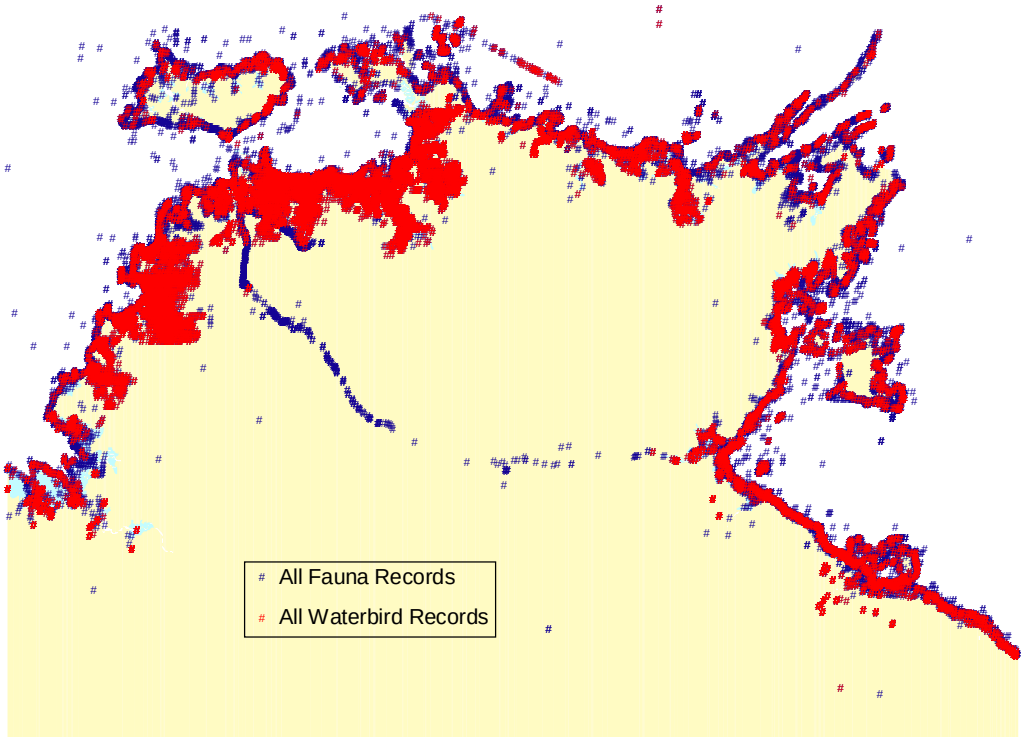

Figure 2. Distribution of all fauna records and all waterbirds records from these surveys.

In general most of the survey area still remains free of regular or major human influence. With the exception of the areas around Darwin, Nhulunbuy, the north-west of Groote Eylandt and the coast near Borroloola in the far south-east, the majority of the Northern Territory coastline and islands are very remote and sparsely populated. Levels of human development and disturbance are correspondingly low around most of the coast.

The key climatic and hydrological features of the Northern Territory coast and Top End wetlands are the relatively large annual rainfall, the intense seasonality of this rainfall and the influence of the large tidal range. Most of the Top End receives an average of at least 1 200mm of rainfall annually with regions in the north-west being in higher rainfall zones than those to the east and south (Figure 3). This rainfall is also highly seasonal, falling mostly between December and March. Mean spring tidal ranges increase from the eastern Northern Territory coast (where they average 2.2m) to the west (Darwin for example has an average range of 5.6m) and then further increases along the coast to the Western Australian border (Wyndham, just over the border in Western Australia, for example has an average 6.5m range). Consequently, in the western parts of the Top End in particular, macro-tidal regimes have significant influences on the flooding characteristics of the coast and coastal wetland systems. The influence of waves around most of the coast is minimal except for periods of exceptional storm activity. Severe storms, including cyclones, combine with seasonal droughts and high temperatures to create a harsh environment.

The high, but short-term, seasonal rainfall followed by long periods without rain has different effects on different types of wetlands. Large deep floodplains retain water longer into the dry season than small, shallow, vegetated wetlands. The latter in turn hold water for longer than the bare, open saline wetlands. Although all three of these wetland types are further influenced by the timing and amount of rainfall in the wet season, the rainfall pattern is still fairly regular compared to most inland wetlands. This has led to somewhat predictable patterns of usage by different species of waterbirds, both in terms of the likelihood of their presence on individual wetlands at different times of the year and the pattern they have evolved in regard to breeding. Some of these patterns can be quite regular, considering the overall nomadic nature of Australian waterbirds in general. In terms of feeding, the state of drying out of wetlands has a major effect. With the different types of wetlands mentioned above drying out at different times of the year, waterbirds are attracted to them in different months. In terms of breeding, some species (for example Magpie Goose and the egrets) are present throughout the year in the survey area, with most, if not all birds likely to breed in the survey area. Other than the international migrants (such as White-winged Black Tern and Common Tern) that regularly migrate out of Australia to breed, some species (such as Straw-necked and Glossy Ibis) are also very regular in the departure from the survey area to breed elsewhere within Australia. Still others (such as Black-winged Stilt and Whiskered Tern) do not breed in the survey area at all and are much less regular in the periods they spend in Top End wetlands. Finally there are those species (such as many of the ducks) which have some individuals that remain in the survey area to breed, while other individuals of the same species leave the survey area to breed. These are discussed in more detail under the individual species sections.

Another point worth mentioning in relation to the different types of wetlands discussed above is that the temporary nature of many of the shallower wetlands enhances their productivity, as reflected by the numbers of feeding waterbirds. It is well known that deep permanent wetlands tend to attract lower diversities and numbers of waterbirds than the shallower wetlands that constantly dry back through the dry season exposing continually changing margins. This occurs on a large scale in wetlands in the Top End of the Northern Territory.

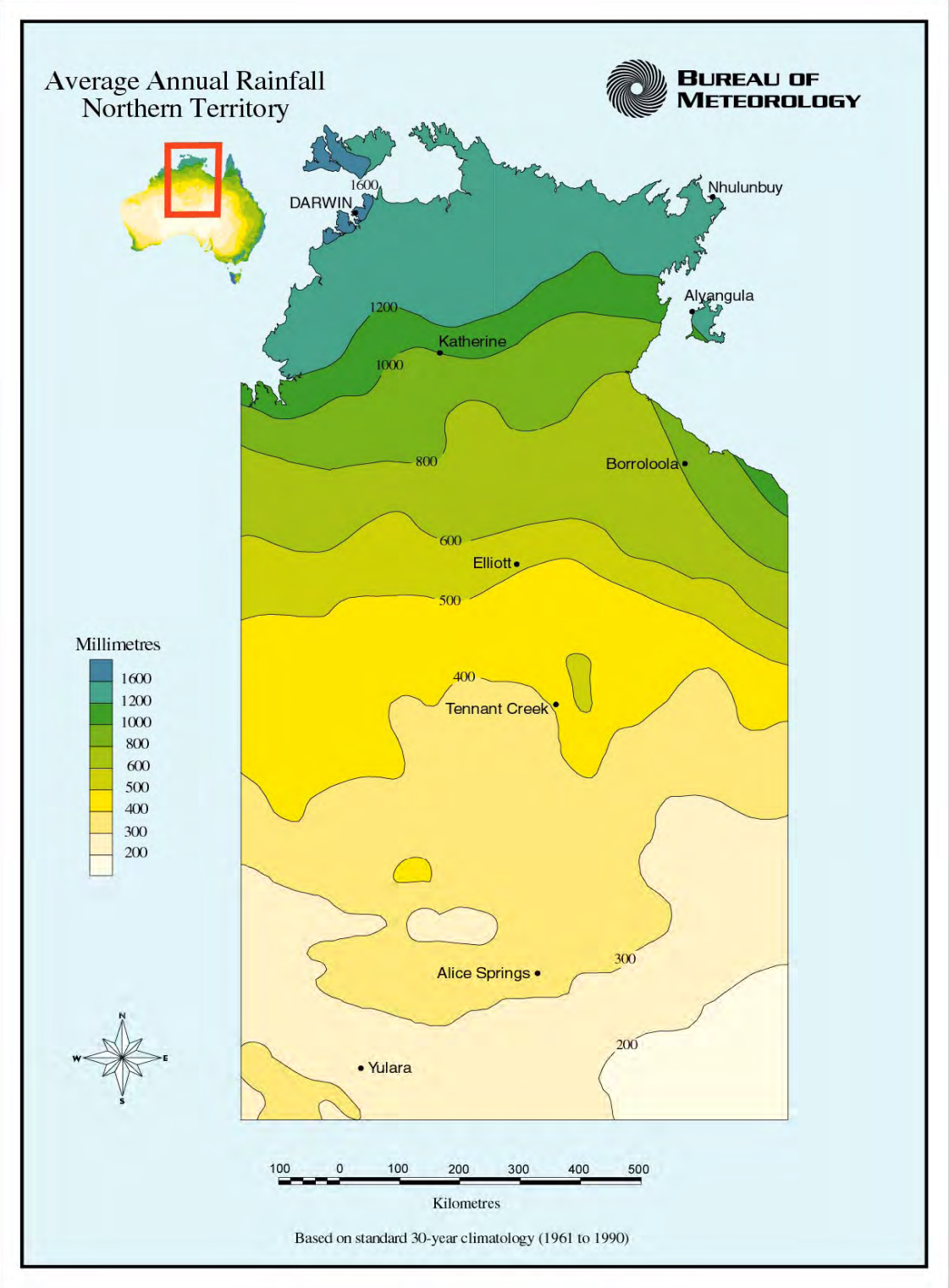

Figure 3. Average annual rainfall isohyets (mm) in the Northern Territory.

SPECIES SELECTED

The methodology adopted for these complex surveys and their subsequent analysis made it difficult to deal separately with species normally specifically defined as waterbirds, shorebirds and seabirds. Even though these groupings were the basis of separating the large number of species dealt with in this project, in terms of producing this series of reports there were some species that did not fit neatly into these recognised groups. For example, Black-winged Stilt normally classified as a shorebird, are one of the species for which it is easier to discuss with species normally classified as waterbirds.

This fourth report in this series on the distribution and status of Top End fauna is the last to deal specifically with aquatic bird species from any of these groups. It picks up any species that have not been covered under previous reports in the series, as well as those conventionally classified as waterbirds. It includes coverage of the non-breeding distribution and status of the colonial breeding waterbirds, whose breeding aggregations were discussed in a previous report (Chatto, 2000b).

The coastal /wetland raptors (Osprey, Brahminy Kite, White-bellied Sea Eagle and Swamp Harrier) were initially going to be included in a separate report. However, time constraints to complete this report series have meant that they are now considered (in less detail) in this report.

The species included in the main analysis of this report are listed in Table 1. These are species that were recorded on five or more occasions and for which the survey methodology of this project (i.e. largely biased towards aerial observations and for short time periods on the ground) is likely to give a fair representation of their Top End distribution and useful indication of their status. This does not necessarily preclude some rare and/or vagrant species, such as Black Swans, that are easily seen and identified from the air. Other species (Table 2) that were recorded fewer than five times and/or may not have been adequately sampled by such surveys because of their small size and/or cryptic behaviour are given only a brief discussion after the main species. Some of these Table 2 species are vagrants (eg Chestnut Teal) and/or occur in small numbers in few locations (eg Great Crested Grebe), but others (eg White-browed Crake) are certainly more abundant than my survey results suggest because of their secretive habits. Table 2 species also include waterbirds recorded by other people, either historically or during the survey period. Other species that may also be regarded as waterbirds (eg grass/reed birds and kingfishers) are not considered at all in these reports. It should also be noted that other species recorded elsewhere in Australia may occasionally occur in the relatively under-surveyed Top End of Australia. These have been given little or no consideration in this report.

Common and scientific names used here are as per Christidis and Boles (1994).

In addition to recording waterbirds to species level (shown in Tables 1 and 2) they were also recorded to various coded combinations at a mixed species level. This varied from pairs of species in a group (such as *whistling-duck spp.*), through larger groups (such as *duck spp.*) to an all encompassing *waterbird spp.* code. (The combination of Whiskered Tern and/or White-winged Black Tern is referred to in the text as *Marsh Tern spp.*). Most of these mixed species records were from aerial surveys. They were recorded in order to ensure significant waterbird areas/records were not missed because individuals could not be identified to species level. There are quite a few of these mixed species codes but only a few were frequently used. These involved records of ducks (the 'brown' species), cormorants and/or darters, egrets and the terns. The record of *egret spp.* was easily the most frequently recoded call for the entire survey period because of there was rarely time to spend on trying to discriminate the different species from the air, and also because of the huge numbers of egrets in the survey area.

Table 1. Waterbird species discussed in detail in this report.

Order	Family	Species	Common name
Anseriformes	Anseranatidae	*Anseranas semipalmata*	Magpie Goose
	Anatidae	*Dendrocygna eytoni*	Plumed Whistling-Duck
		D. arcuata	Wandering Whistling-Duck
		Cygnus atratus	Black Swan
		Tadorna radjah	Radjah Shelduck
		Nettapus pulchellus	Green Pygmy-goose
		Anas superciliosa	Pacific Black Duck
		A. gracilis	Grey Teal
		Anas querquedula	Garganey
		Malacorhynchus mambranaceus	Pink-eared Duck
		Aythya australis	Hardhead
Podicipediformes	Podicipedae	*Tachybaptus novaehollandiae*	Australian Grebe
Pelecaniformes	Anhingidae	*Anhinga melanogaster*	Australian Darter
	Phalacrocoracidae	*Phalacrocorax melanoleucos*	Little Pied Cormorant
		P. sulcirostris	Little Black Cormorant
		P. varius	Pied Cormorant
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican
Ciconiiformes	Ardeidae	*Egretta novaehollandiae*	White-faced Heron
		Ardea garzetta	Little Egret
		A. pacifica	White-necked Heron
		A. sumatrana	Great-billed Heron
		A. picata	Pied Heron
		A. alba	Great Egret
		A. intermedia	Intermediate Egret
		A. ibis	Cattle Egret
		Nycticorax caledonicus	Nankeen Night Heron
	Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis
		Threskiornis molucca	Australian White Ibis
		T. spinicollis	Straw-necked Ibis
		Platalea regia	Royal Spoonbill
		P. flavipes	Yellow-billed Spoonbill
	Ciconiidae	*Ephippiorhynchus asiaticus*	Black-necked Stork
Falconiformes	Accipitridae	*Pandion haliaetus*	Osprey
		Haliastur indus	Brahminy Kite
		Haliaeetus leucogaster	White-bellied Sea-Eagle
		Circus approximans	Swamp Harrier
Gruiformes	Gruidae	*Grus rubicunda*	Brolga
	Rallidae	*Eulabeornis castaneoventris*	Chestnut Rail
		Porphyrio porphyrio	Purple Swamphen
		Fulica atra	Eurasian Coot
Charadriiformes	Jacanidae	*Irediparra gallinacea*	Comb-crested Jacana
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
		Recurvirostra novaehollandiae	Red-necked Avocet
	Charadriidae	*Vanellus miles*	Masked Lapwing
	Glareola	*Stiltia isabella*	Australian Pratincole
	Laridae	*Sterna nilotica*	Gull-billed Tern
		S. hirundo	Common Tern
		Chlidonias hybridus	Whiskered Tern
		C. leucopterus	White-winged Black Tern

Table 2. Species infrequently recorded in my surveys or recorded by others.

Order	Family	Species	Common name
Anseriformes	Anatidae	*Oxyura australis*	Blue-billed Duck
		Chenonetta jubata	Australian Wood Duck
		Anas castanea	Chestnut Teal
		A. acuta	Northern Pintail
Podicipediformes	Podicipedae	*Poliocephalus poliocephalus*	Hoary-headed Grebe
		Podiceps cristatus	Great Crested Grebe
Pelecaniformes	Phalacrocoracidae	*Phalacrocorax carbo*	Great Cormorant
Ciconiiformes	Ardeidae	*Ixobrychus minutus*	Little Bittern
		I. flavicollis	Black Bittern
Gruiformes	Gruidae	*Grus anitigone*	Sarus Crane
	Rallidae	*Gallirallus philippensis*	Buff-banded Rail
		Rallus pectoralis	Lewin's Rail
		Amaurornis olivaceus	Bush-hen
		Porzana pusilla	Baillion's Crake
		P. tabuensis	Spotless Crake
		P. cinerea	White-browed Crake
Charadriiformes	Recurvirostridae	*Cladorhynchus leucocephalus*	Banded Stilt
	Glareolidae	*Glareola maldivarum*	Oriental Pratincole

Plate 2. Magpie Goose with one surviving young, Fog Dam, June 1995. Photo R. Chatto.

Plate 3. Egrets and Magpie Geese South Alligator Floodplain. Photo G. Miles.

METHODS

SURVEY TYPES

The most economical and practical way to cover the long coastline, many islands and large areas of wetland of the survey area was from the air. As fixed wing aircraft fly faster, have greater endurance and are cheaper than helicopters, most surveys to initially locate good ground sites for subsequent total counts were done with a single engine fixed wing aircraft. Most of this flying was done at around 100–300 feet (30-91m) at speeds varying between 40 and 120 knots. These variations reflected the prevailing operating conditions and species/areas being targeted. The positions of sites of interest were recorded, and they were circled as low and as slowly as possible to better assess species and numbers. Significant sites, usually because of large numbers of fauna present, were then revisited in a helicopter (or occasionally boat, airboat, vehicle or quad bike) for ground assessment. This was usually later in the same field trip. Depending on the accessibility of the sites, varying amounts of time, ranging from a few minutes to a couple of hours, were spent recording species and estimating numbers. Because of time and budget restrictions and the huge area being covered, surveys - particularly ground surveys - tended to be biased towards larger groups of fauna so species that less frequently aggregate in large groups are likely to have been less frequently counted from the ground.

In both ground and aerial surveys, all observations and counts were made onto a tape recorder, with frequent reference to latitudes and longitudes (read from a GPS) and time of day. All records were made to the nearest decimal minute or second of latitude and longitude, as called to the tape during the survey. Consequently, the vast majority are point records, with only a small number of records relating to an area or segment of coast. Tapes were then transcribed and written out in long hand on the return from a survey, and relevant data recorded onto three databases. Two of these databases were set up specifically for colonial breeding waterbird and seabird records, and the third and larger database was for all other fauna records. The third database contains all waterbird records, except those relating to waterbirds in active breeding colonies. In total this database currently has nearly 70 000 records, totalling over 5.6 million individuals. Of this, there are currently approximately 30 000 records of waterbirds totalling over 2.6 million individuals.

SURVEYEFFORT

Information presented in this report, and others in the series, is taken from a long term and complex series of surveys incorporating a number of methodologies designed to encompass collection of data on a great deal more than waterbirds. Consequently, it is difficult to accurately quantify survey effort in relation to specific species groups. Nevertheless, I spent around 2 250 hours, over more than 650 different days between 1990 and 2005, conducting aerial and ground surveys that involved at least some emphasis on waterbird/shorebird work. The approximate percentage of all survey hours involved in waterbird/shorebird surveys each month is shown in Figure 4.

Although most effort was focussed on March, April, May and September, all months received at least 5% of the survey hours except January, which only received 3%. This of course introduces a potential bias due to seasonal changes in habitat availability and means that such figures can only be used as a guide. Attempting to directly relate survey hours to species or area counts for comparative purposes would not be wise.

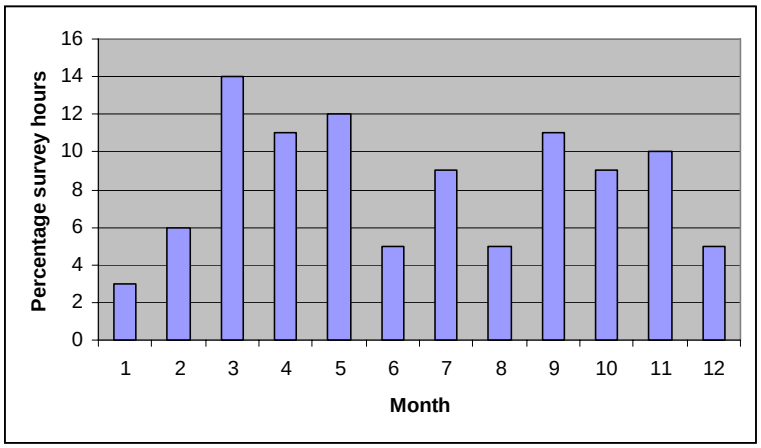

Figure 4. Percentage of total survey hours for each month.

It should be pointed out that the floodplains between the Moyle River (south west of Darwin) and Murgenella Ck (north east of Darwin), usually referred to as the north west of the Top End or survey area (and including Survey Blocks 3-5), were subject to considerably more surveying than the remainder of the survey area. The greater ease and lower cost of surveys close to Darwin led to more being done throughout the project. In addition, the number of records from this area was also boosted by the many hours of aerial transect-based surveying done as part of the annual Magpie Goose surveys between 1990 and 1993. These annual Magpie Goose surveys also introduce a bias into the overall counts in terms of time of year as all were done between February and April (occasionally early May). Consequently, distribution maps and monthly count breakdowns (by record or numbers) are increased for this area and these months. Nevertheless, these north west wetlands are the most extensive in the Top End and they do have greatest numbers of waterbirds. The only records from these Magpie Goose surveys added to my database and used in these reports were those made by myself. Unlike other survey observers in this program, I recorded all species of aquatic bird and so there is no bias toward Magpie Goose.

TEMPORAL COVERAGE

Due to the large size and remoteness of the survey area, logistic and cost constraints prevented regular repeated surveys of areas. Consequently it was necessary to program regional surveys in conjunction with other targeted species (e.g. shorebirds, seabirds and marine turtles), and try to make visits at 2-3 key times during the year. When surveys were to be done in which waterbirds were likely to be an important part of the surveys, attempts were made to focus on the important seasons for these species. For resident species this included wet and dry season surveys, while for migratory species it included arrival and departure times.

In light of the above, and because the main priority of these surveys was to locate significant sites and document the numbers and diversity of species at these sites, the seasonal movements for many species are not discussed in detail. Discussion on seasonal movements is mostly included in the individual species sections rather than on a survey block basis. It is possible that more analysis of the database in conjunction with field notes may reveal more information on seasonality, but this would have taken considerably longer than the time allocated to produce this report. This may be done in the future for more focused papers, but the aim of this phase of the project was to produce a timely record of the main species groups via this series of reports.

QUALITY OF NUMERICAL ESTIMATES

Throughout the report reference is made to ‘records’ and ‘counts’. A 'record' refers to a single count or observation that differs by species, location (i.e. latitude and longitude) and/or time. A record may be of a single individual or a large number of that species. Aerial surveys tended to have more records because the interspersion of the many species (of all fauna, not just waterbirds) required rapid and frequent identification, counting and recording. On the ground, however, there was usually the time to make more than one count of the same species from different parts of the same site and then total them for a record. Around 23 800 aerial records and 6 200 ground records relating to waterbirds were made during the project. (The vast majority of these records were collected by myself, but there were a small number of records made by Jaensch (1994) in his wetland surveys of the sub-humid tropics in 1993. I assisted in some of these surveys but did not visit all the sites that were within my survey area, for which these extra records apply).

The distribution of aerial records essentially covers the survey area so there is no real advantage in showing these separately on a map. Figure 5 shows the sites where counts were made from the ground, which included records collected from the small number of boat surveys. These include the sites where the more detailed waterbird counts were done within the survey area.

'Counts' (or total numbers) are simply the total numbers of individuals recorded. Although many accurate counts were made during ground surveys, many of the counts made during this project are based on estimations. With the large area being covered and the (previously mentioned) main aim of the collection of this information, it was decided at the start to put a greater emphasis on obtaining quick estimates from a large number of sites, rather than more detailed counts from a lesser number of

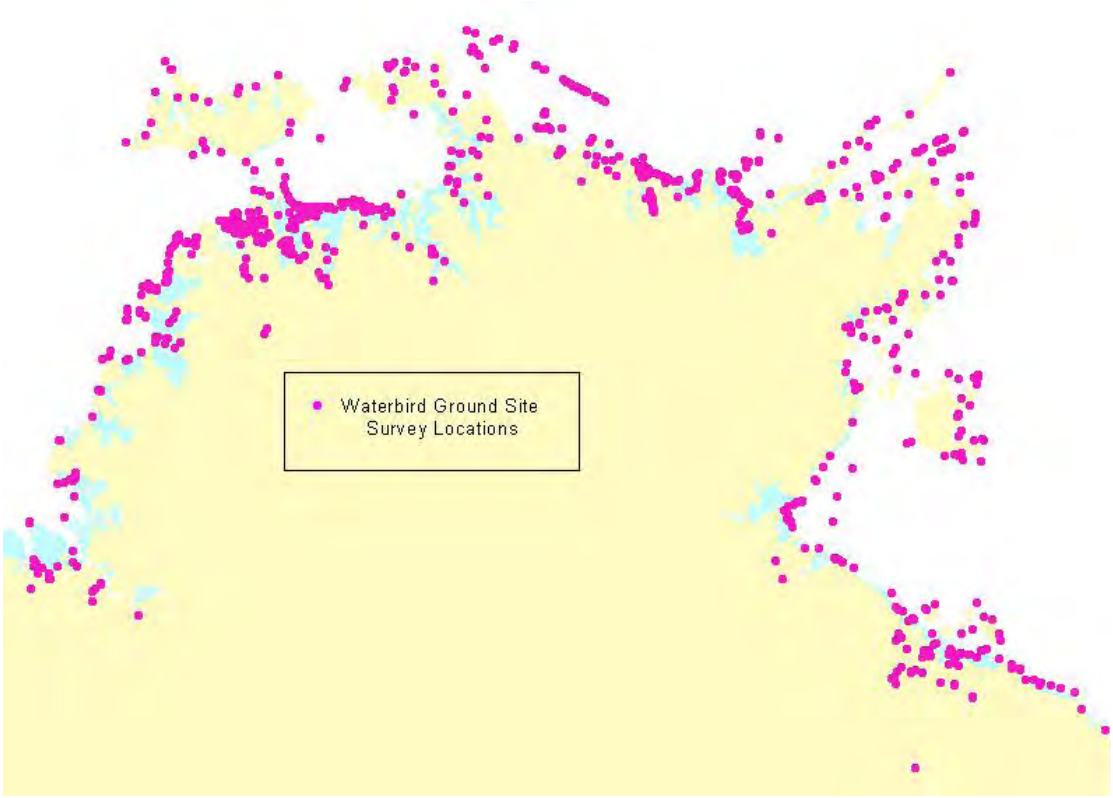

Figure 5. Location of all ground sites involving waterbird data collection.

sites. Estimates in these surveys were made as either a specific minimum number or, very occasionally, a range estimate (e.g. 1 000 - 3 000). The midpoint of any range estimate was then taken to represent the number counted for that record. Throughout the surveys there were over 640 000 waterbirds counted from ground surveys and just under 2 million from aerial surveys.

There are two issues relating to the use of counts in this report. The first concerns the accuracy of the counts themselves and the second concerns their use in relation to estimating the total number of waterbirds in a given area.

In relation to the accuracy of the individual counts, I suggest that most of the counts of smaller groups of birds that involved estimations (rather than accurately counting all individuals) would be reasonably accurate. My justification for this is based on more than 25 years of experience in estimating numbers of varying types of fauna during aerial and ground surveys.

Estimations of numbers in large groups, on the other hand, would be more likely to be under-estimations. It is well documented that estimates of numbers in large groups of animals by both experienced and, more so, inexperienced observers, are usually underestimates (Garnett and Carruthers 1982; Morgan 1986; Bajzak and Piatt 1990; Chatto, pers. obs.). This is especially so for aerial counts. Kingsford (1999) suggests that aerial waterbird surveys may only count half the number of birds that are present.

The second issue concerns the relationship of the counts/estimations to the actual total number of birds in an area, as is discussed for significant areas within this report. With the large number of methods and habitats surveyed in this project there was neither the time nor the money to attempt to apply personal or habitat based correctional factors to counts, particularly in aerial surveys. The data discussed in this report are the raw counts/estimations themselves. Further, large areas of wetland could rarely be completely covered. Consequently, the numbers of waterbirds referred to in specific site/area discussions are, in all but small wetlands, nearly always well under the true numbers present.

Two examples can be given to illustrate the potential variation between raw counts and corrected counts for waterbird numbers in the survey area. The first example relates to the annual Magpie Goose surveys. In these surveys, waterbirds were recorded along a 200 m wide transect, with each of the (east/west) transects 2.5 km apart. Correction for the percentage of area covered needs a multiplication factor of around 13, before observer calibration is even considered. In the case of the Magpie Goose surveys the observer correction factor required a multiplication factor of at least two. Combining both of these correction factors means the number of birds recorded in the raw data may need to be multiplied by up to 26 times to give an estimate for the whole area. The data I have added to my database from these Magpie Goose surveys and used in these reports are the raw un-calibrated data so as to retain comparability to the rest of the records made during this project.

The second example involves the corrected counts done in surveys by other Parks and Wildlife staff in the Arafura Swamp, which is a large wetland in the north east of my survey area. Specific aerial surveys to assess total numbers of waterbirds in June 98 and December 2000 (Brennan *et. al.* 2003) estimated 300 000 waterbirds (after correction and calibration) on both occasions. My raw data without such corrections, and not covering all of the wetland for a July 1998 survey recorded 34 500 birds. These are the figures I have used for discussion in this report. Similar situations apply to Morton *et. al.* (1991) estimates of waterbird numbers in Kakadu compared to my raw counts.

QUALITY OF ANALYSIS

This project was designed to collect baseline data on the distribution and status (primarily their abundance, density and seasonality) of a large range of coastal and wetland fauna. These data were collected over an extensive area that had received few previous surveys. The planning and collecting of this data was primarily based on its being used for ongoing management and as a baseline to assist with the direction of future research. Hence, analysis of the data is kept simple and results presented as approximations of relative abundance or indications of movement or seasonal trends. The main reason for this caution is the large range of methods that were needed to cover all species and areas, but there are many other caveats that make detailed analysis of these waterbird surveys difficult.

In terms of the general ecology of waterbirds, especially in tropical locations, limitations include:

(i) the lack of detailed knowledge about the local, national and international movements of migratory waterbirds using the Top End, and
(ii) the intermittent movements of resident Australian species in and out of the Top End in relation to varying seasonal conditions here or elsewhere.

In terms of these particular surveys, additional limitations include:

(i) the very large survey area and number of different habitats,
(ii) the large variety of species being surveyed, and
(iii) the emphasis on locating as many significant sites as possible rather than repeatedly surveying known sites.

One important factor that counterbalances some of the limitations listed above is the fact that such a large number of surveys done over such a long period of time and extensive area provide robust summaries of major, broad scale patterns.

DATA PRESENTATION

There are two main sections in this report, which follow the same approach as the previous report in the series on shorebirds. The first section looks at individual areas (survey blocks) and the second section looks at each species of waterbird separately. Due to the nature of this report there is a considerable amount of repetition within each survey block and within each species account. Although this can be annoying when reading the report as a whole, I considered that this approach is necessary given that most of the requests for information from my surveys come from people wanting to know about specific species or areas. This approach allows each of the survey blocks or species accounts can be read separately on a ‘stand alone’ basis.

Data Presentation Within Each Survey Block

This section discusses Top End waterbird distribution and status in terms of 15 individual survey blocks. These survey blocks have been kept the same as was used in the previous report in the series on shorebirds, although the presentation within each has been changed a little. There are a small number of waterbird records that lie outside of these survey blocks because of the more extensive distribution of waterbird records compared to shorebird records, but the survey blocks were kept the same to allow the two groups of aquatic birds to be discussed in a comparative way.

Each block has the same method of presentation which involves discussions under the following headings.

Location and Habitat.

This section shows the geographic location of the block within the overall survey area and briefly discusses the main waterbird habitats and other main features of the block.

Survey Effort.

This section gives an approximate breakdown of the percentage of hours of waterbird/shorebird survey per month over the full period of the project. It also shows the total amount of surveys hours as a percentage of all of the 15 survey blocks combined.

Results and Discussion.

This section first summarises the number of records and total counts of waterbirds made throughout all surveys in the block and then compares these figures with the other survey blocks. It also gives the total count of waterbird species (from those listed in Tables 1 and 2) recorded in that survey block over the full period of the surveys. A standard map of the Top End of the Northern Territory then shows the distribution of all waterbird records and significant areas for each survey block. The significant areas are made up of significant feeding, roosting and colonial breeding sites and records. The definition of a significant feeding or roosting record is detailed below.

Species Relative Abundance. This section lists the top few most abundant species in that survey block throughout all surveys. In this section each of the species mentioned is mostly listed in order of abundance. Separate lists were compiled for all aerial surveys and for all ground surveys. The two methods of surveying have not been combined because each has advantages and disadvantages in locating and/or recording numbers of different species. Comb-crested Jacana, for example, are not easily seen from the air, and therefore better recorded from ground surveys. On the other hand, Black-necked Stork are often spread in low densities over large inaccessible areas, and are therefore better surveyed from the air. No single survey method will account for all the species discussed in this report in an even manner. The total numbers counted for all species recorded in each survey block over the full period of the surveys are given in Appendix A. The total numbers of all species combined for all survey blocks, along with a percentage comparison with the other survey blocks, is then given in Appendix B.

Species Recording Rates. These are again discussed separately under aerial and ground surveys. This discussion is based on the number of individual records rather than total numbers because some species are widespread in smaller numbers and thus also significant within the survey block. The list is given again, in order from highest down, for the top few species in terms of the number of times they were recorded. Full lists for the number of records are given in the same tables in Appendix A and B as per discussion above in regard to abundance figures.

Important Areas.

Significant Waterbird Breeding Colonies. Even though these sites have been discussed in detail in the first report in this series (Chatto, 2000b), they are again briefly mentioned in a separate section for each survey block because of their immense importance and relevance to this report. They also form part of the criteria for the selection of the selected individual significant waterbird areas of each survey block that are discussed in more detail below. Of the 76 waterbird breeding colonies located in the survey area only those that contain significant numbers of one or more species are considered here. The selection of what is significant in terms of breeding colonies is based on colonies that were recorded as of regional or national importance in the waterbird breeding colony report. Description of the less significant colonies not mentioned in this report is provided in the waterbird breeding colony report. The species considered as colonial nesting waterbirds during this project are Australian Darter, Little Pied Cormorant, Little Black Cormorant, Pied Cormorant, Australian Pelican, Pied Heron, Nankeen Night Heron, Little Egret, Great Egret, Intermediate Egret, Cattle Egret, Glossy Ibis, Australian White Ibis and Royal Spoonbill. There are other species (for example, Magpie Goose

which breed in large numbers during the wet season in the survey area) that could be on this list but are not included for reasons discussed in the waterbird breeding colony report.

The majority of waterbird breeding colony activity occurs during the wet season. This is a time when many other waterbirds depart the survey area. Consequently, the colonial nesting species listed as significant in this section, are among the species of waterbird present in large numbers in their respective survey blocks during the wet and early dry season. Although the list of significant colonial nesting species will be given for each block, the discussion about the associated wet season importance should be taken as assumed and will not be repeated for each survey block.

There are some comments within the survey block sections on breeding of Magpie Goose, Brolga and some of the ducks. However, as breeding of the rest of the non-colonial breeding species of waterbirds was not actively searched for during these surveys, the limited number of breeding records will be discussed in the individual species sections rather than within the survey block.

Significant Waterbird Areas. These areas combine sites of significant colonial waterbird breeding and/or other areas with significant numbers of feeding or roosting waterbirds. Because these surveys did not concentrate on total counts for areas, significant waterbird feeding and/or roosting areas are depicted by showing sites with a clumping of a number of significant records within a specific area of the survey block. Significant feeding or roosting records are those records where the species or species group count was greater than a minimum number specified as significant for each different species or species group. Obviously this is a little arbitrary and influenced by what I consider to be a significant number for each species for a single record. It also dependent mostly on dry season counts when birds congregate around drying wetlands. Nevertheless, it is seen as a useful pointer to areas of significance from such a large and complex series of surveys. The number allocated as significant for a single record to each species or species group is listed in Appendix C. With this method of using clumping of significant single records to indicate significant areas, these areas do not necessarily relate to separate wetlands or catchments. This is particularly the case in survey block 5 where the area identified as significant overlaps portions of many different wetlands because of the large amount of wetland area and huge numbers of waterbirds.

Significant waterbird areas are marked and numbered on the distribution map for each survey block and discussed in the text for that block. The numbering system with regard to the significant waterbird record areas for each survey block is simply the survey block number followed by the area number within that survey block. Analysis of records for each of these significant areas was done by placing a rectangle of best fit around that area and using Microsoft Access queries to give details of records, counts, dates etc. from that rectangle of area. Consequently, total numbers discussed relate to the area covered by the entire rectangle rather than just the marked significant area, but this should have little effect on most occasions because of the small number of additional records involved. It must also be recognised that the discussions refer to single significant records for a given species. The addition of other records that do not register as significant by count number for that area would have a cumulative effect and increase the numbers of that species even more. The species list given in the text of this section is in taxonomic order rather than an order of abundance because of the difficulty of assigning what numbers are important in terms of the different species: e.g. 1 000 Magpie Goose may be less significant in a conservation sense than 30 Black-necked Stork.

Significant feeding and/or roosting records are also shown (along with significant breeding colonies) on a single map of the entire survey area in Figure D.1 in Appendix D. Also shown in Figure D.2 in this appendix is a map with the significant records for shorebird species based on the same reasoning. This can be used as a quick reference to locations that are important to both groups. Significant shorebird sites were discussed in detail in Chatto (2003) but were not mapped as such.

Also within this section, reference is made to the potential qualification of each area for Ramsar status on the basis of waterbird numbers. (There are a number of criteria for Ramsar qualification, but the

main one used in this report is the greater than 20 000 waterbirds present criteria). These figures only consider numbers of species discussed in this report, and as shown earlier, real totals would usually be much higher. On most occasions the areas would also have large numbers of shorebirds. Potential Ramsar sites listed here are not nominations, merely comments on whether the area meets criteria for significance that have been accepted at a global scale. More detailed examples of a sample of areas that potentially could be listed under an international agreement can be seen in Chatto (2000a), which details a sample of Top End sites in reference to sites for the East Asian-Australasian Shorebird Network.

Other Significant Single Records. Where only one or two significant records exist at a site with no others in the vicinity then these records are mentioned separately at the end of the section. These are individually labelled and shown on the maps for each Survey Block.

Data Presentation With Regard to Individual Species

This section discusses each of the individual species separately in terms of their overall distribution and status within the survey area. In general, sub-species are not considered. Also detailed in this section are comments on the geographic distribution, numbers, seasonality and breeding of each species. A distribution map of all records is also included. In the case of species that do not breed in the Top End the discussion on breeding refers to observations of the birds in breeding. This may have applied to birds coming into breeding plumage before departing the survey area or arriving back in breeding plumage after breeding elsewhere.

Table 1 species (refer to Species Selected section, page 5) are discussed first, and then there are some very brief comments on species that are infrequently recorded in the Top End, or at least during these surveys (Table 2 species).

Much of the explanation of methods required for this section has been previously discussed. However, there are some issues relating to the individual species sections that need a little further explanation.

Geographic Distribution

This section maps and briefly discusses the distribution of all records of each species throughout the project. It includes records confirmed to individual species level and those of combined species records that involve that species. Examples of the more important areas for each species are mapped (slightly larger symbol) and briefly summarised. These are mainly based on the location of the largest 10% (by count) of single records throughout all surveys for the species.

Numbers

This section discusses the number of records and total counts of each species from all surveys throughout the entire survey area. There is no reference to survey blocks in this section. Aerial and ground records and counts are again considered separately. The number of records and total counts of each individual species is also given as a percentage of all waterbirds combined. Only ground records are used for this comparison because they have considerably less bias in terms of observability differences between species than do aerial surveys. Also aerial counts have many grouped *spp.* records, whereas ground counts have considerably fewer. Nevertheless, there are still some combination *spp.* records in ground surveys. Where these combination *spp.* counts are high enough to have an influence on totals of their relevant individual species (for example egrets, ducks and terns) the combination *spp.* records have been broken down and added to the relevant individual species records and counts to give more accurate figures. This is done by calculating the percentage of each of the individual species compared to each other (from all counts) and applying that to the relevant *spp.* records. For example, if there was confirmed count totals of 600 White-winged Black Tern, 400 Whiskered Tern and 500 for the *marsh tern spp.* group, then the total counts for each individual species would become 600 + 60% of 500 for White-winged Black Tern (i.e. 900) and 400 + 40% of 500 for Whiskered Tern (i.e. 600).

Another point needs to be raised in relation to comparing the number of records and/or total numbers between species. This comparison uses data collected from surveys made over the full period of the project, and so species away from the survey area for periods (whether regular migrants such as White-winged Black Tern or intermittently departing species such as Black-winged Stilt) feature less strongly. Species breeding in large colonies, which were not counted as part of the ground counts used in these comparisons, are also disadvantaged for counts during their breeding season at least. Magpie Goose, for example, were easily the most abundantly recorded waterbird in either ground or aerial surveys throughout the project. This does not necessarily make them the most abundant waterbird in the survey area at any given time. If we were to assume that most White-winged Black Tern were away from the survey area for half the time and just look at abundance figures for the six months of the year they were in the survey area, then they would be comparable with Magpie Goose in terms of total numbers recorded. (If numbers could be added in from all the marsh tern spp. or tern spp. records then it is likely this species would be in numbers greater than any other waterbird in the survey area). The same situation also applies to comparisons of the number of records for individual species. Consequently, the ground figures given for individual species records and totals, and subsequent percentages of all species combined, are just a guide and need to be considered in light of the amount of time the species are in the survey area.

The number of aerial records is also given for each species because they are used for distribution records on the map. No further calculations of relative abundance etc. are done with these aerial records.

No attempt was made to relate the percentage abundances of each species to total waterbird counts in order to derive total survey block numbers for each species. This was done for shorebirds in the previous report in the series, but it was much more difficult to obtain total survey block counts for waterbirds. Also ground counts of colonial breeding species used for comparisons with other species in this section are only of birds counted away from active breeding colonies. They do not include numbers found within breeding colonies. This is not only because colony numbers have been previously dealt with in detail in the first report in this series (Chatto, 2000b), but it allows comparisons with other non-breeding species away from actual colony sites throughout the survey area.

The full list of records, total numbers and percentage of each across all species combined is given in Appendix E.

Seasonality

Comments on seasonality are based on examining the number of records and the total counts for each species on a monthly basis throughout all surveys, as well as specific comments noted during the project. Accounting for variation among species associated with different methods of survey meant that monthly totals needed to be separately examined for each method. The large number of tables produced in doing this were too bulky to include in this report, but details are available from the author on request.

Breeding

These surveys were not designed for, nor were they effective at, locating breeding of waterbirds other than colonial nesting species or those that made large, obvious nests, such as those of Black-necked Stork and the raptors. Little to no searching was done for ground nests, other than the Brolga and Magpie Goose nests that were observed from the air. Other breeding records were usually just incidentally recorded – often by the presence of pre-flying young. It also is possible that many ground nesting waterbirds leave the major Top End wetlands (and hence main survey area) to breed. The presence of salt water crocodiles, and the higher densities of other predatory reptiles such as water pythons and goannas and aquatic feeding raptors such as White-bellied Sea Eagle and Brahminy Kite may make nesting much less successful than breeding on wetlands further inland.

Colonial nesting species have been previously discussed in detail in the first report in this series (Chatto 2000b) and these issues are discussed only briefly within the individual species accounts.

DISTRIBUTION MAPS

Distribution maps, in both the survey block and individual species sections, show all records made over the entire period of the surveys. They also show other aspects as discussed below.

Survey Block Maps. Maps within each survey block section show a number of things. The small red solid circular symbols show the sites of all waterbird records (both to species and species group level) made in that survey block through the project via all survey methods. Larger solid green triangular symbols represent significant colonial breeding sites and large solid blue circular symbols represent particularly significant records relating to feeding or roosting waterbirds. Where there are a number of significant records the general area of these records is shaded and labelled on the map as a significant area.

Individual Species Maps. Within the single species maps, two colours and sizes of symbol are used for each species unless of a type of species usually only seen in small numbers at a site. The two symbol sizes and colours are based on numbers involved in that record. The larger symbols (blue solid circles) are the records with largest 10% of individual counts for that species throughout all surveys, and the smaller symbols (red solid circles) are the remainder of the records for that species. For example if there were 100 records of a particular species then there would be 10 larger blue symbols and 90 smaller red symbols. This means that larger symbols for species like Wandering Whistling-Duck will represent counts in the thousands but for species such as Black-necked Stork may only represent counts under ten, but they do show where the relative largest counts were recorded for that species. There were so many records for Magpie Goose that this system was not applied to them, and the distribution of their records is shown with only one size and coloured symbol.

Some of the individual species maps also have combined *spp.* records which could include that species. These are included only to give an indication of likely additional distribution of the individual species. For example the Intermediate Egret distribution map also has all the *egret spp*. records as well. Combined *spp.* records are shown as open black circles or triangles on each map.

Both aerial and ground records are used in these distribution maps to confirm the species presence. Species that can readily be identified from the air will have fairly comprehensive distribution maps. Those that cannot be easily identified from the air will be represented mainly from the patchier ground survey records and therefore will not be fully complete for the species. Nevertheless, as there were many, well spread ground sites surveyed during this project (Figure 5), the confirmed distribution records of these species is still reasonably comprehensive at a Top End scale.

As previously mentioned these surveys were not very efficient at recording breeding of non-colony breeding species. Consequently there are not large numbers of these single nest breeding records. Rather than clutter some of the maps further, when a species had some such breeding records, a second map is sometimes used to depict these sites.

WATERBIRDS – BY SURVEY BLOCK

LOCATION OF SURVEY BLOCKS

This section of the report deals with all species within specified areas called survey blocks. The total survey area was divided into 15 survey blocks (Figure 6). Rectangular blocks were used to simplify querying the database. With this in mind the positioning of blocks was then based on areas for which some separation between significant coastal and wetland habitat could be achieved. Obviously the geography of the land doesn't always fit into convenient rectangular boxes so there are a few area boundaries that bisect some sections of continuous wetland habitat. The latitude and longitude of boundaries, for each of these survey blocks are given in Table 3.

Descriptions of the areas within these survey blocks include an estimate of the length of coastline and an estimate of the area of wetland. The coastline lengths were calculated in Arc View® using the 1:100 000 coastline coverage sourced from the Department of Lands, Planning and Environment of the Northern Territory. To calculate wetland areas, relevant habitat types were selected from Wilson *et al.* (1990). These habitat types have been incorporated into the NT Vegetation Map spatial dataset. Using the functions of Arc View® software and projecting the data to the Albers Equal Areas projection, wetland areas could then be calculated. Both coastline and wetland spatial data sets were in WSG 84. Habitat types used to define wetlands in this report include:

53 – *Melaleuca* forest (Paperbark Swamp)
54 – Mixed closed-grassland/sedgeland (Seasonal Floodplain)
104 – *Xerochloa* (Rice Grass) grassland
105 – Mangal low closed forest (Mangroves)
106 – Saline tidal flats with scattered chenopod low shrubland (Samphire).

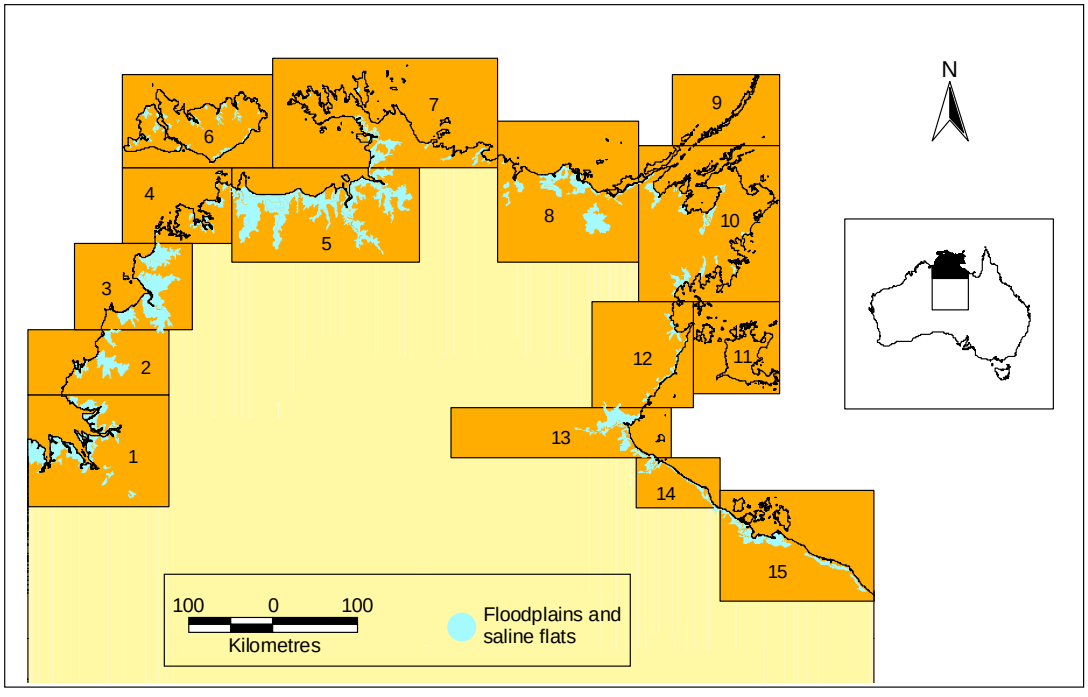

Figure 6. Location of individual survey blocks.

The combination of these habitat types is also shown in Figure 6. The wetland areas shown in this map do not fully represent all of the wetland area surveyed. Some of the smaller wetlands were not included because they are not represented at the scale of the NT Vegetation Map.

Table 3. Latitude and longitude boundaries for survey blocks.

Block No.	General Location	Coast from/to		Survey Box			
		From	To	Northern latitude	Southern latitude	Western longitude	Eastern longitude
1	WA border to Pearce Pt	14º 53′ 129º 00′	14º 25′ 129º 22′	14º 25′	15º 36′	129º 00′	130º 30′
2	Moyle River	14º 25′ 129º 22′	13º 43′ 129º 48′	13º 43′	14º 25′	129º 00′	130º 30′
3	Daly/Finniss Rivers	13º 43′ 129º 48′	12º 48′ 130º 21′	12º 48′	13º 43′	129º 30′	130º 45′
4	Darwin	12º 48′ 130º 21′	12º 11′ 131º 10′	12º 00′	12º 48′	130º 00′	131º 10′
5	Adelaide to East Alligator Rivers	12º 11′ 131º 10′	12º 00′ 132º 37′	12º 00′	13º 00′	131º 10′	133º 10′
6	Tiwi Islands	–	–	11º 00′	12º 00′	130º 00′	131º 36′
7	Cobourg Peninsula	12º 00′ 132º 37′	11º 52′ 134º 00′	10º 50′	12º 00′	131º 36′	134º 00′
8	Boucaut and Castlereagh B	11º 52′ 134º 00′	12º 06′ 135º 30′	11º 30′	13º 00′	134º 00′	135º 30′
9	Wessels Islands	–	–	11º 00′	11º 46′	135º 51′	137º 00′
10	NE Arnhem Land	12º 06′ 135º 30′	13º 22′ 135º 56′	11º 46′	13º 25′	135º 30′	137º 00′
11	Groote Eylandt	–	–	13º 25′	14º 24′	136º 05′	137º 00′
12	Southern Blue Mud Bay	13º 22′ 135º 56′	14º 32′ 135º 33′	13º 25′	14º 33′	135º 00′	136º 05′
13	Roper River	14º 32′ 135º 33′	15º 05′ 135º 40′	14º 33′	15º 05′	133º 30′	135º 50′
14	Limmen Bight River	15º 05′ 135º 40′	15º 37′ 136º 21′	15º 05′	15º 37′	135º 28′	136º 22′
15	Port McArthur to Qld border	15º 37′ 136º 21′	16º 36′ 138º 00′	15º 26′	16º 36′′	136º 22′	138º 00′

COMPARATIVE SURVEY EFFORT OF ALL BLOCKS

This section briefly discusses the survey effort in terms of a very approximate survey hours estimate (Figure 7) and the number of separate ground surveys (Figure 8) that were done in each block in relation to waterbird/shorebird dominated surveys. As mentioned in the 'Methods' section, the number of hours spent specifically on waterbird surveys is very difficult to assess in light of all the other species covered in this project. This is particularly so for separation of waterbird and shorebird survey time so they are lumped together. It can be seen that survey effort was not uniform across all survey blocks. Some survey blocks (e.g. 4, 5 and 10) received much more effort than others.

Although the number of ground surveys per block is accurate, differences in the amount of time spent specifically doing waterbird work on each ground count could not be accurately determined. Thus, again, it would not be wise to attempt to relate species count numbers to ground counts. As with survey hours, the number of ground surveys done in each survey block also shows considerable variation.

Within the survey effort section of each block the number of separate sites for the ground surveys is given. When the number of ground surveys is greater than the number of sites there has been some repetition of surveys at the same site but at different times.

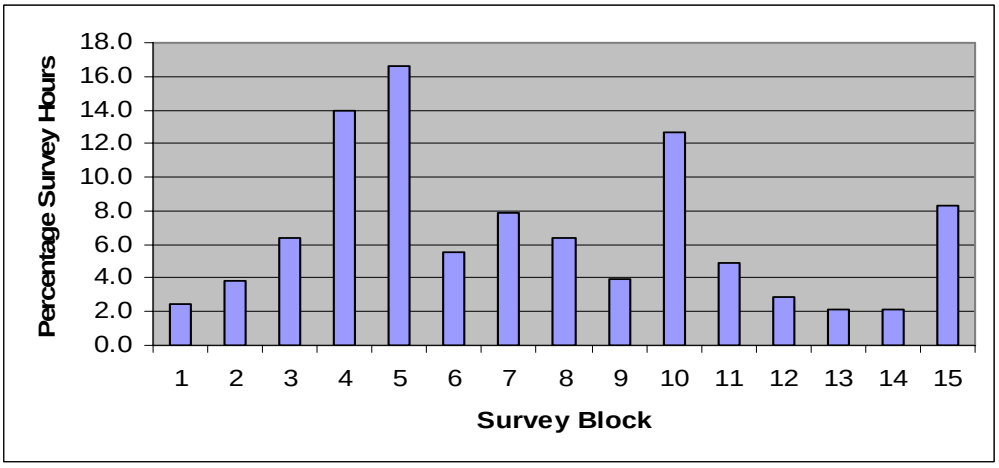

Figure 7. Percentage of survey hours for each survey block.

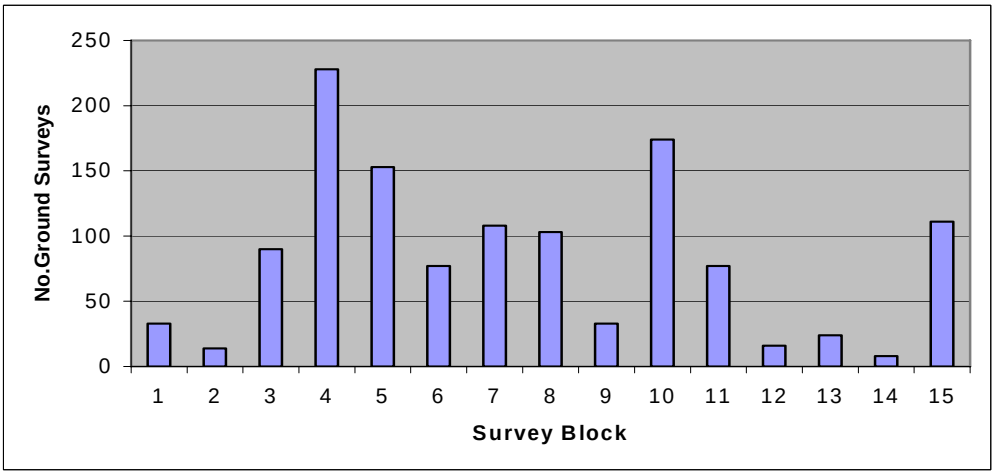

Figure 8. Total number of ground surveys in each survey block.

INDIVIDUAL SURVEY BLOCK SUMMARIES

SURVEY BLOCK 1

Location and Habitat

This survey block includes the coast, islands and adjacent inland wetlands in the far south west of the Top End, adjacent to the Western Australian/Northern Territory border. This is essentially the Joseph Bonaparte Gulf area and it lies approximately 300 kilometres to the south west of Darwin. It is a very remote area with no major towns or permanent communities. There are a small number of pastoral property homesteads and irregularly used Aboriginal outstations, but most of the coast and adjacent wetlands are infrequently visited and relatively undisturbed.

This survey block has extensive waterbird habitat with approximately 1 040 kilometres of coastline and 3 250 square kilometres of wetland. The majority of the coastline for this block has a considerable area of intertidal mudflat, backed by mangroves and narrow sandy stretches. Most of the mangroves in this survey block are sparse and small compared to other mangroves around the Northern Territory coast. There are also extensive saline coastal wetlands around Joseph Bonaparte Gulf, with most being open and relatively bare saline flats. Much of this saline flat wetland area does not hold water for most of the year, except for that influenced by tidal water from the high tides. These areas rarely have many waterbirds, or even shorebirds, except around the channel or creek areas at times. The majority of the freshwater wetlands are in the north east and south west of the survey block with the better ones, in terms of waterbird numbers, being found around the Legune Station area (between the Keep and Victoria Rivers) and the wetlands inland from Fossil Head.

Survey Effort

The survey block, being so far from Darwin, and not showing large numbers of waterbirds to be present in early surveys, did not receive a great deal of survey effort over the period of the project compared to some other survey blocks. The block received a total of approximately 50 hours (approximately 2.5% of all survey blocks) of surveys dominated by waterbird/shorebird work during the period of this project (Figure 9). These surveys were spread over 13 separate days. Aerial survey dominated the effort in this area, but there were 33 separate ground surveys involving 24 different and well-spread sites. All ground surveys were confined to March and late June.

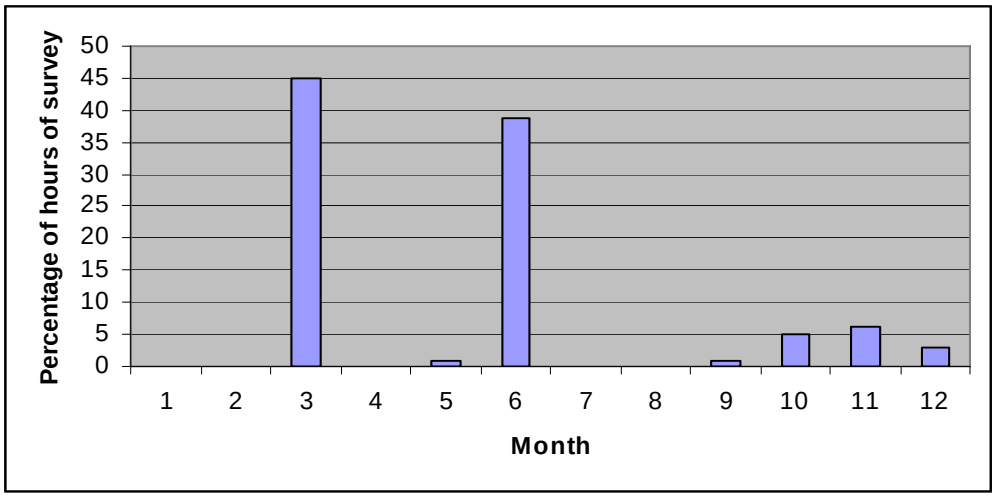

Figure 9. Approximate percentage of surveys hours relating to waterbirds for survey block 1.

Results and Discussion

Most of Joseph Bonaparte Gulf had not received any significant waterbird surveying prior to this project. Jaensch (1994) surveyed a few sites in the south, but for most of this block the current surveys probably represent the first documented information on waterbirds.

Even though the survey block has a large amount of wetland area, much of it is bare saline flats which do not often have waterbirds present in significant numbers. Apart from the coast most of the waterbirds of this survey block are found on the wetlands in the south and the north of the block. During the full period of this project there were around 770 combined aerial and ground records of waterbirds totalling around 92 000 individuals (Figure 10). These represented only 2.5% of the records and 3.5% of the total numbers of waterbirds recorded in the fifteen survey blocks. However, the relatively low survey effort should be taken into consideration. Forty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Thirty-nine species were recorded in aerial surveys of this survey block. Magpie Goose were clearly the most abundant waterbird seen in these surveys. The next most abundant species were much less common and included Wandering Whistling-Duck, Australian Pratincole, White-winged Black Tern, Glossy Ibis, egrets (as a combined group, but including all four species), Black-winged Stilt, Australian White Ibis and Brolga.

Forty-one species were recorded in ground surveys of this survey block. The most abundant species recorded during these surveys were Grey Teal, followed by Wandering Whistling-Duck, Glossy Ibis, Plumed Whistling-Duck, Eurasian Coot, Pacific Black Duck, Black-winged Stilt, White-winged and/or Whiskered Tern, Hardhead, Purple Swamphen, Brolga and Australian White Ibis.

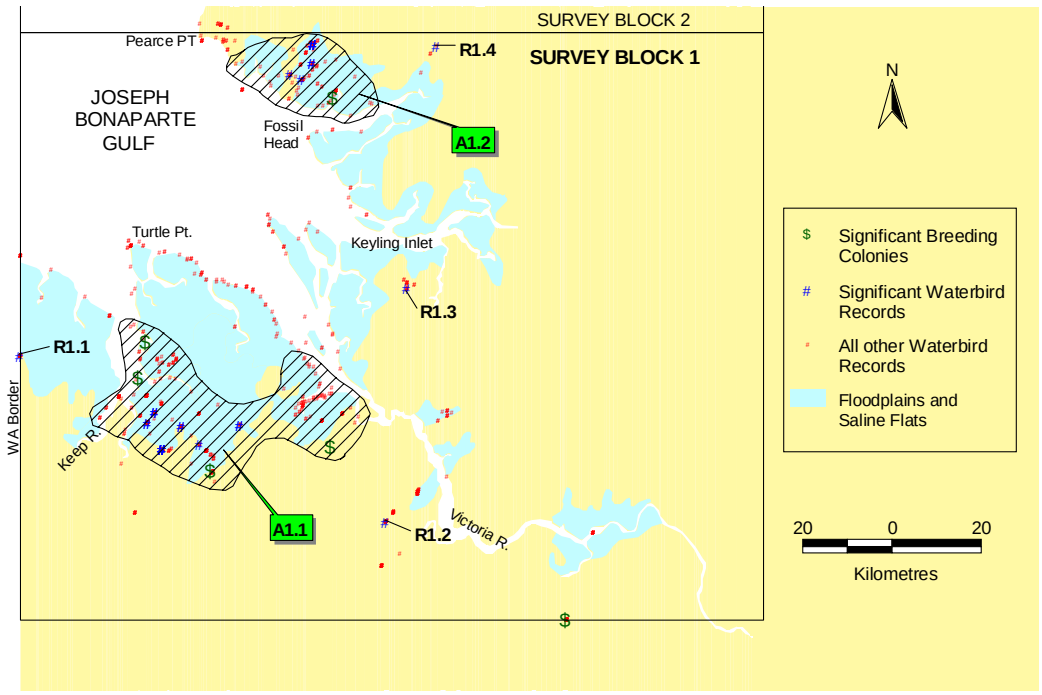

Figure 10. Distribution of waterbird records for survey block 1.

Species Recording Rates. In terms of the number of separate records (and an indication of the most wide-spread waterbirds in the survey block) the egrets were by far the most frequently recorded in aerial surveys. The next most frequently recorded were Australian White Ibis, White-faced Heron, Black-winged Stilt, Black-necked Stork, Magpie Goose, Gull-billed Tern, Glossy Ibis, Australian Pelican and Brolga.

In terms of the number of separate records, the most frequently recorded in ground surveys were Pacific Black Duck, Australian White Ibis and Masked Lapwing. These three species were all recorded 15 times. The next most frequently recorded species were White-faced Heron, egrets (all species except Cattle Egret), Glossy Ibis, Black-necked Stork, White-necked Heron, Brolga, Grey Teal and Magpie Goose.

Important Areas.

Significant Waterbird Breeding Colonies. There were six significant waterbird breeding colonies in this survey block (Figure 10). Five were in the general area of the two significant feeding and roosting areas discussed below. One of these colonies, in the Keep River Estuary, was the second largest colony recorded in the Top End and the only one to contain nesting Glossy Ibis (5 000 birds in 1999). Within the six colonies Australian Darter, Little Pied Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Nankeen Night Heron, Australian White Ibis and Royal Spoonbill were breeding in significant numbers. The presence of these colonies adds to the significance of the survey block during the wet season when the colonies are active. Further details on each of these colonies, and other less significant ones, can be found in Chatto (2000b).

Significant Waterbird Areas. Two significant areas for waterbirds were located during these surveys for this block. These areas were the wetlands between the Keep and Victoria River Estuaries in the south of the block, and the wetlands to the north of Fossil Head in the north of the survey block. These are shown as A1.1 and A1.2 in Figure 10.

Area A1.1 The wetlands between the Keep and Victoria River estuaries are one of the many highly significant waterbird areas in the Top End. These include the wetlands associated with Legune Station in the west (the most important part of this area) and the wetlands near Indian Hill in the east of this area. The area has a large amount of open saline wetland with networks of mangrove-lined channel, as well as some significant freshwater wetlands. No surveys were done that covered the entire area. The highest count for this area was over 40 000 waterbirds from a survey of part of the area in June 1999. This count easily qualifies this area for potential Ramsar listing. The June 1999 survey was numerically dominated by Wandering Whistling-Duck, Grey Teal, Glossy Ibis and Eurasian Coot. Further surveys were also done of part of this area in March, April and November. The next highest count in this area when a lot more water was present in April 1993 was over 8 000 birds. This count was dominated by Magpie Goose. The November survey showed much of the wetland area was dry, but at the same time there were good numbers of the tern species covered in this report around the coast and saline wetlands. The higher counts in this area in the June survey compared to surveys in the other months suggest that these wetlands are important as they are drying back during the dry season.

Over the full period of the project there were 21 separate significant records made during the surveys of this area. Most of these were made in the June 1999 survey. They are also shown in Figure 10. There are not 21 symbols on the map because there were a number of these records at some sites. The significant records involved 15 different species including Magpie Goose, Plumed and Wandering Whistling-Duck, Pacific Black Duck, Grey Teal, Pink-eared Duck, Hardhead, White-necked Heron, Glossy and Australian White Ibis, Black-necked Stork, Purple Swamphen, Eurasian Coot, Comb-crested Jacana and Black-winged Stilt. Single records of around 7 000 Glossy Ibis, 5 000 Eurasian Coot and 2 000 Purple Swamphen were all easily the largest made throughout the Top End survey area for these species. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative

total numbers from surveys in the area include Pied Heron, egrets, Brolga, Gull-billed Tern and Whiskered and/or White-winged Black Tern. All four species of egret were present and well represented. This included good numbers of Cattle Egret in their non-breeding season. Few Cattle Egret were in the egret breeding colonies, suggesting that this species goes elsewhere to breed.

Area A1.2 The second of the two significant areas for this survey block are the wetlands north of Fossil Head (Figure 10). These combine large areas of open saline flats with freshwater wetlands further inland of the area. Most of the waterbirds are found on the freshwater wetlands. The highest single count of over 17 000 waterbirds was made in a July 1999 survey. This survey did not record all birds and it is likely that the area would have had more than the 20 000 birds necessary for Ramsar listing. It certainly would if shorebirds were included. The July 1999 count was dominated by Brolga, all ibis species and ducks, particularly Grey Teal, Pacific Black Duck and both whistling-ducks. There were also relatively high numbers of White-necked Heron in this area during this survey.

This area had nine separate significant records made throughout the surveys. The records involved seven to nine species and included Magpie Goose, Plumed and Wandering Whistling-Duck, Pacific Black Duck, Grey Teal, Brolga, Australian Pratincole and either of both of Whiskered or White-winged Black Tern (probably the latter). Other surveys, done in the months of March and November showed a similar story to the above area (A1.1). Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Glossy Ibis, Black-necked Stork and Masked Lapwing.

Other Significant Single Records. There are also four additional significant records (shown in Figure 10) that are not part of the two general areas discussed above. They are all inland records.

Record R1.1. The site near the Western Australia border had over 1 000 White-winged Black Tern reported by R. Jaensch (*pers. comm.*) in April 1993.

Record R1.2. The record to the south east of the Legune wetlands, was of 1 000 Plumed Whistling-Duck in June 1999. There were also reasonable numbers of Magpie Goose, egrets and Brolga present at this time.

Record R1.3. This record was of 3 000 Magpie Goose in March 1999. This was a large, flooded wetland to the south of Keyling Inlet. There were also reasonable numbers of egrets present on this survey.

Record R1.4. The last of these four records was of 2 000 Australian Pratincole in July 1999, to the east of the Fossil Head wetlands. The large areas of dry, burnt floodplain in this survey block were not well surveyed and this species is probably well under-estimated in terms of the number of records and total numbers.

SURVEY BLOCK 2

Location and Habitat

This survey block includes the coast, islands and adjacent inland wetlands from Pearce Point on the northern point of Joseph Bonaparte Gulf to the northern point of the Little Moyle River estuary located about half way between Cape Dombey and Cape Scott (the latter is located in survey block 3). This survey block is approximately 200 kilometres south west of Darwin.

Although not as remote as survey block 1, survey block 2 is also another section of the Northern Territory coastline that is largely undisturbed by humans. Apart from the Aboriginal community of Port Keats (Wadeye) located near the coast in the southern section there are no permanent settlements within the survey area of this survey block.

This survey block has a coastline of approximately 200 kilometres. This is relatively short compared to most of the other survey blocks. This survey block, however, does have a reasonably large area of wetland (approximate 950 square kilometres) for its coastal length. Most of this wetland area is concentrated in three main areas. These include the freshwater floodplains associated with the Moyle and the Little Moyle Rivers, and a large area of mangroves, creeks, channels and bare saline flats in the Cape Hay to Tree Point area. Most of the coastal mudflat area occurs on the coast adjacent to these three areas. The remainder of the coastline consists of long stretches of sandy beach, backed by small cliffs and/or forest. Much of this sandy coastline habitat is not really suitable for regular use by most species of waterbirds.

Survey Effort

The survey block received approximately 75 hours of surveys dominated by waterbird/shorebird work during the period of this project. These were spread over 32 separate days. The number of hours represents approximately 3.8% of all survey blocks. Most survey time for this survey block was in March – a reflection of the annual aerial Magpie Goose surveys of the early 1990s (Figure 11). No surveys were carried out in June but the remaining months were similarly represented, albeit by the relatively small amount of surveying. Aerial survey dominated the effort in this area, and there were only 14 separate ground surveys done involving 11 different sites.

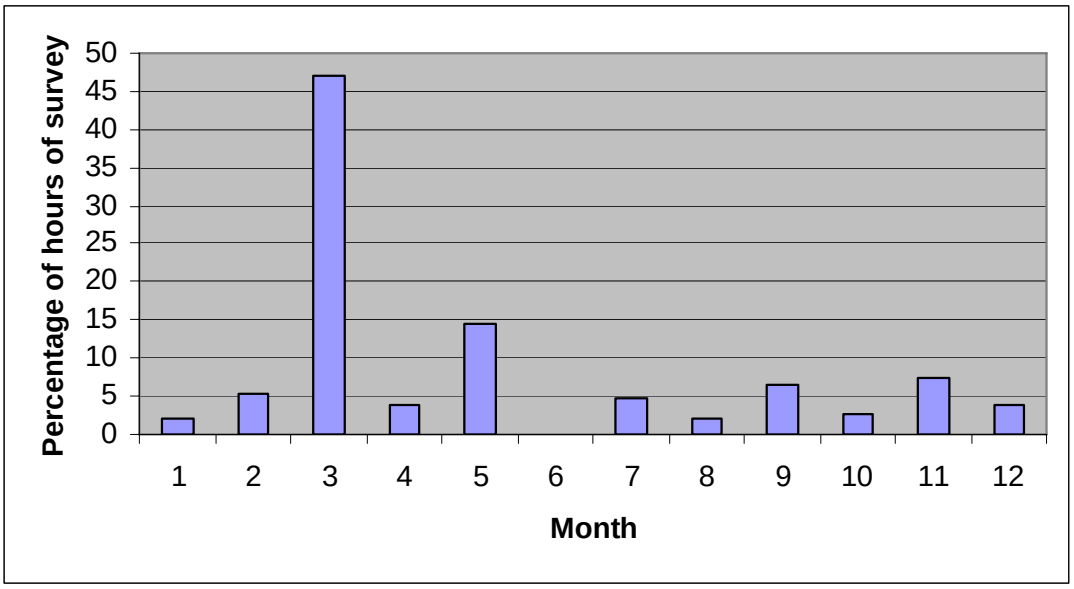

Figure 11. Approximate percentage of surveys hours relating to waterbirds for survey block 2.

As this survey block had only a small number of ground surveys, most of the waterbird records were from aerial observations, with some species therefore not well recorded to species level. It also was the only survey block that did not have any ground surveys of inland wetlands. Coverage of inland wetlands was via aerial surveys of parts if the area. These were mostly in the late wet season while still very flooded and prior to the normal dry season increases in resident waterbirds. They did not reveal large numbers of waterbirds. Dry season surveys of the inland wetlands would almost certainly increase the numbers of waterbirds for this survey block.

Results and Discussion

This survey block was another section of the Northern Territory coast that has had few waterbird surveys prior to this project. During the full period of this project there were around 900 combined aerial and ground records of waterbirds totalling around 22 400 individuals (Figure 12). These represented around 3.0% of the records and <1% of the total numbers of waterbirds recorded in the fifteen survey blocks.

The majority of waterbirds in this survey block were distributed on the floodplains of the Moyle and Little Moyle Rivers. Thirty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Thirty-seven species were recorded in aerial surveys of this survey block. Magpie Goose were clearly the most abundant waterbird seen in these surveys. The next most abundant species were the egrets as a group (all four species represented), Rajah Shelduck, Grey Teal, Pacific Black Duck, White-winged Black Tern, Brolga, Straw-necked Ibis, Pied Heron and Glossy Ibis.

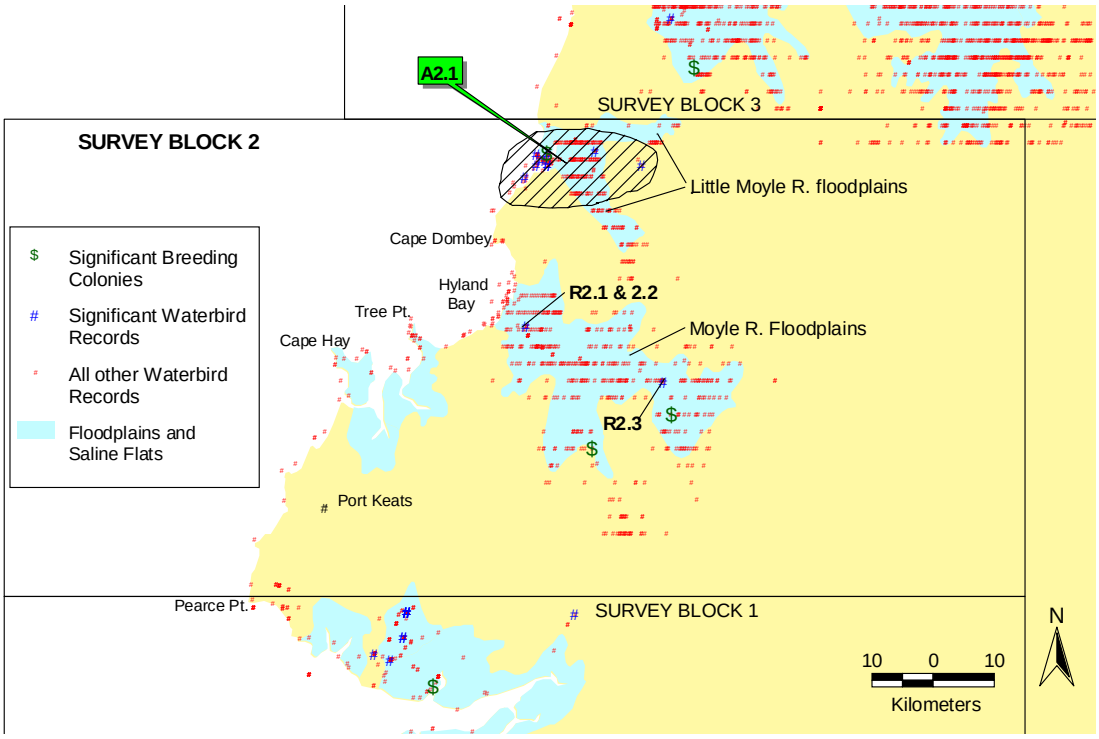

Figure 12. Distribution of waterbird records for survey block 2.

There were few waterbird species recorded from the 14 ground surveys in this block. All ground surveys were concentrated coastally, and mainly for shorebirds, seabirds and marine turtles – reflecting the importance of this block for these species. The relatively small size of this survey block also contributed to the lower number of ground counts. As a result only 11 waterbird species were recorded in ground surveys. These mainly reflected waterbirds that utilize the coastline and wetlands immediately behind. The most abundant species recorded during ground surveys were Gull-billed Tern, Rajah Shelduck, White-winged Black Tern, Whiskered Tern, Grey Teal, Masked Lapwing and Black-winged Stilt.

Species Recording Rates. In terms of the number of separate records, and hence the most wide-spread waterbirds in the survey block, the egrets were by far the most frequently recorded in aerial surveys. The next most frequently recorded were Straw-necked Ibis, Black-necked Stork, Australian White Ibis, Rajah Shelduck, White-bellied Sea-Eagle, the egrets as a group (including all four species), White-faced Heron, Brolga, Pied Heron, Black-winged Stilt and Little Pied Cormorant.

No species was recorded more than four times in ground surveys. Species recorded on more than one occasion included Gull-billed Tern, Whiskered Tern, Masked Lapwing, Rajah Shelduck, Grey Teal, White-winged Black Tern and Little Egret.

Important Areas.

Significant Waterbird Breeding Colonies. There were three significant waterbird breeding colonies in this survey block (Figure 12). Two of these were Royal Spoonbill and mixed cormorant/darter breeding colonies in the upper parts of the Moyle River floodplain, and the third, a large mixed species colony on an island in the mouth of the Little Moyle River in the far north of the block. Species represented in significant numbers in these colonies include Australian Darter, Little Pied Cormorant, Little Black Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Nankeen Night Heron and Royal Spoonbill. These, and other less significant colonies, are detailed further in Chatto (2000b).

Significant Waterbird Areas. There was only one significant waterbird area confirmed during surveys for this block (Figure 12). This was in the vicinity of the downstream parts of the Little Moyle River. (If more extensive surveys had been done of the Moyle River floodplain in the south of the block in the late dry season, it probably would have revealed many more waterbirds and be listed as another significant area. There is also some quite significant Magpie Goose nesting on this floodplain in the wet season).

Area A2.1 The area includes the coast, estuary and associated wetlands of the downstream Little Moyle River in the north of the survey block (Figure 12). The highest single count for waterbirds in the area was around 7 000 birds in September 1995. This count was dominated by Magpie Goose. The count did not include the breeding colony, which was not active at the time. The highest number estimated in the colony when in use was around 5 500 birds in March 1993. Should this be totalled with counts of the associated floodplain at the same time, it is likely the total number would have been well over 7 000. However, it is uncertain if it would reach the 20 000 needed to qualify for Ramsar in terms of waterbird numbers. The addition of shorebirds could combine to reach this number but a more detailed specific survey of the total area would be needed before confirming such numbers.

There were nine significant single records made in this area during surveys of this particular area (Figure 12). These involved five to six species including Magpie Goose, Rajah Shelduck, Pacific Black Duck, Gull-billed Tern, White-winged Black Tern and possibly Whiskered Tern. Although Magpie Goose and the egrets breed in the area, and are present all year round, the area was more significant for the other species in the later dry season. With counts of between 300 and 900 Rajah Shelduck in March, August, October and December, this area is one of the more significant all year round areas for this species in the Top End. Although breeding of this species was only recorded once during these surveys, these counts suggest the area is also likely to be an important breeding area for Rajah

Shelduck. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Pied Heron, egrets (all species present, but it is uncertain of which species were the most abundant) and Australian White Ibis.

In some seasons there was dense, but not extensive, Magpie Goose nesting in this area.

Other Significant Single Records. The three significant single records made in addition to the significant area discussed above were all on the Moyle River floodplain (Figure 12). Two were in the downstream section and one in the upstream section. It is worth noting that the Moyle River floodplain was still free from the effects of the weed Mimosa pigra during the project period. This weed is found on all of the major floodplains to the north of this site.

Record R2.1. This aerial record was of at least 1 000 waterbirds in the downstream area of the Moyle River floodplain in early May 1993. Other than mentioning Black-winged Stilt, no other comments were made on the species present, but at this time of the year they are likely to be dominated by Magpie Goose and egrets.

Record R2.2. This record was another of at least 1 000 waterbirds made during a single aerial run along the Moyle River in November, 1998. These birds were in a similar area to the above record. On this occasion the dominant waterbirds were Magpie Goose, ducks, egrets (all species except Cattle Egret), Brolga and terns.

Record R2.3. This was an aerial record of at least 750 egrets in October 1995. It was made during a single cross of the floodplain on route from Joseph Bonaparte Gulf back to Darwin. The egrets were along an upstream billabong/river section of the Moyle River. At the time most of the floodplain in the area was dry. There were no individual egret species confirmed on this survey, but all four egrets species were recorded in that area at other times of the year during the project.

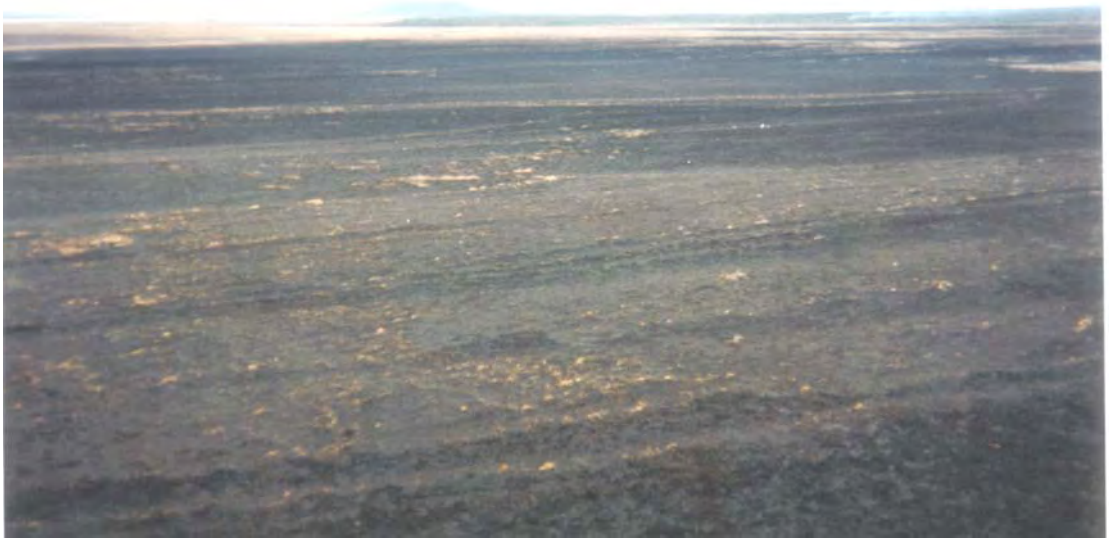

Plate 4 Burnt floodplain adjacent upstream Moyle River, dry season 1999. Photo R. Chatto.

SURVEY BLOCK 3

Location and Habitat

This survey block includes the coast, islands and adjacent inland wetlands from the northern point of a small estuary located about half way between Cape Dombey (survey block 2) and Cape Scott, through to just south of Stingray Head in the northern part of Fog Bay. The mouth of the Daly River, which is approximately the middle of the coastline of this survey block, is approximately 120 kilometres south west of Darwin. As this survey block is much closer to Darwin than the previous two, there is considerably more human activity in parts of the block. The coastal resort of Dundee Beach (actually in survey block 4) in the northern part of Fog Bay has a resident population as well as many visiting tourists. Although most activity revolves around boat fishing there is considerable vehicle and quad bike driving on the beach in Fog Bay between the Dundee township and the Finniss River in the north of this survey block. A second, smaller group of mostly holiday residences is located on the coast opposite North Perron Island. There are also a number of pastoral properties, particularly around the Daly, Reynolds and Finniss River areas, which have access tracks to the coast. Despite this there are still many areas of coast that are difficult to access and thus relatively undisturbed. Similarly, the floodplains are too wet for most of the year for access other than airboat.

This survey block has considerable waterbird habitat with approximately 300 kilometres of coastline and 2 500 square kilometres of wetland. Freshwater wetland areas include the extensive floodplains of the Daly, Reynolds and Finniss Rivers. These are all highly significant for waterbirds. There is a large amount of intertidal mudflat, backed by extensive mangroves and open saline wetlands, in Anson Bay (north and south sections), Fog Bay (southern section) and areas around the Perron Islands.

Survey Effort

This survey block received considerably more survey effort than the previous two. Approximately 130 hours of surveys dominated by waterbird/shorebird work were done in this survey block during the period of this project. This represented approximately 6.6% of the hours of survey in all survey blocks combined. These surveys were spread over 55 separate days. Again, most of the survey effort was in the month of March (Figure 13). This was due to the annual Magpie Goose surveys as previously mentioned. There were 90 separate ground surveys involving 56 different sites. Most of these ground sites were on or near the coast, with only a few inland sites on the Daly and Reynolds Rivers. The other major river, the Finniss, did not receive any inland ground surveys.

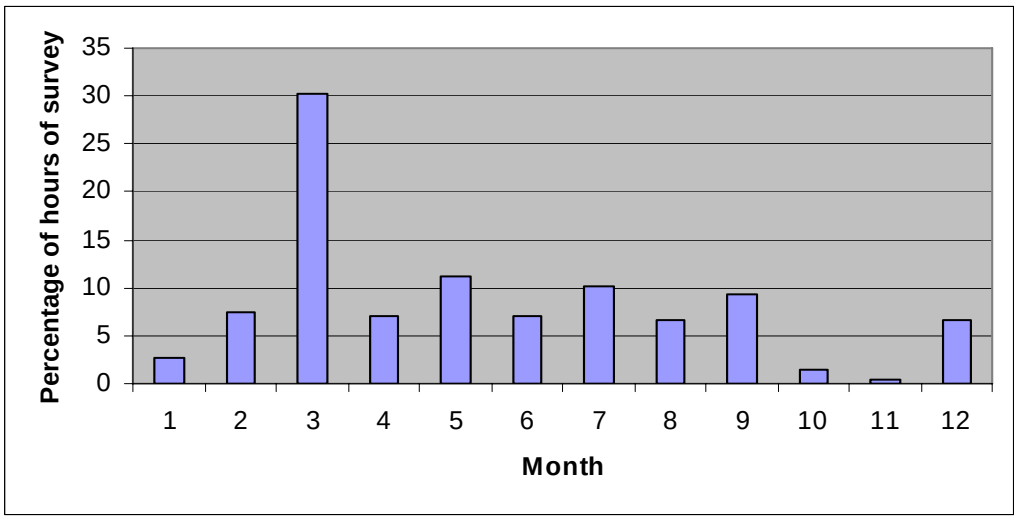

Figure 13. Approximate percentage of surveys hours relating to waterbirds for survey block 3.

Results and Discussion

Around 4 200 separate waterbird records were made for this survey block during the full period of this project (Figure 14). These totalled over 230 000 birds. These represented around 13.8% of the records and 8.7% of the total numbers of waterbirds recorded in the fifteen survey blocks. This survey block has the second highest number of records of all survey blocks. The large numbers of waterbirds recorded for this block is reflective of the large area of significant waterbird habitat, while the high proportion of total records is due to both this and also the large amount of survey effort in this block.

Forty-five species of waterbird from Tables 1 and 2 were recorded in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Forty-two species were recorded in aerial surveys. The egrets, as a combined group, were recorded at nearly twice the abundance of the next species, the White-winged Black Tern. All four egret species were well represented among the *egret spp.* records in this survey block. The next most abundant species were Magpie Goose, both Wandering and Plumed Whistling-Duck, Australian Pelican, all three ibis species, Pied Heron, Black-winged Stilt, Whiskered Tern, Grey Teal and Brolga.

Twenty-five species were recorded in ground surveys. The most abundant species recorded in ground surveys was the White-winged Black Tern. This species was recorded at nearly three times the abundance of the next species, the Magpie Goose. The abundance of the White-winged Black Tern was influenced by the large flocks that formed on North Perron Island each March/April prior to migration. Flocks of up to 15 000 were observed at this site. The next most abundant species recorded in ground surveys were Common Tern, Glossy Ibis, Grey Teal, Gull-billed Tern, Whiskered Tern, Wandering Whistling-Duck, Masked Lapwing, Black-winged Stilt, Straw-necked Ibis and Pacific Black Duck.

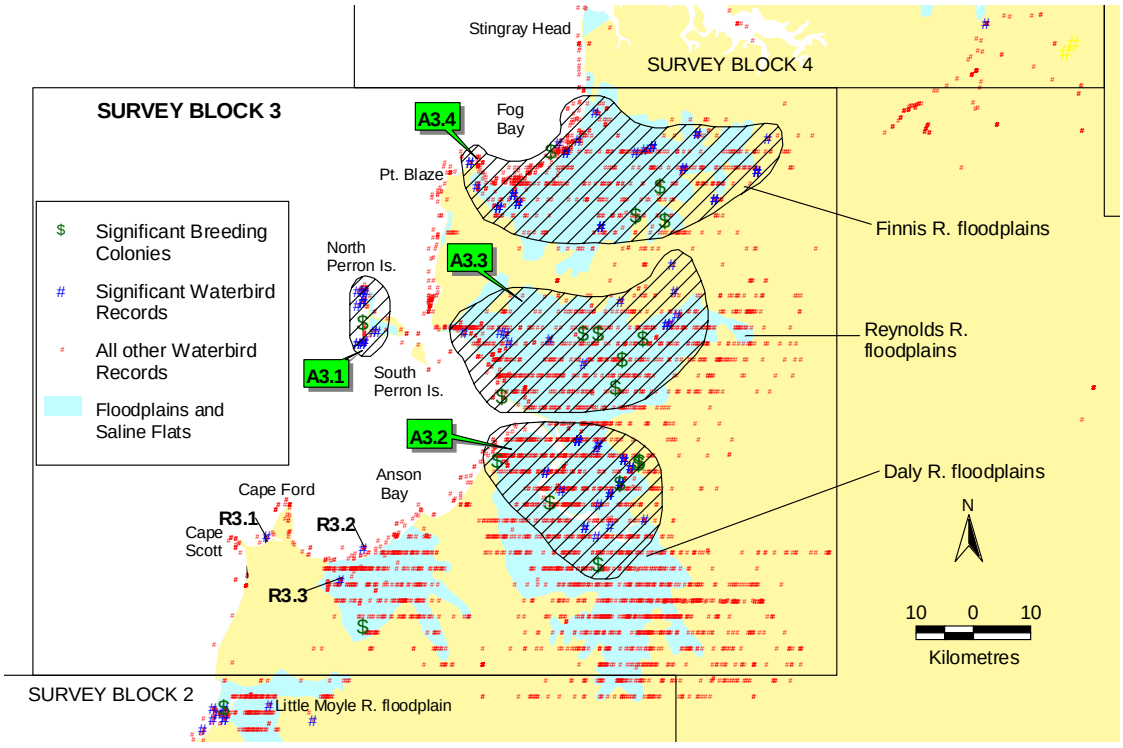

Figure 14. Distribution of waterbird records for survey block 3.

Species Recording Rates. In terms of the number of separate records, and hence the most wide-spread birds in the survey block, the egrets again were by far the most frequently recorded in aerial surveys. The next most frequently recorded were Australian Ibis, Australian Pelican, Black-necked Stork, Straw-necked Ibis, Pied Heron, Black-winged Stilt, Brolga, Rajah Shelduck and White-faced Heron.

In ground surveys the Gull-billed Tern was easily the most frequently recorded. This bird is very common along the coast of this survey block. The next most frequently recorded species were Whiskered Tern, White-winged Black Tern, Common Tern, Australian Pelican, Little Egret, Masked Lapwing, Black-winged Stilt, Great Egret, Magpie Goose and Rajah Shelduck.

Important Areas.

Significant Waterbird Breeding Colonies. This survey block had a large amount of highly significant waterbird area. Nineteen of a total of 76 waterbird breeding colonies located throughout the entire survey area during the project, were located in this one survey block (Figure 14). Eighteen of these have been classified as significant for one or more species. Some colonies here are among the largest ever recorded in Australia for certain species. All of the species of waterbird that nest colonially in the Top End are represented in significant numbers in one or more of the colonies in this survey block except the Glossy Ibis. The sole Top End colony of this species was previously mentioned in survey block 1. Survey block 3 also has the only regular Australian Pelican colony in the Top End. It is therefore very significant. Unfortunately as it has been burnt out on at least one occasion (Chatto, 1995) and on other occasions had all the eggs methodically smashed, it needs concentrated efforts to improve its security. Further details on colonial waterbird breeding can be found in Chatto (2000b).

Significant Waterbird Areas. This survey block has four areas of significance (Figure 14). These include North Perron Island and the wetlands associated with the Daly, Reynolds and Finniss River floodplains.

Area A3.1 The Perron Islands consist of two islands, North and South Perron Island. Off the south west of North Perron Island is another small sand island that is exposed for all but the higher parts of tides. This sand island and the western side of North Perron Island are of significance for roosting terns, particularly White-winged Black Tern and Common Tern. There were 16 significant waterbird records for these islands (Figure 14). Most involve the large White-winged Black Tern roosts (up to 15 000 birds) that form in March and April prior to migration. With the large numbers of shorebirds in this area, it would easily qualify for Ramsar listing. The other significant records are for Common Tern. Although this species was not confirmed forming large pre-migration flocks like White-winged Black Tern, there were still some large groups of Common Tern seen roosting on these islands, particularly the sandy one off North Perron Island. Common Tern hunt further offshore than the other terns and so their hunting and resting times are of longer duration. As they often do not come in from hunting until dusk, and this area was not surveyed at this time, it is likely that even higher numbers of Common Tern than recorded could roost here at times. There are also a few significant counts of Whiskered Tern for this site. Whiskered Tern are mostly a bird of the freshwater wetlands but will sometime hunt along the coast, and they also hunt with White-winged Black Tern. These two factors may lead to them roosting on these islands occasionally.

The other waterbird species with significant records in this area was the Australian Pelican. As well as breeding on North Perron Island, there were also good numbers of non-breeding birds recorded there at times.

Area A3.2 This area involves the wetlands along the north side, and to a lesser extent, south side of the downstream Daly River. It is highly significant for waterbirds and was recorded as the most significant part of the overall Daly River wetlands. This area has a large and diverse amount of wetland habitat that is not dominated by the solid sedge/reed vegetation of many floodplains. Heavily vegetated areas

tend to attract larger numbers of only a few species such as Magpie Goose, Whiskered Tern, White-winged Black Tern and the egrets (except Cattle Egret). The openness of the wetlands in this area (probably assisted by grazing) attracts a large diversity and number of waterbirds. It was often noted as the best area for waterbirds (other than for Magpie Goose and egrets) between Darwin and the Moyle River during the March/April wet season Magpie Goose aerial surveys.

The highest single survey count for this particular area was in May 1995, where 30 000 waterbirds were recorded in a reasonable, but not full, count of the area. Hence, this area would easily qualify for Ramsar listing based on waterbird numbers alone. As with most of the significant areas discussed in this report the greater diversities and higher densities of waterbirds tended to be at this time of the year, when many species concentrate around the remaining water of open, drying wetlands. This includes species that remain all year in the area, and others returning after having left the area during the wet season. This was also the case with this area, but it was also one of the better areas for waterbird numbers in the height of the wet season as well.

Throughout all surveys there were 33 single significant records from this area. They involved records of Magpie Goose, both Plumed and Wandering Whistling-Duck, Grey Teal, egrets, Glossy Ibis and Straw-necked Ibis all in their thousands; and records of Rajah Shelduck, Pacific Black Duck, Hardhead, White-faced Heron, Pied Heron, Australian White Ibis, Purple Swamphen, Masked Lapwing, Whiskered Tern and White-winged Black Tern in their hundreds. Black-necked Stork were recorded in groups of up to 20 birds in a single record. All four species of egrets were present and all very abundant, but there were insufficient counts to species level to say which species were most abundant over all. Of these species listed as significant for this area, the Magpie Goose, egrets and Australian White Ibis were present in good numbers throughout the year. These birds all breed in large numbers during the wet season. Black-winged Stilt, Whiskered Tern, White-winged Black Tern and some of the ducks could also be fairly abundant during the wet season. The presence of ducks at this time suggests the area is likely to be important for breeding, particularly for the Rajah Shelduck. The other species were mostly present in the dry season between about April and October, after having been present in relatively small numbers through the January to early March height of the wet season. Much of the area is generally dry by November/December, by which time many birds have left, although quite large aggregations of some species (eg Magpie Goose and ducks) sometimes remain around the remaining patches of water at this time. Another species that has not been listed for the area from significant single records, but is also present in significant numbers is the Black-winged Stilt.

Area A3.3 The wetlands of the Reynolds River floodplain area were also of great significance to waterbirds within this survey block. This area did not receive full survey coverage at any stage during the dry season when waterbird numbers are generally higher. Two partial counts in May and August 1995 both recorded in excess of 10 000 waterbirds in the area, with egrets and Straw-necked Ibis featuring prominently at these times. The latter species is virtually absent during the wet season, but very large numbers can be seen among the large areas of paperbark growing in the floodplains during the dry season. Dry seasons counts of this full area would certainly total more than the 20 000 birds needed to qualify for Ramsar listing. Wet season counts for this area are generally much lower in numbers and diversity, with Magpie Goose and egrets being the main species present. Black-necked Stork, Rajah Shelduck, Whiskered Tern, White-winged Black Tern and the colony nesters are also well represented at this time.

Throughout all surveys there were twelve single significant waterbird records for this area. Except for one December record of whistling-ducks and one January record for Magpie Goose, these significant records were all made in the dry season. They involved counts of hundreds to low thousands of Magpie Goose, Plumed and Wandering Whistling-Duck, Pied Heron, egrets, Australian White Ibis and Straw-necked Ibis. All four species of egrets were present and all very abundant, but again there were insufficient counts to species level to say which species were most abundant. There were also good numbers of Black-necked Stork in the area, although they did not register as a specific significant

record. As with the Daly River significant area, Magpie Goose and the egrets were present in this area throughout the year, both breeding in large numbers during the flooded wet season. Other species were mostly present in the dry season between about May and September.

Area A3.4 The coast and wetlands associated with the downstream Finniss River floodplains are also highly significant for waterbirds. The highest single count of waterbirds in this area was a partial count in excess of 22 000 in July 1996. Hence, this area would qualify for Ramsar listing. Partial counts were also made of in excess of 13 000 in June 1995 and in excess of 8 000 in September 1995.

Throughout all surveys there were 34 single significant records for this area. Most were either close to the coast or in the northern part of the wetlands. They involved counts of Magpie Goose, Plumed and Wandering Whistling-duck, Pacific Black Duck, Grey Teal, Pied Heron, egrets, all three ibis species and Brolga in their thousands; and counts of Australian Darter, Little Pied and Little Black Cormorant, Australian Pelican, Nankeen Night Heron, Black-winged Stilt, Australian Pratincole and Gull-billed Tern in their hundreds. All four species of egrets were present and all were very abundant. There were insufficient counts to species level to say which species were most abundant, although one single July record was of 3 000 Cattle Egret. Seasonal use of this wetland area by the different species was similar to the above two significant areas (A3.2 and A3.3), although the wetlands nearer the coast dry out quicker than in the other sites. Area A3.4 does have good Magpie Goose breeding but not as good as the Daly and Reynolds areas covered above. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area, include Rajah Shelduck, Brahminy Kite and White-bellied Sea-Eagle.

Other Significant Single Records. There are also three other separate significant records that are away from the above discussed areas (Figure 14). These were in the southern part of Anson Bay in the south east of the survey block. Two of these records were along the coast and the other on a freshwater wetland just inland from the coast.

Record R3.1. This was a record of 800 White-winged Black Tern between Capes Scott and Ford in April 1997. This is the time of the year when this species is aggregating prior to departure on migration. There are a number of such sites in this central west coast area of the Top End, some having already been mentioned.

Record R3.2. This record was of over 300 Gull-billed Tern roosting along the coast in the southern part of Anson Bay. There are also other sites with good numbers of this species along this central part of the west coast of the Top End.

Record R3.3. The third of these single records was of 800 Glossy Ibis on the wetlands in behind the southern part of Anson Bay in September 1995. The wetlands in this vicinity also had good numbers of other species of waterbirds that did not register as high single records. In surveys in February/March these included Magpie Goose (breeding), Wandering Whistling-Duck, egrets, Australian Pelican, Black-winged Stilt and the marsh tern group (particularly the White-winged Black Tern), and in September surveys they included Magpie Goose, ducks, Glossy Ibis and Brolga. A November 1998 flight over this area showed it to be mostly dry with few waterbirds.

SURVEY BLOCK 4

Location and Habitat

This survey block extends from the northern part of Fog Bay to Point Stevens, the latter place being about 40 kilometres to the north east of Darwin. The area includes Bynoe Harbour and the islands to its north west, Darwin Harbour and the Vernon Islands, which are to the north east of Darwin. With most of the area being close to Darwin, this is easily the most populated, and therefore most disturbed, survey block around the Northern Territory coast. Of course, such 'disturbance' is obviously much less than many areas along the eastern and south eastern coasts of Australia.

With the large number of bays and inlets in this survey block there is a long length (approximately 680 kilometres) of coast compared to the other survey blocks. A high percentage of this coast, including nearly all of Bynoe and Darwin Harbours and most of the islands, is lined with mangroves. Much of the area behind these extensive mangrove areas is forested high ground rather than wetlands. There are a few rocky areas but little in the way of dune or cliff-backed stretches of sandy beach. This survey block lacks the large floodplains present elsewhere in the project area, and so lacks a large area of freshwater wetland. Its wetland area of around 400 square kilometres is among the smallest of all blocks. The majority of wetland area is in the form of small wetlands to the east and south east of Darwin. Smaller wetlands are a characteristic of this particular block.

Survey Effort

This survey block received approximately 275 hours of surveys dominated by waterbird/shorebird work during the period of this project. This represented approximately 14.1% of the hours of survey in all survey blocks combined. These hours were spread over 163 separate days. Being close to Darwin this block received a larger number of separate survey days than the other survey blocks, but many surveys were of short duration. Although the survey block also had a relatively high survey effort compared to the other areas it did not receive the heavy bias in the month of March because little of the regular (aerial) Magpie Goose survey area was within this survey block. Except for the month of April, all other months were well represented in the survey effort (Figure 15). In total there were approximately 200 separate ground surveys involving 55 different sites, although some sites were quite close together.

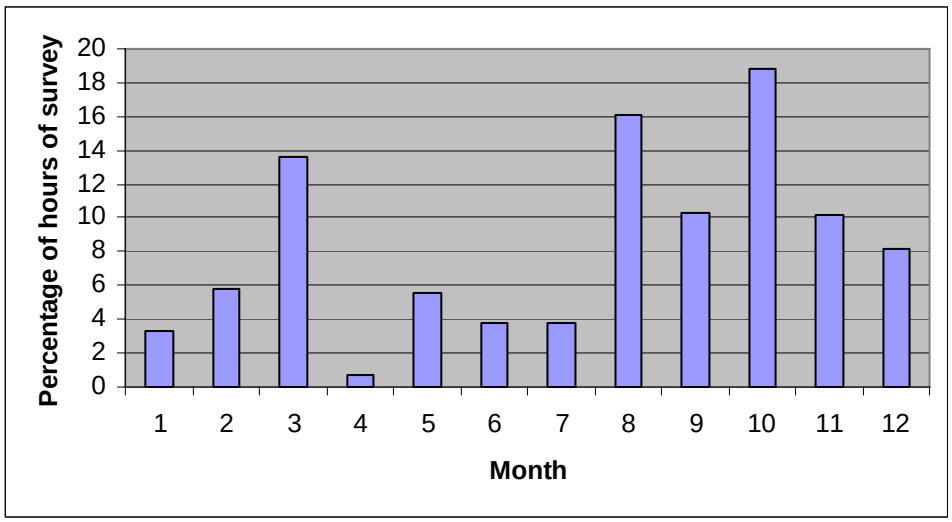

Figure 15. Approximate percentage of surveys hours relating to waterbirds for survey block 4.

Results and Discussion

Except for the coastal zone, waterbird records were not widely distributed in this survey block. Much of the coast is thickly lined with mangroves and densities of waterbirds were not generally high. Inland, most waterbirds were located on the numerous small wetlands in the north east of the block and along drainage channels into Darwin Harbour from the south east which were specifically surveyed by air on one occasion. During the full period of this project there were around 2 900 separate waterbird records made, totalling over 114 000 birds (Figure 16). These represented around 9.5% of the records and 4.3% of the total numbers of waterbirds recorded in the fifteen survey blocks. This survey block has the third highest number of records of all survey blocks.

Fifty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. With its close proximity to Darwin this block was the only one to receive more ground work than aerial surveys. Many of the aerial surveys were done when flying out of Darwin on route to other areas. Thirty-eight species were recorded in aerial surveys. Rajah Shelduck and Magpie Goose were easily the most abundant species recorded from the air. The next most abundant species were Whistling-Duck, egrets, Black-winged Stilt, Australian White Ibis, Straw-necked Ibis, Green Pygmy-goose, Brolga and Masked Lapwing. All four egret species were well represented among the egrets recorded from the air in this survey block.

Fifty-seven species were recorded in ground surveys. The most abundant was easily the Magpie Goose which was recorded in numbers ten times greater than any other species. The next most abundant species recorded in ground surveys were Green Pygmy-goose, Wandering Whistling-Duck, Pacific Black Duck, Whiskered Tern, Masked Lapwing, Pied Heron, Grey Teal and Comb-crested Jacana.

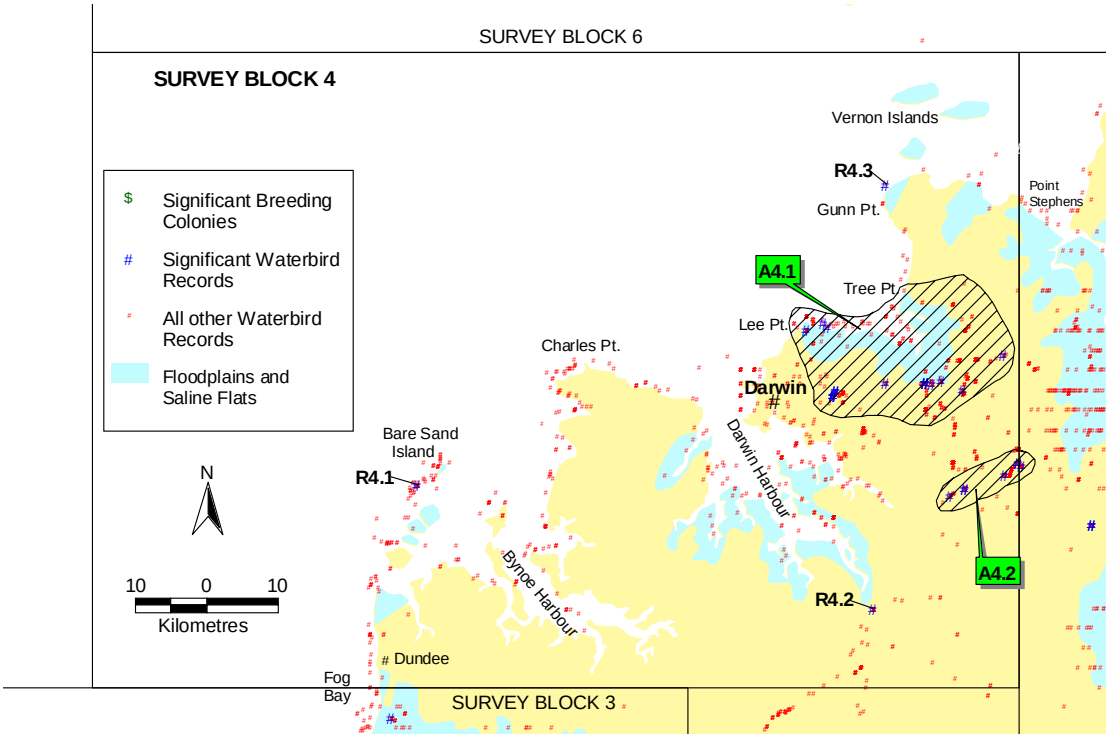

Figure 16. Distribution of waterbird records for survey block 4.

Species Recording Rates. Species recorded most often during aerial surveys were dominated by the egrets as a combined group. These were followed by Australian White Ibis, Australian Pelican, Black-necked Stork, Rajah Shelduck, Pied Cormorant, Australian Darter, Great-billed Heron, Masked Lapwing and Straw-necked Ibis.

Species recorded on the greatest number of individual occasions during ground surveys were Masked Lapwing, Intermediate Egret, Green Pygmy-goose, Comb-crested Jacana, Magpie Goose, Whiskered Tern, Little Pied Cormorant, Rajah Shelduck, Australian White Ibis and Great Egret. As many of the ground surveys were of small wetlands close to Darwin, these records represent those species that frequented these types of sites.

Important Areas.

Significant Waterbird Breeding Colonies. There were no waterbird breeding colonies located in this block. Small colonies of cormorants, darters or Nankeen Night Heron may exist on an irregular basis but there are no regular significant colonies.

Significant Waterbird Areas. This survey block does not have the large areas of freshwater wetlands like the survey blocks either side of it. Apart for the wetlands associated with the area between Lee and Tree Points, most of the brackish or freshwater wetlands of this survey block are scattered smaller swamps. Nevertheless, some of these smaller wetlands have quite significant numbers of waterbirds on them at times.

Apart from three widely spaced single significant records in this survey block, all significant records are clustered in two general areas in the central part of the block (Figure 16). Most of these are grouped around the wetlands associated with the above mentioned area between Lee and Tree Points, or the wetlands of the McMinns Lagoon area. These are discussed below as the two significant areas listed for this survey block.

Area A4.1 This area includes the coast and the saline and freshwater wetlands between Lee Point (part of Darwin) and Tree Point. It includes sites such as Leanyer Swamp (and the associated sewage ponds), Knuckey Lagoons, and the Howard River and Shoal Bay Hunting Reserves. Being close to Darwin, these areas have received much waterbird survey work which has been reported on by a number of other authors (eg Crawford, 1972, Shurcliff and McLean, 1990, Goodfellow, 2001 and McCrie and Watson, 2003). As such it will not be discussed in great detail in my report.

There were no surveys done over this entire area, or even most of it, to attempt to give an estimate of the total number of waterbirds that may be present. Most surveys were done on the ground of single swamps on different days. Some of these counts, being only a small part of the area, do suggest that the area as a whole, would easily have in excess of the 20 000 birds necessary to qualify for Ramsar listing. For example, counts of two small sections of this area recorded several thousand waterbirds (without including shorebirds or seabirds). Counts of in excess of 10 000 Magpie Goose alone have been made on Howard Swamps, and several counts of between 3 500 and 6 000 waterbirds have been made on Knuckey Lagoons in Darwin.

Within this area there were 24 single significant records during the survey period. These involved numbers in their thousands for Magpie Goose, Wandering Whistling-Duck, Rajah Shelduck, Pacific Black Duck and Australian Pelican, numbers in their high hundreds for Green Pygmy-goose, Brolga, Comb-crested Jacana, Masked Lapwing, Whiskered Tern, and numbers in their high tens for White-necked Heron. All of these records and the majority of the other separate large species counts were made in the late dry season before the wet season rains commence. Following these rains most of these birds quickly leave the survey area. Larger numbers of waterbirds do not return again until the wetlands start drying back considerably from July onwards, depending on the individual wetland and/or season. Of particular importance in the late dry season are the coastal swamps for Rajah Shelduck. The highest single flock count for the whole survey area was of 2 000 Rajah Shelduck in November

1994. The drying back floodplains are also of importance for Brolga, and the drying swamps and mango crops for Magpie Goose. All are discussed in greater detail in their respective species sections later in the report.

Area A4.2. This site covers the McMinns Lagoon area and some of the associated smaller swamps to the east of this lagoon. All are small isolated wetlands that are becoming progressively surrounded by houses as the Darwin urban expansion continues. They are also sites that have become very accessible to the public for recreational activities, including bird watching. There were seven separate records, involving three species, in this area that have been classified as significant. The highest single counts for each of these species were around 400 for Green Pygmy-goose, 200 for Comb-crested Jacana and 70 for Australian Grebe. These were all dry season counts. Other species counted in reasonably significant numbers in this area during the surveys included Magpie Goose, Masked Lapwing, Whiskered Tern and several other duck species. The highest total count for this area was just under 4 500 waterbirds in mid October 1991. This count would be close to a total count for this area. Being close to Darwin and popular with bird watchers these areas have been better detailed by others (eg Crawford, 1972, Shurcliff and McLean, 1990, Goodfellow, 2001 and McCrie and Watson, 2003).

Other Significant Single Records. There were three other significant single records in this survey block that were not associated with the two areas discussed above (Figure 16). These were scattered over three widely spaced locations within the survey block. Two were coastal and one on an inland freshwater wetland.

Record R4.1. In December 1992, 3 000 White-winged and/or Whiskered Tern were recorded from the air as roosting on Bare Sand Island, one of the small islands off Bynoe Harbour. This would have been almost certainly dominated by White-winged Black Tern. These islands are mainly of importance to shorebirds, seabirds and marine turtles, but there were also good numbers of other species of waterbird (eg Gull-billed Tern and Common Tern) recorded here at other times during these surveys.

Record R4.2. This is a record of 1 000 Magpie Goose in October 2003 on Goose Lagoon. This is part of the Territory Wildlife Park in Berry Springs, just out of Darwin. This shallow open lagoon had dried back to little more than about an acre of water. There were a number of other species of waterbirds also present but none in significant numbers.

Record R4.3. This record was of 1 500 ‘waterbirds’ recorded in a passing aerial survey of the wetlands near Gunn Point, north east of Darwin, in March 1991. There was no comment on the species present.

SURVEY BLOCK 5

Location and Habitat

This survey block lies just to the east of Darwin. It extends from Point Stevens near the mouth of the Adelaide River to just north of the mouth of the East Alligator River. This is essentially the southern coastline of Van Diemen Gulf. It includes the mouth of many major rivers such as the Adelaide, Mary, Wildman and the Alligator Rivers system. The latter system is near the eastern boundary of the survey block and is approximately 200 kilometres east of Darwin. As this survey block is close to Darwin, there is considerable human activity in parts of the area. In the west of the survey block there are a number of pastoral properties with access through to the coast, though most of this is only during the dry season. The eastern section is made up mostly of Kakadu National Park, which is between the eastern end of Finke Bay and East Alligator River, and extends from the coast to around 200 kilometres inland. Although there is a lot of fishing in the rivers and around the coast, the dominance of mangroves and mudflats tend to keep most other forms of human visitation down in these areas. The extensive floodplains are only accessible by airboat in the wet season.

This survey block has extensive waterbird habitat with approximately 400 kilometres of coastline and 5 380 square kilometres of wetland. Although only an average coastline length compared with the other survey blocks the amount of wetland is easily the largest. Freshwater wetland areas include the extensive floodplains of the above mentioned rivers plus others such as the Coopers Creek system in the far east of the block. The vast majority of the coastline consists of intertidal mudflats, backed by extensive mangroves and open saline wetlands.

Survey Effort

This block received approximately 330 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 16.7% of the hours of survey in all survey blocks combined. Surveys were spread over 90 separate days. All months received some surveying in this survey block with April receiving the most (Figure 17). Although a little lighter in January, February and June, all other months received a reasonable amount of survey. There were 145 separate ground surveys involving 70 different and well-spread sites.

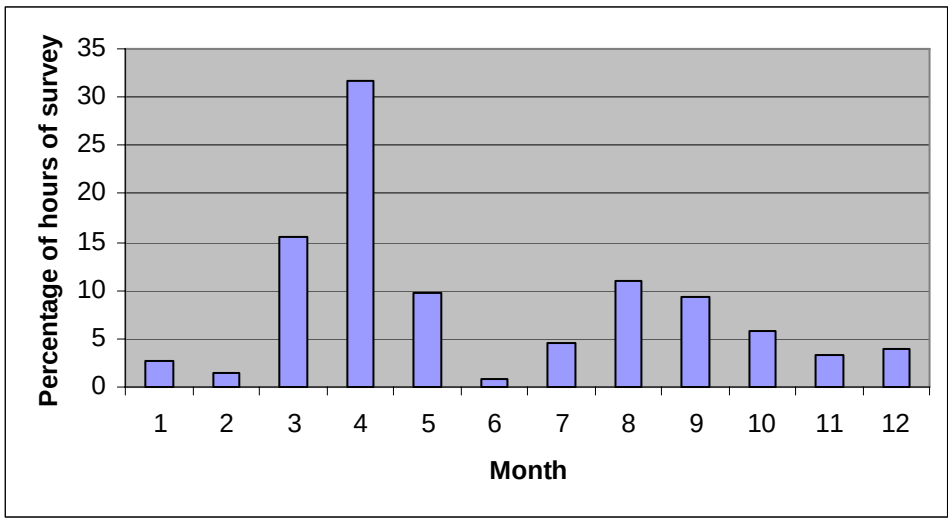

Figure 17. Approximate percentage of surveys hours relating to waterbirds for survey block 5.

Results and Discussion

Waterbirds were spread throughout the entire survey block, with most wetlands and the entire coastline having varying but generally high densities of birds. This survey block has a large amount of waterbird habitat and this is reflected in the high numbers of waterbirds recorded during these surveys. During the full period of this project there were around 11 700 separate waterbird records made, totalling over 905 000 birds (Figure 18). These represented 38.7% of the records and 34.3% of the total numbers of waterbirds recorded in the fifteen survey blocks. These figures are the highest of all survey blocks, but this is a very large block with extensive wetland habitat.

Fifty-three species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Forty-seven species were recorded in aerial surveys of this survey block. By far the most abundantly recorded waterbird was the Magpie Goose. This species was recorded in numbers nearly three times that of the next most abundant species which were the combined egrets, with all four species being well represented. The next most abundant species were Wandering and Plumed Whistling-Duck, Glossy Ibis, Pied Heron, Australian White Ibis, Black-winged Stilt and White-winged Black Tern.

Fifty-one species were recorded in ground surveys of this survey block. Again, Magpie Goose dominated, being recorded in ground surveys at over three times the abundance of any other species. The next most abundant species were Grey Teal, both the Wandering and Plumed Whistling-Duck, the egret group, Black-winged Stilt, Glossy Ibis, Pied Heron and Whiskered Tern.

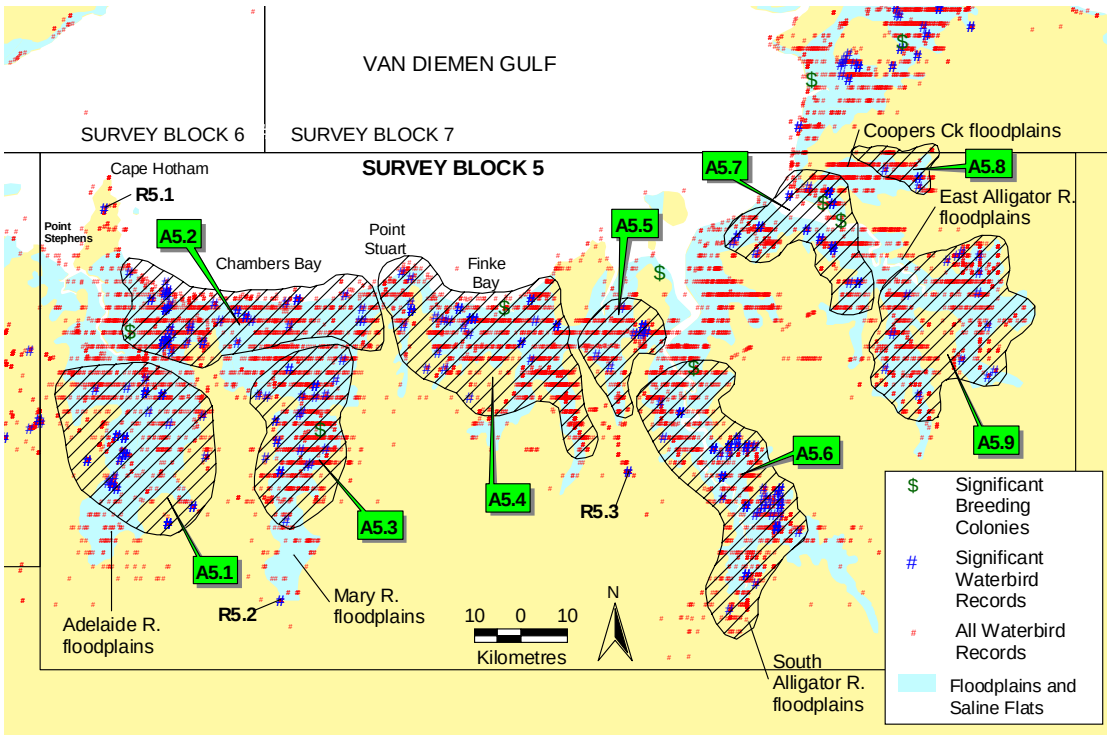

Figure 18. Distribution of waterbird records for survey block 5.

Species Recording Rates. The most frequently recorded species in aerial surveys were the egrets which were recorded over twice the number of times of the next most frequently recoded species, the Magpie Goose. Both of these were recorded on many more occasions than any other species. The next most frequently recorded species were Australian White Ibis, Black-winged Stilt, Pied Heron, Glossy Ibis, Black-necked Stork, Straw-necked Ibis, Rajah Shelduck, Masked Lapwing and White-winged Black Tern.

The most frequently recorded species in ground surveys was again the Magpie Goose, but not by many more records than the Whiskered Tern, Intermediate Egret and Masked Lapwing. The next most frequently recorded species were the Australian White Ibis, Pied Heron, Black-winged Stilt, Glossy Ibis, Black-necked Stork and the other three species of egrets.

Important Areas.

Significant Waterbird Breeding Colonies. There were seven significant waterbird breeding colonies located in this survey block (Figure 18), including the largest one in the Top End, which regularly has well in excess of 20 000 birds. Two of the others have in excess of 10 000 birds. These colonies involve all of the colonial breeding species except Glossy Ibis and Australian Pelican, both of which have only one breeding site in the Top End. The combination of colonies in this survey block and survey block 3 totals over two thirds of the numbers of colony breeding waterbirds in the Top End. See Chatto (2000b) for further details.

Significant Waterbird Areas. This survey block has a very large amount of waterbird habitat, and a large proportion of it is highly significant for aquatic birds, particularly the waterbirds discussed in this report. There were an amazing 280 separate species records in this survey block classified here as significant. There are so many significant records that nearly all of the wetland area in the block is classified as significant. Consequently, it was hard to separate individual significant areas, but this has to be done to bring some detail into the discussion of such a large and important wetland area. The resultant separation of individual significant areas does not necessarily adhere to separate wetlands or catchments. The separations of significant areas within the Adelaide and Mary River catchments, for example, may seem strange at first glance. Rather than treat the two river catchments as two areas, the downstream areas of both were linked and treated as one significant area (A5.2, Figure 18). This is because the two upstream areas (A5.1 and A5.3) are clearly geographically separated, while their relevant downstream areas merge. More importantly the two downstream areas have similar habitats and waterbird assemblages, which are different to those in their upstream catchments. Based on the above, nine areas were separated to be individually discussed in a west to east direction across the block. Some of these areas are part of Kakadu National Park and have been reported on extensively in the past (eg Bamford, 1990 and Morton *et. al.*, 1991).

Area A5.1. The first of the significant areas for this survey block are the floodplains and wetlands associated with the upstream Adelaide River. It also includes well known and frequently visited places like Fogg Dam and the nearby wetlands along the Arnhem Highway at Beatrice Hill. Although a management issue, and not a major part of the focus of these reports, these latter wetlands are one of many good examples of the effects of grazing. In the first half of these surveys when buffalo grazed these wetlands there were a large number and diversity of waterbirds to be seen on these wetlands as they dried back in the latter part of the dry season. They were very popular for bird watchers to view because they could stop on the Arnhem Highway and easily look out over thousands of birds in the dry season. Removal of the buffalo led to the wetlands becoming clogged with vegetation and the inability for most birds to then use the area. In many areas this clogging is dominated by an introduced weed (Olive Hymenachne) but the removal of grazing from areas of the native Hymenachne often leads to the same end result, although the native one could perhaps be controlled by burning.

There were no surveys that covered anywhere near this entire area in one survey. The highest count of waterbirds for this area was just over 14 000 birds in August 1995. This aerial survey covered only a

small portion of the total area. Based on records from other parts of the area in different surveys, there is little doubt that numbers in access of the 20 000 waterbirds would meet one of the criteria needed to qualify for Ramsar listing if the full area was counted at this time of year. There were 52 separate records, of 26 species of waterbirds, in this area that have been classified as significant. These involved Magpie Goose, most of the duck and cormorant species, Australian Grebe, all of the egret species, Pied and Nankeen Night Heron, Glossy and Straw-necked Ibis, Black-winged Stilt, Masked Lapwing, Whiskered Tern and White-winged Black Tern. Records of significance varied between 10 000 (Wandering Whistling-Duck) and 150 (Australian Grebe). The majority of these records were between May and November, but the area still has large numbers of the species such as Magpie Goose and the colonial breeding species (especially the egrets) spread throughout the area during the flooded wet season. Other species for which the number of individual records in this area was significant included Black-necked Stork, Brolga and Comb-crested Jacana. Species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Brahminy Kite and Black-necked Stork. Both species also breed in good numbers in the area, the former particularly in the mangroves on the coast and the latter species throughout the area.

Although there are no waterbird breeding colonies in the area the largest breeding colony in the Top End is just to the north and birds from this colony feed in this area. There is also significant Magpie Goose breeding in the northern part of this area during the wet season, and former Parks and Wildlife 'Sites of Conservation and Recreational Significance Register' (S.C.R.S.R.) reports Fogg Dam to have very significant breeding for Green Pygmy-goose. To the south of this area the McKinley, Margaret and upper Adelaide Rivers are reported (S.C.R.S.R.) to be a major Brolga breeding sites, but this region was not well covered during my surveys.

Area A5.2. The next significant area within this survey block is the coastal wetlands along Chambers Bay and the downstream floodplains of the Adelaide and Mary River catchments. This area has both saline coastal wetlands and the downstream limits of the freshwater wetlands. It also has the area where the two habitats meet and there is a gradual change from one to the other. This mixed and varied habitat is particularly popular with many species of waterbirds. It can also attract good numbers and diversities of birds in the wet season, while most of the large upstream area of deeper, vegetated floodplains, has lower densities and diversities of birds at this time. There are also many channels running from the floodplains across the saline flats of these areas closer to the coast. Some of these are dammed to reduce saltwater intrusion into the upstream freshwater wetlands. Both the channels, and more particularly the dams, hold water longer into the dry season and form focal points for many waterbirds.

The highest count of waterbirds for this area was around 17 000 birds in August 1995. This was not a full count of all the waterbirds in the area. A full count of the area in this survey would have easily recorded numbers in access of the 20 000 needed to qualify for Ramsar listing.

Throughout all surveys there were 62 separate records, involving 20 species of waterbird, that have been classified as significant for this area. These included Magpie Goose, Rajah Shelduck, Pacific Black Duck, Grey Teal, Green Pygmy-goose, Pied Heron, Australian Pelican, all of the egret species, Glossy and Australian White Ibis, Royal Spoonbill, Black-winged Stilt, Red-necked Avocet, Masked Lapwing, Australian Pratincole and Gull-billed, Whiskered and White-winged Black Tern. Records of significance varied between 13 000 (Magpie Goose) and 100 (Great Egret). The majority of these records were between April and September, signifying the importance of the area in terms of significant records for many species of waterbirds during the dry season. However, the presence of two significant mixed species waterbird breeding colonies, and large numbers of breeding Magpie Goose, also showed the area to be important in the wet season for these species.

The more saline nature of much of this area compared to the previous upstream area (A5.1) is reflected in the differences in species involved in the significant records. This area, for example, has a higher

representation of species such as Australian White Ibis, Black-winged Stilt, Red-necked Avocet and Gull-billed Tern, and lower representation of species such as the Green Pygmy-goose, the cormorants, Straw-necked Ibis and Comb-crested Jacana. There were also a lower number of significant records continuing into October and November compared with the previous upstream area. This is partly due to the shallower, downstream wetlands drying out earlier. Nevertheless, there are still parts of this downstream area (e.g. Lake Finniss) that retain relatively good numbers of resident wet season waterbirds like Magpie Goose and the egrets as discussed for the above upstream area.

Area A5.3. The next significant area is the wetlands of the upstream Mary River floodplains. There were no surveys that covered anywhere near this entire area in one survey. The highest count of the waterbirds discussed in this report for this area was over 32 500 birds in August 1995, with whistling-duck and Magpie Goose dominating. This aerial survey covered only a small portion of the total area but clearly indicated sufficient numbers of waterbirds to qualify for Ramsar listing.

There were 26 separate records of waterbirds in this area that have been classified as significant. Because many of these records were of *spp.* combinations it is difficult to say accurately how many species were involved, but there were at least seven. Confirmed species included Magpie Goose, Green Pygmy-goose, Australian Pelican, Cattle Egret, all three ibis species, Whiskered Tern and White-winged Black Tern. It is likely they also included each of the other egrets and both whistling-ducks at least. Individual records varied between 7 500 (Magpie Goose) and 200 (Green Pygmy-goose). Except for two records in February, all were between mid March and August, signifying the importance of the area for many species of waterbirds during the late wet season through to the dry season. However, the presence of two significant mixed species waterbird breeding colonies and large numbers of breeding Magpie Goose, also shows the area to be important in the wet season for these species. There were also good wet season numbers of some of the other waterbirds that did not breed in these colonies, such as Whiskered Tern, White-winged Black Tern and, when they returned from breeding, Glossy Ibis. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area, include Australian White Ibis and Black-necked Stork.

Although not recorded in my surveys, part of this area is reported to have one of the highest recorded densities of White-bellied Sea Eagle nesting in Australia (S.C.R.S.R.). There were reported to be at least 21 active nests in the particular area.

Area A5.4. The next significant area within this survey block is the coastal wetlands along Finke Bay and the downstream floodplains of Swim Creek and the wetlands associated with the Wildman River and western side of the West Alligator River. The highest single survey count of the waterbirds for this area was over 36 500 birds in September 1993. This count was clearly dominated by egrets and Magpie Goose. Not all birds were counted in this survey, but there were tens of thousands of Magpie Goose and at least 15 000 egrets on the Swim Creek floodplain alone. (Those birds counted were combined and represented by a single symbol on the map on this occasion). This September survey was a combined aerial and ground survey. It consisted of a single survey along the coast from west to east, then another single run back from east to west inland from the coast. It covered only a small proportion of the total area, which easily demonstrates enough waterbirds to qualify for Ramsar listing. There were also very good numbers of waterbirds (including nesting Magpie Goose) present on the narrow Swim Creek floodplain in a May 1995 survey. The area was still very flooded then and there were nowhere near the numbers of Magpie Goose that flock to the area later in the dry season. Along with Swim Creek, there is also good wet season Magpie Goose nesting on Carmor Plain to the east.

There were 45 separate records, of at least 14 (probably 17) species of waterbirds, in this area that have been classified as significant. They involved Magpie Goose, Wandering Whistling-Duck, Rajah Shelduck, Grey Teal, Pink-eared Duck, Australian Pelican, White-necked Heron, the egrets (Little Egret at least, and almost certainly the other three egret species as well), Australian White Ibis, Glossy

Ibis, Royal Spoonbill, Black-necked Stork, Gull-billed Tern and White-winged Black Tern. Records varied between 20 000 (Magpie Goose) and 30 (White-necked Heron). The records were spread throughout the year, but the majority were between April and September, signifying the importance of the area for many species of waterbirds during the dry season. As with the previous areas in this survey block, the presence of a significant mixed species waterbird breeding colony, along with significant Magpie Goose breeding, also shows the area to be important in the wet season for these species. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Rajah Shelduck, Australian White Ibis, Black-winged Stilt and Masked Lapwing.

Area A5.5. The next significant area within this survey block is a mostly inland section between the eastern side of the Wildman River and the western side of the South Alligator River, and includes the West Alligator River. It is a considerably smaller area than those discussed so far within this survey block. This area is essentially dominated by two separate important sites. The first and most significant of these two sites is a small floodplain "bay" area in the north east. This has very large numbers of ducks (especially Wandering Whistling-Duck, and to a lesser extent, Plumed Whistling-Duck) and reasonable numbers of Magpie Goose. Numbers of all of these species are lower in the wet season. It is also an area where many separate crèches containing many hundreds of pre-flying Whistling-Duck ducklings were seen from the air in April 2004. They may have also been there, but not detected, in an April 1992 aerial survey that recorded many thousands of whistling-ducks. There have been no ground surveys done at this site, but it is assumed the birds (mostly Wandering Whistling-Duck) bred at this site. At least 500 White-winged Black Tern were also recorded near this area in April 1993. The second site within this area is in the south west of this block. It had well over the 5 000 Magpie Goose recorded, among other birds, including low hundreds of Brolga, in January 1994.

In terms of the entire area, there were no surveys done to produce a total waterbird estimate. The highest survey total count for this area was 15 500 in April 1992, but this was dominated by a single whistling-duck roost. The next highest count of 12 500 was from a single, straight-line flight across the area in October 2001. Full counts of the area, at these times at least, should demonstrate enough waterbirds to qualify for Ramsar listing.

Throughout all surveys there were 14 separate single significant records from this area. These involved at least five species - Magpie Goose, Wandering Whistling-Duck, Purple Swamphen, Gull-billed Tern and White-winged Black Tern. They may have also involved Plumed Whistling-Duck. Records varied between 10 000 (Wandering Whistling-Duck) and 100 (Gull-billed Tern). The records were mostly from April and October surveys, but there was also one record for Magpie Goose in a January survey. This would be partly due to the good Magpie Goose nesting in the eastern part of this area at this time. The presence of a large Nankeen Night Heron breeding colony in the north west of the area also means it is significant for these birds, at least in the wet season when the colony is active. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Australian White Ibis and the egrets, with all four species being recorded.

Area A5.6. The next significant area is the upstream South Alligator River floodplains. The highest count of waterbirds for this area was just under 172 500 in October 2001. Even though this is a large number of birds, the survey did not cover all of the wetland in the area. This survey consisted only of a single meandering flight over part of the wetlands. A full survey and count at this time would have revealed many more waterbirds than this figure. The huge numbers of waterbirds on these wetlands in the dry season have been previously reported by a number of other authors, for example Morton *et. al.* (1991). Needless to say the area would easily qualify for Ramsar listing. It also forms part of the Ramsar listed Kakadu National Park and includes the very important Boggy Plains area which has very large numbers of congregating waterbirds (particularly Magpie Goose) in the dry season.

There were 59 separate records of waterbirds from this area that have been classified as significant. Because many of these records were of *spp.* combinations it is difficult to say how many species were involved, but there were at least 14. Confirmed species included Magpie Goose, Plumed and Wandering Whistling-Duck, Rajah Shelduck, Green Pygmy-goose, Australian Pelican, Pied Heron, Glossy Ibis, Australian White Ibis, Black-necked Stork, Masked Lapwing and Australian Pratincole. It is likely they also included Pacific Black Duck and Grey Teal and each of the egret species. Records varied between 14 000 (Wandering Whistling-Duck) and 20 (Black-necked Stork). All records were in surveys done in either April or October. There is also significant Magpie Goose breeding throughout much of this area during the wet season. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Little Pied Cormorant, Black-winged Stilt and White-necked Heron.

Leichhardt's Lagoon in the south west part of this area is reported in the S.C.R.S.R. to also have very important Wandering Whistling-Duck breeding – up to 30 000 birds are mentioned but it is not clear whether all were breeding.

Area A5.7. This significant area combines the downstream floodplains of the East Alligator River and Coopers Creek. There were no surveys done to produce a total waterbird estimate for this significant area. A survey of part of the southern section of this area in October 2001 recorded nearly 23 000 waterbirds, dominated by ducks and Magpie Goose. This area could easily qualify for Ramsar listing. There were 40 separate records, of between 15 and 18 species that have been classified as significant for this area. They involved Magpie Goose, Plumed and Wandering Whistling-Duck, Pacific Black Duck, Grey Teal, Pink-eared Duck, Australian Pelican, Pied Heron, Great Egret, Intermediate Egret (and likely Little Egret and Cattle Egret among the significant *egret spp.* records), Glossy Ibis, Australian White Ibis, Royal Spoonbill, Black-necked Stork, Brolga, Whiskered Tern and White-winged Black Tern. Records varied between 10 000 (Plumed Whistling-Duck and Magpie Goose) and 20 (Black-necked Stork). All records were between April and October, signifying the importance of the area for many species of waterbirds during the dry season. The presence of two significant mixed species waterbird breeding colonies, and good Magpie Goose nesting throughout a lot of this area, also means the area is important in the wet season for these species. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Black-winged Stilt, Masked Lapwing, Rajah Shelduck and Straw-necked Ibis.

The area around the Coopers Creek and East Alligator River junction and the area to the south on the other (south) side of the East Alligator are reported as one of the most important dry season refuges for Rajah Shelduck in Australia (S.C.R.S.R.). It also reported as having significant breeding in the wet season for this species.

Area A5.8. The next significant area within this survey block is the Mount Borradale wetland area in the upstream Coopers Creek vicinity. This area can have large numbers of waterbirds when other areas are drier. An aerial survey of most of this area in August 1992 recorded around 17 500 waterbirds, dominated by Plumed Whistling-Duck. It is likely that a thorough count of this area would reveal sufficient waterbirds to qualify for Ramsar listing. There were six separate records, of at least four species of waterbirds, in this overall area that have been classified as significant. They involved Plumed Whistling-Duck, Green Pygmy-goose, Nankeen Night Heron and Whiskered and/or White-winged Black Tern. Records varied between 15 000 (Plumed Whistling-Duck) and 300 (Green Pygmy-goose and Nankeen Night Heron). All significant records were in April and August surveys. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Magpie Goose and the egrets.

Area A5.9. The final significant waterbird area for this survey block involves the upstream floodplains of the East Alligator River, including the Magela Plain. A survey of part of this area in October 2001 recorded just under 49 000 waterbirds of many species, easily qualifying the area for Ramsar listing. This survey consisted only of a single meandering flight over part of the wetlands. A full survey and count at this time would have revealed many more waterbirds than this figure. The huge numbers of waterbirds on these wetlands in the dry season have been previously reported by a number of other authors, for example Morton *et. al.* (1991).

Throughout the surveys there were only 14 separate records that have been classified as significant. This relatively low number is a reflection of a lack of surveying of this area in the late dry season when the larger numbers of many species of waterbird are present. These records also involved a number of mixed species records and the only waterbirds confirmed to species level included Plumed and Wandering Whistling-Duck, Pied Heron, Intermediate Egret, Glossy Ibis, Black-necked Stork and Whiskered Tern. Records varied between 1 000 (whistling-ducks) and 10 (Black-necked Stork). All significant records were in the previously mentioned October 2001 survey, which was the only reasonably comprehensive survey of this area in the late dry season. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Magpie Goose, Rajah Shelduck, White-necked Heron, each of the other three species of egrets, Australian White and Straw-necked Ibis, Masked Lapwing and Black-winged Stilt. The inclusion of Magpie Goose in this latter list of important species is a good example of why looking at the total number of records and counts is important for adding species that were not recorded in single specific counts. Magpie Goose were easily the most abundant species recorded in this area (three times more than any other species) but were never called in single counts of in excess of the 3 000 allocated to them as a significant number in terms of this report.

Other Significant Single Records. There were three additional single significant records outside of the significant areas listed for this survey block (Figure 14).

Record R5.1. This record was of 300 Gull-billed Tern and 300 Whiskered Tern on a small swamp on Cape Hotham in December 1992.

Record R5.2. This record was of 2 000 Plumed Whistling-Duck and 2 000 Wandering Whistling-Duck at Bird Billabong along the upstream Mary River in October 2001. There were also reasonable numbers of Magpie Goose, Rajah Shelduck, Green Pygmy-goose and Royal Spoonbill present among other birds at the same time.

Record R5.3. This record was of 300 Comb-crested Jacana and 300 Rajah Shelduck on a swamp to the west of the South Alligator River in October 2001. There were also reasonable numbers of Magpie Goose, both whistling-ducks, Pied Heron, Little Egret and Intermediate Egret present among other birds at the same time.

SURVEY BLOCK 6

Location and Habitat

This survey block includes the coast, islands and adjacent inland wetlands of the Tiwi Islands. These include Melville and Bathurst Island and two small islands off their northern and southern shores. The Tiwi Islands lie just to the north of Darwin. The coast of the Tiwi Islands is a mixture of intertidal mudflat backed by mangroves and saline wetlands, sections of beach backed by dunes and/or forest and, to a lesser extent, mangrove/reef coast. Although there is an intermixing of these habitats all around the islands, the majority of beach is in the western third of the island group and the majority of mangrove/reef is in the north east of Melville Island. There are a number of scattered freshwater wetlands on both islands. None of these are large compared to some of the floodplains on the mainland. Melville and Bathurst Islands are separated by the mangrove-lined Apsley Straits. There are two significant coastal Aboriginal communities in the north west of Melville Island and one in the south east of Bathurst. Although there is a number of smaller, irregularly used outstations around the coast there are still large sections of coast, particularly in the north east, that are relatively undisturbed.

This survey block has a large amount of waterbird habitat with approximately 970 kilometres of coastline and 790 square kilometres of wetland. Most of this wetland is associated with saline mangrove swamps lying immediately adjacent to the coast. There are none of the large freshwater floodplains that are associated with most other survey blocks.

Survey Effort

Up to the completion of the previous report in this series (shorebirds), this survey block had a comparatively small amount of surveying compared to most of the other blocks. This has been rectified to a certain extent over the last couple of years. In total it has now received approximately 110 hours of surveys, which represent approximately 5.5% of the hours of survey in all survey blocks combined. These surveys were spread over only 26 separate days. The block was not surveyed in January, July and November (Figure 19). There were 75 separate ground surveys involving 40 different and well-spread sites.

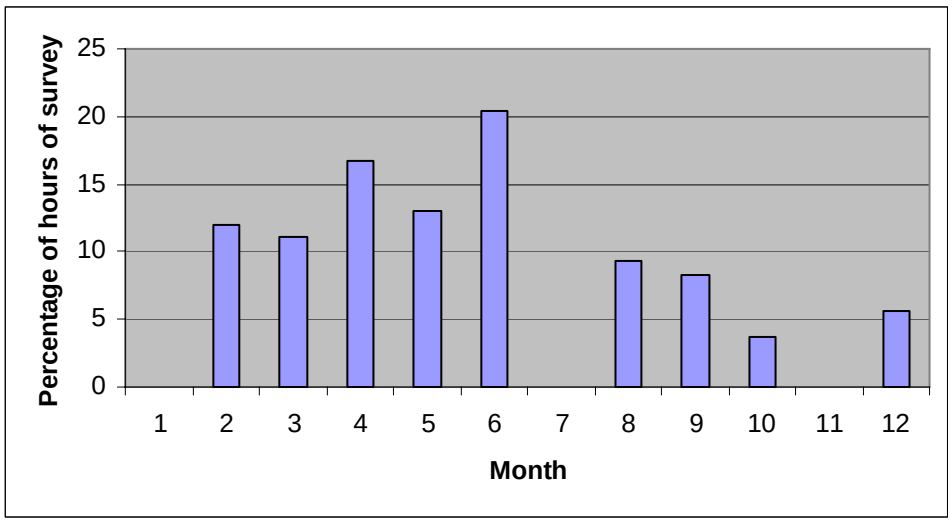

Figure 19. Approximate percentage of surveys hours relating to waterbirds for survey block 6.

Results and Discussion

During the full period of this project there were around 630 separate waterbird records made, totalling over 4 900 birds (Figure 20). These represented around 2.1% of the records and <1% of the total numbers of waterbirds recorded in the fifteen survey blocks. Thirty-eight species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Thirty-six species were recorded in aerial surveys, but nothing was recorded in exceptionally high abundances. The most abundant species were the egrets, Wandering Whistling-Duck, Australian White Ibis, Masked Lapwing, Black-winged Stilt, Gull-billed Tern, Australian Pelican and Rajah Shelduck.

Twenty-eight species were recorded in ground surveys of this survey block. No species were recorded on a large number of occasions and so those that live in larger groups tended to dominate the small number of records. The most abundant species was Common Tern, followed by Pied Heron, White-winged Black Tern, Masked Lapwing and the egrets.

Species Recording Rates. Egrets were the most frequently recorded group from the air, although Cattle Egret were not recorded very often. The next most abundant species were Australian White Ibis, Black-necked Stork, Osprey and Australian Darter.

No species was recorded more than eight times in ground surveys in this block. The most frequently recorded species were Osprey, Masked Lapwing, White-bellied Sea-Eagle, Black-necked Stork, Gull-billed Tern, Australian White Ibis, Black-winged Stilt, Common Tern and Little Egret.

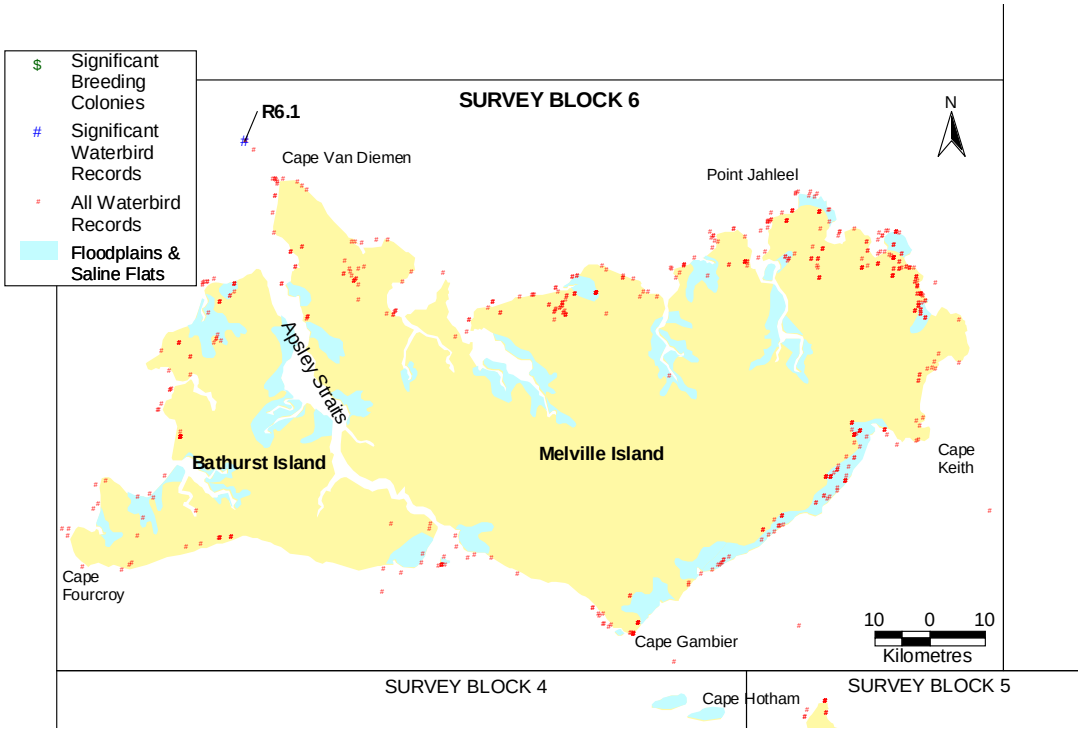

Figure 20. Distribution of waterbird records for survey block 6.

Important Areas.

Significant Waterbird Breeding Colonies. No waterbird breeding colonies were located in this survey block during the project. It is very unlikely that any regular or significant colonies were missed during the surveys, but it is possible that small breeding groups of cormorants or darters (for example) may have been missed.

Significant Waterbird Areas. There were quite a number of surveys done around the coast of this survey block, but not many of the inland wetlands. Although this survey block does not have a large amount of freshwater wetlands no surveys were done in November and December, before the wet season rains come. This is likely to be when waterbird numbers of most species are at their highest in this area. Although highly significant numbers of most waterbird species are unlikely to occur here, there may have been more significant records that can be reported here if surveys were done at this time. There were no significant waterbird areas identified in this survey block. The greatest number of waterbirds reported from a single survey (of around 70% of the wetlands on or near the coast) was around 3 500.

Other Significant Single Records. There was only one record classified as significant for this survey block (Figure 20).

Record R6.1. This was of 500 Common Tern on a small island off the north west of Melville Island in September 1996. Apart from roosting terns, the island is not significant for waterbirds, but it is a major Crested Tern breeding colony and has significant Olive Ridley Turtle nesting. This island was not surveyed just before dusk at any stage during the project. It is likely that species such as Common Tern returning to roost from the days hunting at sea would regularly use this island over night in much higher numbers (given the number of Common Tern seen at sea) than was observed in these surveys.

Other than this the highest single count of any species was of 400 Pied Heron on a swamp on the mid coast of Melville Island in August 2004.

SURVEY BLOCK 7

Location and Habitat

This block extends from the mouth of the East Alligator River, around the Cobourg Peninsula and along the northern coast to Junction Bay, just west of Maningrida. It includes the main islands of Croker, North Goulburn and South Goulburn, and a number of smaller islands, mainly around Cobourg Peninsula and to the east of Croker Island. This entire block is made up of the western part of Arnhem Land (Aboriginal land) and the Garig Gunak Barlu National Park on Cobourg Peninsula. There are no pastoral properties within this block. Apart from the park, which has controlled visitor numbers, the main Aboriginal communities are Murgenella and those on Croker and South Goulburn Islands. There are also many small outstations that are seasonally used along the northern coast, but in general the majority of this survey block is relatively undisturbed by people.

This survey block has one of the more diverse ranges of habitat of all blocks in the western half of the Top End. There are approximately 1 530 kilometres of coastline and 1 050 square kilometres of wetland. This represents the second longest length of coastline, but only an average area of wetland compared to the other survey blocks. There are extensive areas of intertidal mudflat backed by mangroves in the south west of the block and in the bays along the coast in the eastern half of the block. Extensive freshwater floodplains are associated with the northern part of the East Alligator River and the Murgenella Creek systems in the south west, and there are smaller floodplains associated with a number of rivers in the eastern half of the block. Interspersed along the northern coastline of this block are wide sandy beaches, sometimes backed with dunes and others with some of the highest cliffs along the Northern Territory coast (north east of Murgenella). The islands along the northern coast, particularly the smaller ones to the east of Croker Island, are mostly sand and coral, and are surrounded by clear blue seas. The islands in Van Diemen Gulf, in the western part of the block are dominated by mangroves and surrounded by turbid water.

Survey Effort

This survey block received approximately 155 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 7.9% of the hours of survey in all survey blocks combined. These surveys were spread over only 55 separate days. All months had some surveys but there was a large variation between months (Figure 21). February, April, August, November and December received the highest amount of survey time while January and July received very little. There were 110 separate ground surveys involving 75 different and well-spread sites.

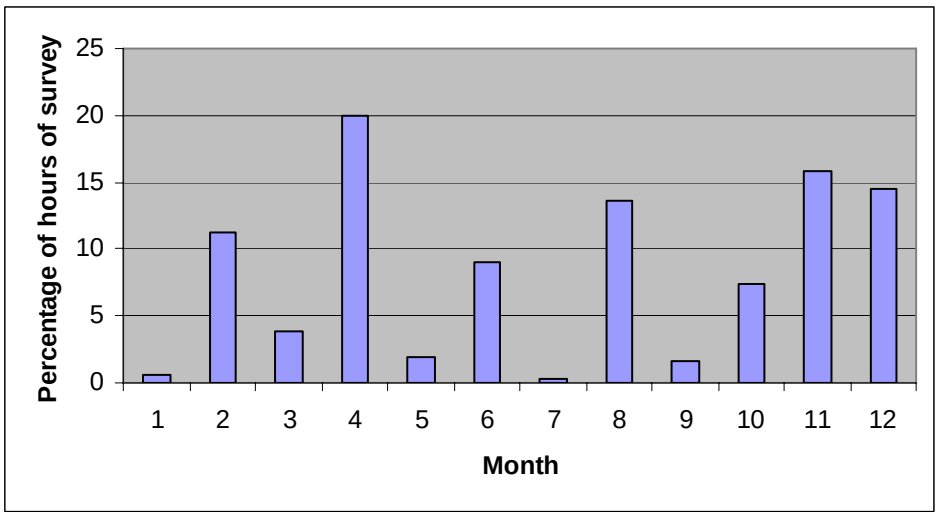

Figure 21. Approximate percentage of surveys hours relating to waterbirds for survey block 7.

Results and Discussion

During the full period of this project there were around 2 300 separate waterbird records made, totalling over 270 000 birds for this survey block (Figure 22). These represented around 7.6% of the records and 10.2% of the total numbers of waterbirds recorded in the fifteen survey blocks. The total number of birds recorded in the block was the third highest for all survey blocks. Forty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Forty-seven species were recorded in aerial. Magpie Goose were again the most abundant species in this block. It was followed by the egrets (including all four species), Grey Teal, Brolga, both Wandering and Plumed Whistling-Ducks, Pacific Black Duck, Glossy Ibis and Pied Heron.

Forty-four species were recorded in ground (including boat) surveys of this survey block. The most abundant species recorded was the Common Tern. This was largely a result of a single boat survey across the top of this survey block in which large numbers of Common Tern were seen hunting at sea during the trip. This is further discussed in the Common Tern section. The next most abundant species from ground surveys were Wandering Whistling-Duck, Grey Teal, Magpie Goose, Plumed Whistling-Duck, Purple Swamphen, Pink-eared Duck, Comb-crested Jacana and Rajah Shelduck.

Species Recording Rates. The egrets were the most frequently recorded species during aerial surveys of this survey block. They were followed by Magpie Goose, Australian White Ibis, Osprey, Black-necked Stork, Australian Darter, White-bellied Sea-Eagle, Black-winged Stilt and Masked Lapwing.

The most frequently recorded species in ground surveys were Common Tern, Great Egret, Little Egret, Osprey, White-bellied Sea-Eagle, Masked Lapwing, Intermediate Egret, Royal Spoonbill, Whiskered Tern and Australian White Ibis.

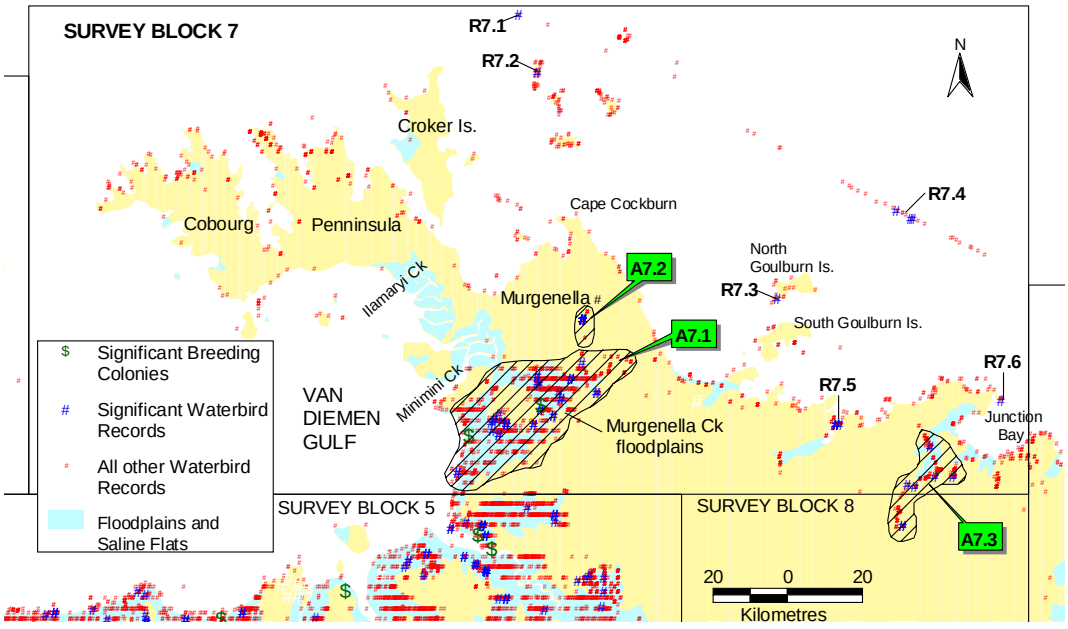

Figure 22. Distribution of waterbird records for survey block 7.

Important Areas.

Significant Waterbird Breeding Colonies. There were two significant waterbird breeding colonies located in this survey block during the project (Figure 22). These were both in the south west and associated with the larger wetlands of the block. The two colonies were especially significant for Little Pied Cormorant, Little Black Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Cattle Egret and Australian White Ibis. There were also smaller colonies in this area but no colonies were located anywhere else in the survey block. See Chatto (2000b) for further details.

Significant Waterbird Areas. There were three significant areas located for waterbirds within this survey block (Figure 22). Two of these (A7.1 and A7.2) are adjacent to each other but have been treated as different areas because of the way they were surveyed.

Area A7.1 The most significant waterbird area within this survey block combines the wetlands of Murgenella and Salt Water Creeks. This is an extremely significant area for a large diversity of waterbirds, particularly in the north east section. There were no surveys done to produce a total waterbird estimate for this significant area. Surveys done over three consecutive days in April 1994 counted just under 30 000 birds. There was a little overlap with a small part of these surveys with some resultant possible double counting, but there was still much wetland area that was not surveyed and so this count would still have been an under estimate for the area. These counts were dominated by Magpie Goose, ducks and egrets. The area could easily qualify for Ramsar listing on the basis of waterbird numbers alone.

Throughout all surveys there were 25 separate records classified as significant. Depending on the individual egret and duck species representation among the combined species records, there were between 12 and 17 species involved. Confirmed species among this included Magpie Goose, Wandering and Plumed Whistling-Duck, Grey Teal, Pink-eared Duck, Little Pied Cormorant, Little Black Cormorant, Nankeen Night Heron, the egrets (with all four species well represented), Brolga, Purple Swamphen, Whiskered Tern and White-winged Black Tern. Records varied between 7 000 (whistling-duck) and 300 (Nankeen Night Heron) and were all in the months April, August, September or December. With the area still being very wet in April and largely dry in December, this shows the importance of the area in both wet and dry seasons. The presence of two significant mixed species waterbird breeding colonies and significant Magpie Goose breeding further shows the importance of the area in the wet season for these species. Other species that have not been listed for the area from significant single records, but are also regarded as important because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Australian Darter, Pied Heron, Glossy Ibis, Australian White Ibis, White-bellied Sea-Eagle, Black-necked Stork, Black-winged Stilt and Masked Lapwing.

The mangroves between Minimini Creek and Ilamaryi Creek near Cobourg Peninsula are reported to be among the most important wet season breeding sites for Rajah Shelduck in Australia (S.C.R.S.R.).

Area A7.2 Although this relatively narrow band of floodplain (about 18 km long by half a km wide) runs into the floodplains of the previously discussed area, it is listed as a separate area of significance. The area was only surveyed twice, both times from the air. All of the significant records were made from only one of these surveys. Also, because of the phenomenal number of birds present along the flown survey route they could not be continually recorded to individual positions so they were all entered as between a starting and ending point. When retrieving the data for the distribution map record, only the start point of such records is retrieved. This can be seen as the single significant site symbol at the northern end of the system (Figure 22).

The large number of waterbirds in this area was recorded in the late dry season of 1992. The estimate, of 163 000 waterbirds present on this single flight was very much a minimum estimate and well under the true numbers that were in the area. The area could easily qualify for Ramsar listing on the basis of waterbird numbers alone. The only other survey of the area was in April 1994. This April survey

revealed reasonable numbers of birds, particularly egrets, but nowhere near the numbers of the 1992 survey. Although the area may be of some significance in other late dry seasons, it is unknown if the number of waterbirds present in the conditions of 1992, occurs on a regular basis. Earlier in 1992 a cyclone passed over the area, dropping 17 inches (~43 mm) of rain in this area, but little on other floodplains in the north west of the Top End. This caused a large amount of water to remain in this area later in the dry season when other areas were much drier. Waterbirds from these other areas converged on this floodplain in huge numbers.

In total, 25 separate records, involving 28 species of waterbirds have been classified as significant for this area. (The reason for there being more species than records is that the four egret species were unable to be separated in the count estimate and were combined in an *egret spp.* record, but they were clearly all present in significant numbers). As all the waterbirds along the entire route were totalled for the one record for each species, it is not possible to compare such records to other specific high count records throughout the Top End for the respective species. The records involved all or most of the ducks, cormorants, egrets and ibis species, as well as Magpie Goose, Australian Pelican, Pied Heron, Nankeen Night Heron, Royal Spoonbill, Black-necked Stork, Brolga, Eurasian Coot, Comb-crested Jacana, Masked Lapwing, Australian Pratincole, Gull-billed Tern and Whiskered Tern. Other species such as Australian Grebe and Black-winged Stilt, also recorded as present but not in numbers to be classified as significant, would likely have been in significant numbers given the underestimates of the counts in this survey. Records varied between 50 000 (Magpie Goose) and 100 (Royal Spoonbill). Virtually every species of the more common waterbirds covered in this report were present, with the only obvious absentees from this site being White-faced Heron and White-necked Heron.

Area A7.3 The third significant waterbird area within this survey block combines the wetlands of Goomadeer River and Jungle Creek in the east of the block. There were no surveys done to produce a total waterbird estimate for this significant area. A survey of part of the area in August 2004 counted around 9 500 birds. It is not known if this area would have had 20 000 waterbirds at this time and there were limited other surveys were done of this area in the late dry season when the largest numbers of waterbirds are present. There were seven separate records, involving four species of waterbird in this area that have been classified as significant. They involved Green Pygmy-goose, Pacific Black Duck, Hardhead and Brolga. Records varied between 1 000 (Pacific Black Duck) and 300 (Green Pygmy-goose). All significant records were in the one survey, in April 2004. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Australian Darter, Little Pied Cormorant, Nankeen Night Heron, the egrets (particularly Great Egret), Glossy Ibis, Australian White Ibis, Black-necked Stork and Masked Lapwing.

Other Significant Single Records. There were six sites at which additional single significant records were made. These were spread along the coast, on islands and in the open ocean offshore. Most relate to Common Tern hunting at sea or roosting out on islands, and are discussed in more detail in the species section dealing with Common Tern later in the report.

Record R7.1. This record was of 1 000 Common Tern hunting at sea to the north east of Croker Island in December 2004. It was one of several significant Common Tern records made from a boat whilst travelling along the north coast of the Top End during daylight hours (see also record R7.4). Most records on this trip were of groups in the low hundreds and so do not register as significant records, but there were many, many thousands of Common Tern hunting or resting on the sea throughout the waters from Croker Island eastward. They were easily the dominant bird in the area. This particular survey is further discussed in the species section dealing with Common Tern later in the report.

Record R7.2. This record was of 500 Common Tern coming in to roost on Oxley Island (one of the small islands off the north east of Croker Island) in October 1994. This count was made around sunset as the Common Tern began coming in from hunting at sea to roost for the night. When the site was first checked in the late afternoon there were no Common Tern present, but and as sunset approached

more and more Common Tern continued to arrive. They were still arriving when we had to depart the island, which was still well before dark. Based on other observations during the project, numbers would have continued to increase until just before dark.

Record R7.3. This is another significant count for Common Tern. It was a record of 800 birds roosting during the day in November 2004 on the south west tip of North Goulburn Island. There was another roost of 250 Common Tern a little further eastward along the south side of this island at this time.

These last three records are good examples of Common Tern behaviour. When weather conditions are good and they are hunting well out to sea they will rest on the sea during the day, returning to land at night to roost. When weather conditions are poor or they are able to find food close to islands, they will come in during the day to rest between bouts of foraging.

Record R7.4. This site contains three records, each of 500 Common Tern recorded on the above mentioned boat survey. These records were the three largest single records in this part of the ocean. As mentioned in record 7.1, there were a number of other separate records numbering in their low hundreds (but individually not exceeding the 499 count set as a minimum for significant Common Tern records) in this general area. Given these records were obtained from a single transect through the area, and birds could be seen in all directions for as far as the horizon, there is likely to have been many, many thousands of Common Tern hunting the seas off this part of the central north coast of the Northern Territory.

Record R7.5. This site was a single swamp just in behind the coast on the eastern side of the mouth of the King River. There were six significant records, involving five species, made during two ground surveys of this site. There were around 300 Purple Swamphen present in an August 2004 survey. There were another 19 species of waterbird recorded in this survey but none in significant numbers. A second survey in late November of the same year, again recorded around 300 Purple Swamphen. This suggests they had remained in this swamp for the period between surveys. Many of the other waterbirds had increased in numbers in this time. Significant counts of 4 000 Magpie Goose, 2 000 Wandering Whistling-Duck, 400 Comb-crested Jacana and 300 Hardhead were among the waterbirds present in the November survey. On this occasion there were also low hundreds of Plumed Whistling-Duck, Rajah Shelduck, Pacific Black Duck, Pied Heron and Glossy Ibis.

Record 7.6. This is another significant count for Common Tern. It was a record of 750 birds roosting during the day in November 2001 on Braithwaite Point.

SURVEY BLOCK 8

Location and Habitat

This survey block covers the area from just west of Maningrida, east to just short of the western end of Elcho Island. It includes a number of islands close to shore but also North East and North West Crocodile Islands which are around 50 kilometres offshore. The entire block is contained within Arnhem Land and is Aboriginal land. The largest Aboriginal communities are at Maningrida and Millingimbi. There are also many small, seasonally used, outstations along the northern coast of the survey block, but in general the majority of this survey block is relatively undisturbed. One Aboriginal pastoral property is located in the Arafura Swamps, which are extensive wetlands associated with the Glyde and Goyder River systems.

The survey block has a relatively short (approximately 670 kilometres) coastline but quite a large area (approximately 1 900 square kilometres) of wetland. There are extensive areas of intertidal mudflat backed by mangroves in both Boucaut and Castlereagh Bays. Sand and rock beaches occur on the points at both ends of these bays. Extensive freshwater floodplains are associated with the Liverpool/Tomkinson Rivers (south of Maningrida), the Blythe/Cadell Rivers (south of Boucaut Bay) and the Glyde/Goyder Rivers (the Arafura Swamps).

Survey Effort

This survey block received approximately 125 hours of surveys related to waterbird/shorebird work during the period of this project. This represented approximately 6.4% of the hours of survey in all survey blocks combined. These surveys were spread over 34 separate days. The majority of survey effort in this block occurred in the dry season. The survey block received little or no surveying in the January/February and September/October periods (Figure 23). There were 70 separate ground surveys involving 55 different and well-spread sites.

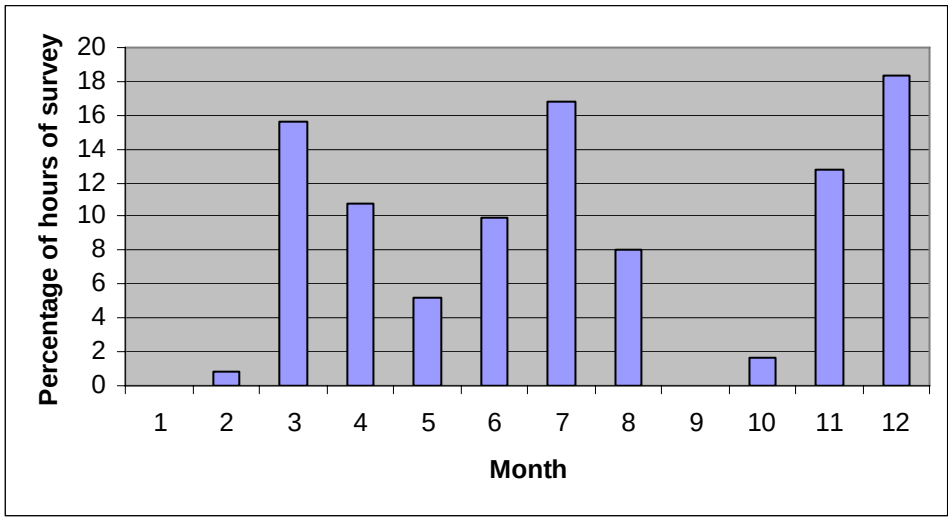

Figure 23. Approximate percentage of surveys hours relating to waterbirds for survey block 8.

Results and Discussion

Waterbirds were reasonably well distributed all around the coast, islands and near coastal wetlands of this survey block. During the full period of this project there were over 1 300 separate waterbird records made, totalling over 137 000 birds (Figure 24). These represented around 4.1% of the records and 5.5% of the total numbers of waterbirds recorded in the fifteen survey blocks. Forty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Forty-one species were recorded in aerial surveys. The most abundant species was the Magpie Goose, followed by the egrets. Cattle Egret were individually in the top five but they are easier to identify from the air and tend to be seen in larger groups than the other egrets, which were also all well represented. The next most abundant species were Straw-necked and Australian White Ibis, Brolga, Wandering Whistling-Duck, Pied Heron, Glossy Ibis, Nankeen Night Heron and Australian Pelican.

Forty-six species were recorded in ground surveys. The most abundant species was Wandering Whistling-Duck, followed by the egrets, Glossy Ibis, Common Tern, Masked Lapwing and Plumed Whistling-Duck.

Species Recording Rates. Species recorded most frequently from aerial surveys were the egrets, Magpie Goose, Australian White Ibis, Black-necked Stork, Brolga, Australian Pelican, Straw-necked Ibis, Osprey, White-bellied Sea-Eagle and Australian Darter.

The species recorded on the most occasions from ground surveys were Gull-billed Tern, Little Egret, Great Egret, Australian White Ibis, Black-necked Stork, Whiskered Tern, Common Tern, Pied Heron, Masked Lapwing, White-bellied Sea-Eagle and Osprey.

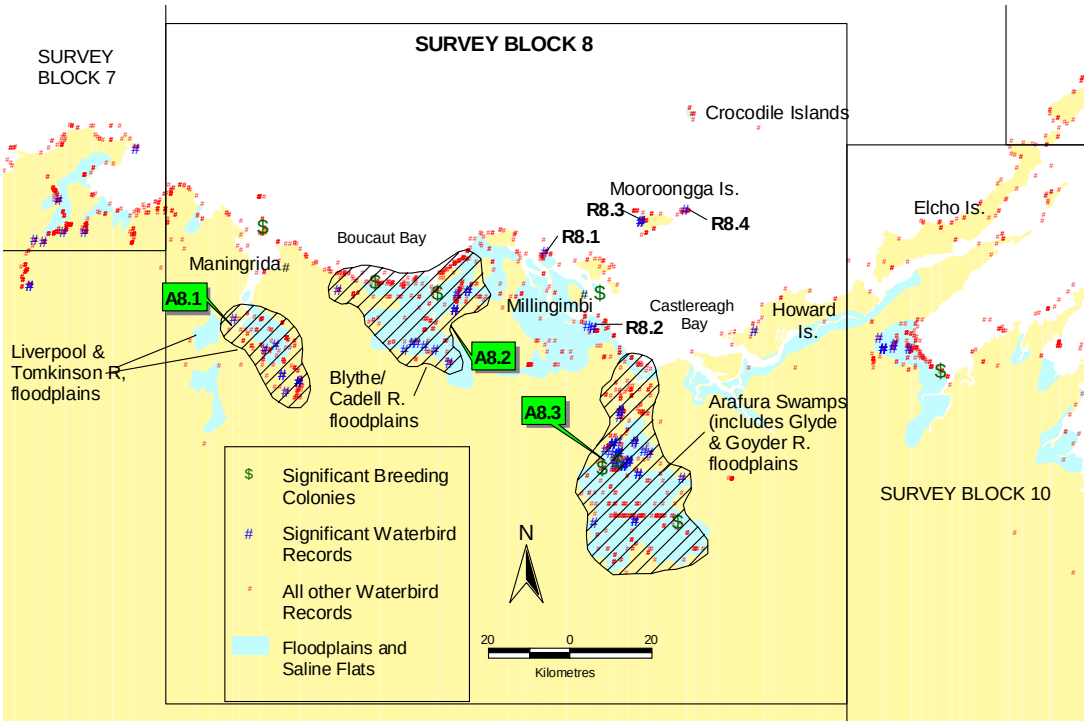

Figure 24. Distribution of waterbird records for survey block 8.

Important Areas.

Significant Waterbird Breeding Colonies. Six well spread breeding colonies were located in this survey block (Figure 24). These colonies involve all colonial breeding species except Australian Pelican and Glossy Ibis, both of which only breed in single locations in the Top End. Colonies in this survey block had up to 5 000 birds regularly using them, and were especially significant for Australian Darter, Little Pied Cormorant, Pied Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret and Royal Spoonbill. See Chatto (2000b) for further details.

Significant Waterbird Areas. Three areas within survey block 8 have been classed as significant waterbird areas. These are the wetlands associated with the Tomkinson River, those associated with the Blythe/Cadell River system and the Arafura Swamp.

Area A8.1 This first area involves the wetlands of the Tomkinson River to the south east of Maningrida. A reasonably comprehensive aerial survey in May 1995 observed many thousands of waterbirds, particularly on the Tomkinson floodplain. These were dominated by egrets, Australian White Ibis and Straw-necked Ibis, with good numbers also of Pied Heron, Australian Darter and cormorants. Although only around 15 000 were actually recorded on this survey there would have been easily in excess of 20 000 if a more comprehensive survey was done.

Throughout the project there were nine separate records of waterbirds classified as significant for this area. These involved between 7 and 10 species (depending on the egret representation in the combined *egret spp.* records). They included Magpie Goose, Pied Heron, egrets (with all four species well represented), Australian White Ibis, Straw-necked Ibis and Brolga. Specific records classed as significant varied between 5 000 (Magpie Goose) and 10 (Black-necked Stork). All significant records were made in March and July. This floodplain dries out before the other floodplains in this part of Arnhem Land: these records show this area to be important for waterbirds in the late wet season as well as the dry season. Other species that have not been listed for the area from significant single records, but are also important because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include White-necked Heron and Black-winged Stilt.

S.C.R.S.R. reports good wet season breeding of Brolga on the Liverpool River floodplain, upstream from the junction with the Tomkinson River.

Area A8.2 The next area classified as significant in this survey block are the wetlands associated with the Blythe River and those abutting the coast of Boucaut Bay. There have not been any single surveys to cover all of these wetlands at once. Around 8 000 waterbirds were recorded on mostly aerial surveys in July 1998 and March 1999, but both of these surveys covered only a small part of the area. It is not known whether this area would total in excess of 20 000 waterbirds but it would be expected to do so if the area was to be fully counted. There were 13 separate records, involving 7 species of waterbirds in this area that have been classified as significant. They included Magpie Goose, Cattle Egret, Glossy Ibis, Australian White Ibis, Masked Lapwing and Australian Pratincole. Records varied between 3 500 (Magpie Goose) and 300 (Masked Lapwing and Australian Pratincole). All significant records were March, May or July. The presence of two significant mixed species waterbird breeding colonies also shows the area to be important in the wet season for these species. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Australian Pelican, Little Egret, Straw-necked Ibis, Black-necked Stork, Osprey, White-bellied Sea-Eagle and Gull-billed Tern.

S.C.R.S.R. reports good wet season breeding of Brolga on the downstream Blythe River floodplain and the coastal flats between Millingimbi and the mouth of the Glyde River.

Area A8.3 The last of the areas listed as significant in this block is the Arafura Swamp and the coastal wetlands to its north. This area has a large diversity of wetland habitat from open saline flats, through reed and sedge dominated floodplain to huge areas of paperbark wetland. This area can have some very large numbers of waterbirds at times, but at other times has relatively few. Transect-flown aerial surveys in March 1992, for example, recorded few waterbirds over most of the swamp, particularly the upstream areas. Most were Magpie Goose and egrets. This area was more intensely surveyed for flora and fauna (including waterbirds) by other Parks and Wildlife staff, with 13 field trips between July 1998 and August 2000. The results of these surveys can be found in Brennan *et. al.* (2003).

The largest single count of waterbirds for this area during my surveys was of 35 500 birds. This was in an aerial survey of a reasonable percentage of this area in July 1998. Unlike many other Top End wetlands at this time of year, much of this swamp was still very flooded. (It was still recorded as quite flooded when I did a mid December survey of part of this area). My July count (which is just the raw count and not covering the entire area) was well under the estimate of Brennan *et. al.* whose (corrected and calibrated) estimate for the Arafura Swamp on both of two surveys done in July 1998 and December 2000 was 300 000 waterbirds. This is a good example of how the figures I am quoting for significant areas in this report are below the likely true numbers for many sites.

Throughout my surveys there were 28 separate records of waterbirds in this area that have been classified as significant. These involved at least 13 species (depending on the species representation in the combined *egret spp.* and *duck spp.* records). Species confirmed in single significant records were Magpie Goose, Plumed and Wandering Whistling-Duck, Pied Heron, Nankeen Night Heron, Cattle Egret, Intermediate Egret, Great Egret, all three ibis species, Brolga, Masked Lapwing and Whiskered Tern. Individual records varied between 7 500 (Cattle Egret) and 300 (Nankeen Night Heron). All significant records, except one, were in July during the only reasonably extensive survey of this area. The exception was a large Cattle Egret record, which was just a sample of the many thousands that were seen in a single flight across the swamp in May 1995.

Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area may include Australian Darter, Little Pied Cormorant, Little Egret, Royal Spoonbill, Black-necked Stork, White-bellied Sea-Eagle and Black-winged Stilt.

Other Significant Single Records. There were four other sites that had between one and three specific significant records (Figure 24). These were all on coastal wetlands, or islands in Arafura Sea and Castlereagh Bay areas.

Record R8.1. This record was of 300 Gull-billed Tern roosting on an island near Millingimbi in June 1996. There were also another 230 nearby. At the same site there were 150 Whiskered Tern and 100 Little Egret present.

Record R8.2. These records were of 500 Australian Pelican and 1 000 egrets in the saline wetlands of the mainland near Millingimbi in July 1998. There were no Cattle Egret confirmed amongst the egrets but the other three species were all well represented. Also at this same site were 100 Masked Lapwing, 200 Gull-billed Tern and 160 Whiskered Tern.

Record R8.3. This site involved three records in a swamp on the western side of Mooroongga Island. In November 2001 there were 2 500 *duck spp.* and 2 500 Wandering Whistling-Duck seen from the air. It is likely that many of the *duck spp.* would have been Wandering Whistling-Duck, but good numbers of Plumed Whistling-Duck, Pacific Black Duck and Grey Teal have been recorded in other surveys of this swamp. For example, in the December 2004, a significant record of 1 000 Rajah Shelduck, and other records of 400 Grey Teal and 200 Pacific Black Duck were made in a ground survey of the site.

It is also interesting to note that the ducks using this swamp on the main part of Mooroongga Island regularly fly out to a much smaller island off the north west tip that has no freshwater, possibly in order to ingest little stones for their gizzards.

Record R8.4. This record was from another smaller island off the eastern end of Mooroongga Island. In October 1994 there were 3 000 Common Tern roosting during the day on the island. There were also around 100 Pacific Black Duck seen on this island on another occasion but it is not known whether they use this island in the same manner as discussed with the other island in record R8.3.

There is also another significant site symbol shown on Howard Island in the east of the survey block. This one is not included as a significant site in this waterbird report. This is because it was of 100 Gull-billed and/or Caspian Tern, and it is possible that at least some of the birds in this record may have been Caspian Terns which are not covered in this report.

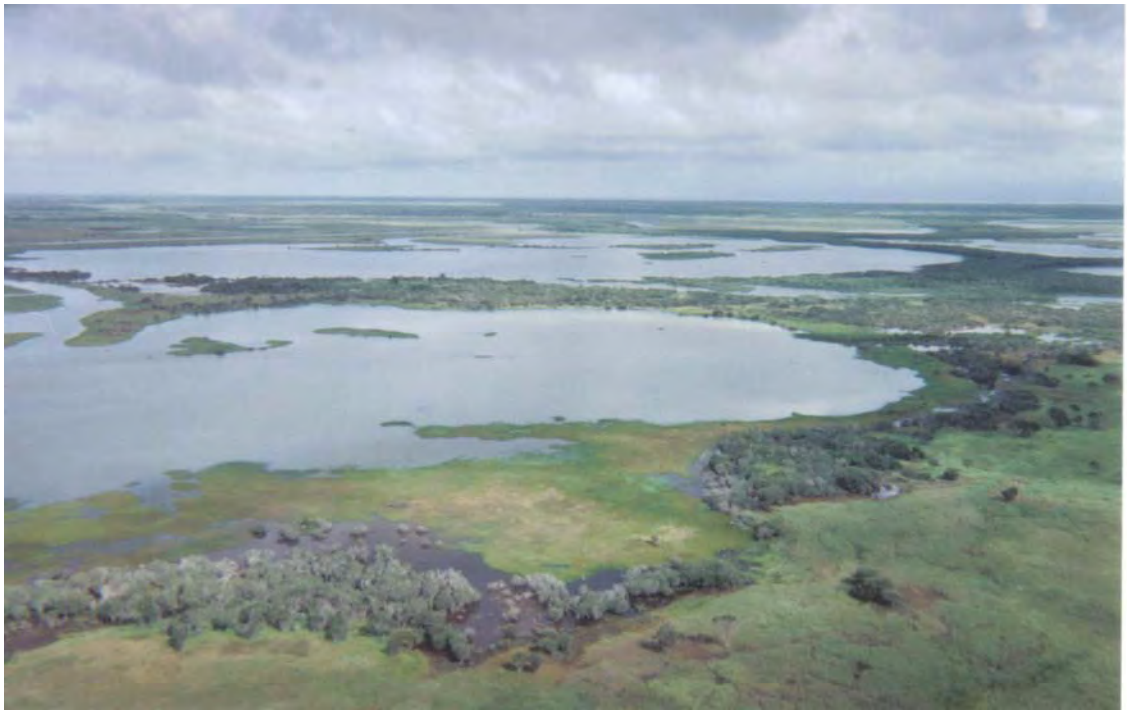

Plate 5. Blythe River Floodplain, July 1999. Photo R. Chatto.

SURVEY BLOCK 9

Location and Habitat

This survey block includes most of the islands off north east Arnhem Land. They include the northern part of the Cunningham Islands, the Wessel Islands, and three small islands that are off the eastern end of the English Company Islands. (This latter, large chain of islands is mostly included in survey block 10). One of these three small islands is Truant Island. This survey block is all part of Arnhem Land, and therefore all Aboriginal land. There are no significant Aboriginal communities in the survey block. There are some small, seasonally used outstations that are visited from Elcho Island to the south west and from Nhulunbuy to the south east, but most of this survey block is relatively undisturbed by people.

The survey block, which is composed only of islands, has approximately 580 kilometres of coastline but only one small wetland. This is situated in the far north east of the Wessel Islands. There are no extensive sections of intertidal mudflat in this survey block but there are small reef/mangrove areas and some sand areas that are exposed at low tide. Most of the islands are dominated by sandstone, with sand beaches on the western sides and cliffs on the eastern sides. Cliffs on the eastern side of the outer Wessel Islands are very high for the Northern Territory. Most islands have a reasonable cover of low vegetation.

Survey Effort

This survey block received approximately 80 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 3.9% of the hours of survey in all survey blocks combined. These surveys were spread over 20 separate days. The majority of survey effort in this block occurred in the September to November period (Figure 25). This was largely due to the amount of work done on seabird breeding colonies in this area. February, August and December received no surveying but visits were made in January and most of the dry season months. There were 33 separate ground surveys involving 22 different and well-spread sites.

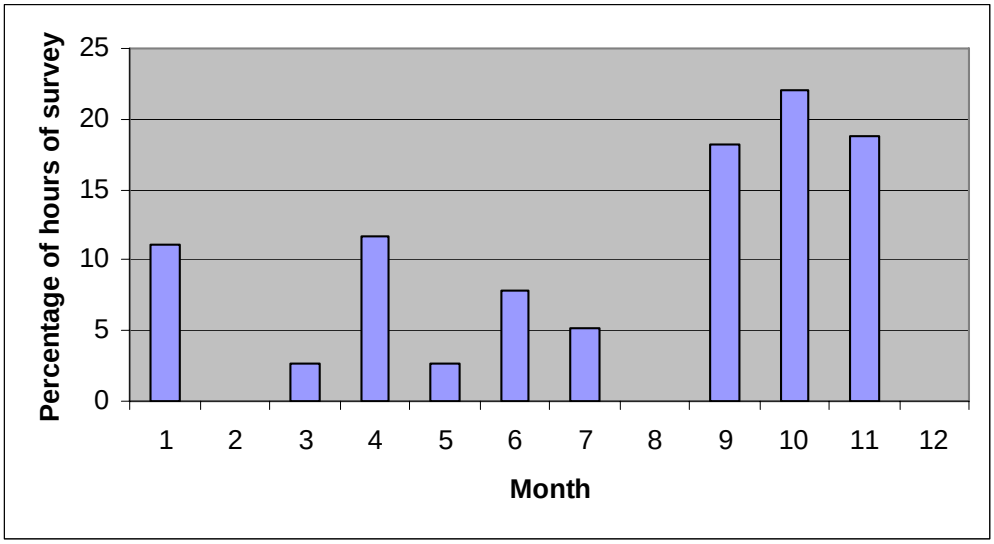

Figure 25. Approximate percentage of surveys hours relating to waterbirds for survey block 9.

Results and Discussion

During the full period of this project there were around 175 separate waterbird records made, totalling over 580 birds (Figure 26). These represented <1% of the records and <1% of the total numbers of waterbirds recorded in the fifteen survey blocks. This block had the least number of records and total number of birds of any survey block. Thirty-one species of waterbird from Tables 1 and 2 were recorded throughout the project. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Twenty-five species were recorded in aerial surveys. No species were recorded in large numbers because this survey block is more used by seabirds and marine turtles than waterbirds. The species recorded in the greatest numbers was Little Black Cormorant, but only 180 in total of this species was recorded. Other species were all recorded in total numbers of less than 100. Those recorded as the next most abundant were egrets, Osprey, Australian Pelican, White-bellied Sea-Eagle, Australian Grebe, Pied Cormorant and Black-necked Stork.

Sixteen species were recorded in ground surveys. The most abundant species recorded from the small number of ground surveys was the Osprey. This was followed by Chestnut Rail and White-bellied Sea-Eagle. No other species were recorded in total numbers of more than five.

Species Recording Rates. Osprey were recorded on the most occasions from the air, followed by egrets, White-bellied Sea-Eagle, Australian Pelican, Black-necked Stork and Brahminy Kite.

Osprey were also the most frequently recorded (11 times) in ground surveys. They were followed by White-bellied Sea-Eagle and Chestnut Rail.

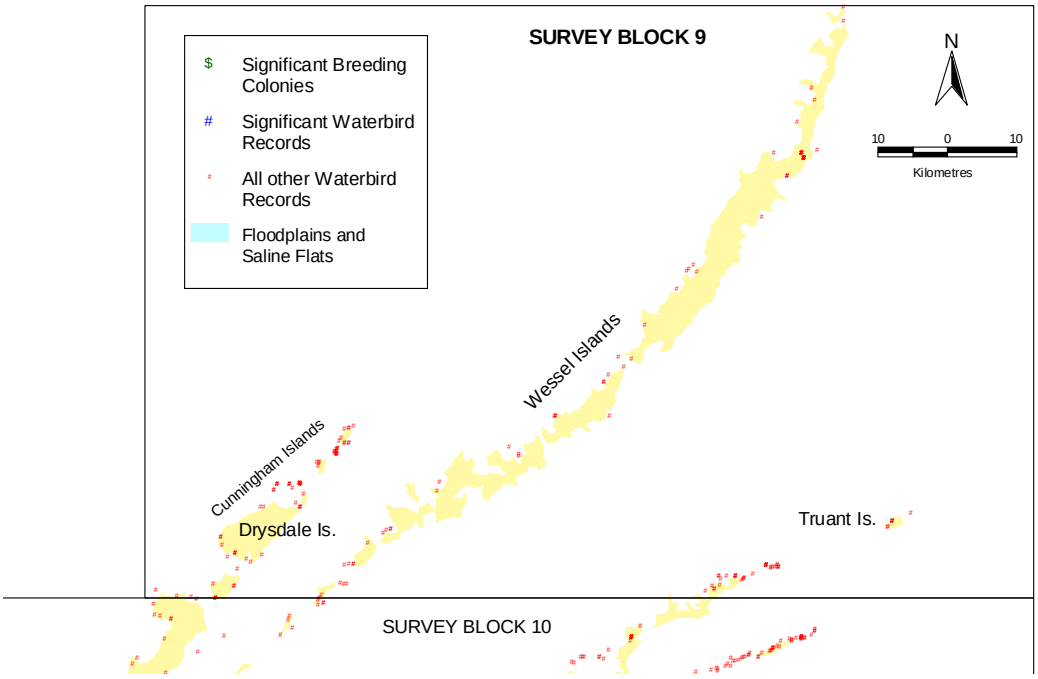

Figure 26. Distribution of waterbird records for survey block 9.

Important Areas.

Significant Waterbird Breeding Colonies. There were no colonies located in this survey block. Given the relative lack of wetlands and predominantly coastal nature of this block, it is unlikely that any would have been missed during these surveys.

Significant Waterbird Areas. Although this survey block provides fairly good habitat for coastal raptors such as Osprey and White-bellied Sea-Eagle, it is clearly not one of much significance to the majority of species of waterbirds covered in this report. As such there were no significant waterbird areas to report on from the surveys of this block.

Other Significant Single Records. There were no significant single waterbird records for this survey block.

Plate 6. One of few swamps in this survey block, northern part of Wessel Islands, November, 1993. Photo R. Chatto.

SURVEY BLOCK 10

Location and Habitat

This survey block includes much of the north east Arnhem Land mainland and the many small and large islands off its coast. In the north these islands include Elcho Island, the southern islands of the Cunningham Islands, all of the Bromby Islands and most of the English Company Islands. Along the eastern mainland shore there are also many islands from Port Bradshaw south to the northern part of Blue Mud Bay. The survey block also includes a number of other bays, including Buckingham Bay and Arnhem Bay.

The entire block is Aboriginal land and there are no pastoral properties. The majority of the population is Aboriginal, however the town of Nhulunbuy in the far north east also has the highest white population (mostly associated with the Nabalco mine) in the Top End outside of Darwin. The other main populations of Aboriginals are on Elcho Island and Lake Evalla (Gapuwiyak). There are also many small, seasonally used outstations along the coast and on some of the bigger islands. Nevertheless, the majority of this survey block is still relatively undisturbed by people. The southern coastal wetlands in the region have seen what were originally small numbers of buffalos and pigs increase greatly in numbers over the years of this project.

This survey block has a very diverse range of waterbird habitats. It has the largest length of coastline of all survey blocks, with approximately 2 100 kilometres, and a substantial area of wetland, totalling around 1 100 square kilometres. There are extensive coastal sections of intertidal mudflat backed by mangroves in both Buckingham and Arnhem Bays, and the many smaller bays and inlets of Blue Mud Bay. Some of these mangrove areas also abut large open, saline wetlands. There are also scattered smaller areas of similar habitat in many of the smaller bays around the mainland and on the larger islands. Reasonably extensive freshwater floodplains are associated with many of the rivers and creeks running into the coast. Smaller isolated freshwater wetlands are also scattered around the block. The islands along the northern coast are composed of a mixture of large forested islands with rocky cliffs and sand beaches, and smaller sand and coral islands. Most of the islands down the eastern coast of this survey block consist of large granite boulders or sand/coral, and so have little habitat for most species of waterbirds. Islands closer to the coast are often surrounded by turbid water but further offshore the seas become clear.

Survey Effort

This survey block received approximately 250 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 12.7% of the hours of survey in all survey blocks combined. These surveys were spread over 66 separate days. All months were represented by some surveys except August. February, June and December received the least amount of the survey time (Figure 27).

There were 175 separate ground surveys involving 130 different and well-spread sites.

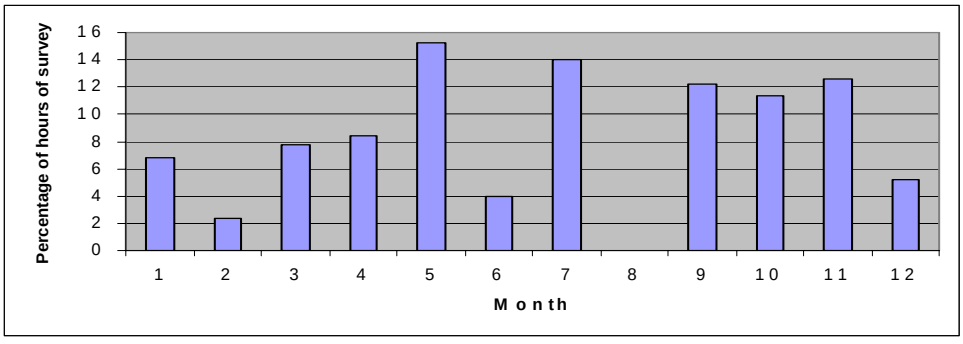

Figure 27. Approximate percentage of surveys hours relating to waterbirds for survey block 10.

Results and Discussion

During the full period of this project there were around 1 600 separate waterbird records made, totalling over 710 000 birds (Figure 28). This total number of birds was dominated by two records totalling 500 000 Magpie Goose which will be further discussed below. These represented around 5.5% of the records and 26.5% of the total numbers of waterbirds recorded in the fifteen survey blocks. Forty-three species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. Thirty-nine species were recorded in aerial surveys of this survey block. Magpie Goose dominated the abundance records, mainly due to the large numbers found in a single survey of a wetland near Blue Mud Bay. This is further detailed below. The next most abundant species were Wandering Whistling-Duck, egrets, Brolga, Glossy Ibis, Pacific Black Duck, Black-winged Stilt and Australian White Ibis.

Forty species were recorded in ground surveys. The most abundant species recorded was again, by far, Magpie Goose. The next most abundant species were Brolga, Black-winged Stilt, Glossy Ibis, egrets, Grey Teal, Australian White Ibis, Pacific Black Duck and Wandering Whistling-Duck.

Species Recording Rates. The most frequently recorded species in aerial surveys were the egrets followed by Osprey, White-bellied Sea-Eagle, Australian White Ibis, Australian Pelican, Brolga, Black-necked Stork and Magpie Goose.

The most frequently recorded species in ground surveys were Osprey, Little Egret, Great Egret, Masked Lapwing, White-bellied Sea-Eagle, Brolga, Pied Heron, Black-winged Stilt, Gull-billed Tern and Grey Teal.

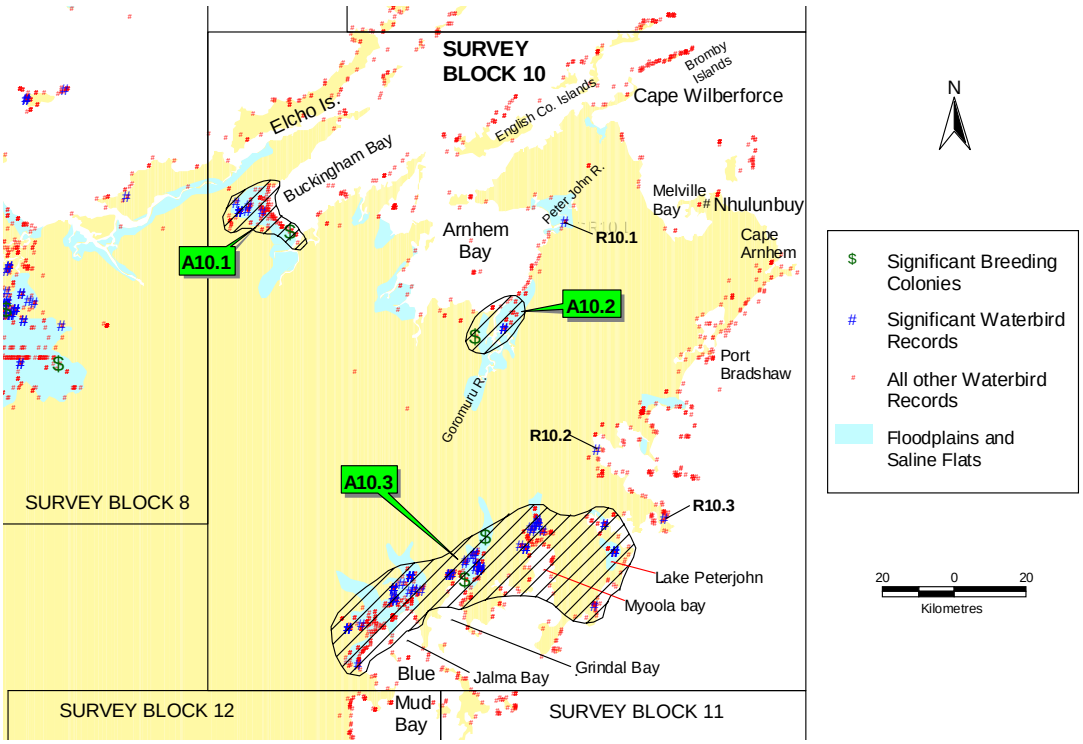

Figure 28. Distribution of waterbird records for survey block 10.

Important Areas.

Significant Waterbird Breeding Colonies. Four significant breeding colonies were located in this survey block (Figure 28). These colonies involved most of the colonial breeding species but were particularly significant for Australian Darter, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Nankeen Night Heron and Australian White Ibis. Colonies were all on, or close to the coast. The largest colony, in Buckingham Bay, regularly had between 5 000 and 10 000 birds using it. The remainder had between 1 000 and 5 000 birds regularly using them. See Chatto (2000b) for further details.

Significant Waterbird Areas. Three areas within survey block 10 have been classed as significant waterbird areas. These include the coast and wetlands associated with Buckingham Bay, the wetlands around the mouth of the Goromuru River and the coast and numerous wetlands associated with the small bays to the north of Blue Mud Bay and through to Lake Peterjohn. Even though the significant records are a little scattered they have been included in the one area.

Area A10.1 This first of the three selected areas, involves the coast and wetlands associated with Buckingham Bay in the north west of the survey block. Wetlands here include large areas of bare saline flats near the coast and vegetated wetlands inland of these saline flats. The highest total waterbird count for this area was in excess of 8 500 in July 1998. This was a combined aerial and ground sampling survey which covered a reasonable percentage of the area but note was made at the time that the count was not recording all of the waterbirds of the area. It is unknown, but doubtful, whether in excess of 20 000 waterbirds would have been present in the area during this survey, or any other surveys of the area. The next highest total count was around 7 500 in May 1995, but this involved a large record of Magpie Goose in one part of the area. Other species (eg egrets) were mentioned but in much lower numbers. This aerial survey had to be aborted just after starting because of bad weather.

There were nine separate records of waterbirds in this area that have been classified as significant. They involved seven species which included Magpie Goose, Intermediate Egret, all three ibis species, Brolga and Gull-billed Tern. Records varied between 7 500 (Magpie Goose) and 350 (Gull-billed Tern). All significant records were in the dry season months of May, July and September. Most of this area dries out in the late dry season, with the saline flats (except the parts flooded by high tides) drying out sooner than the wetlands. A significant mixed species waterbird breeding colony active between January and the dry season insures good numbers of these species remaining in the area over the wet season. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Australian Pelican, Nankeen Night Heron, Little and Great Egret, Black-necked Stork and White-bellied Sea-Eagle.

This area is also reported to be a major Brolga breeding area in the wet season (S.C.R.S.R.).

Area A10.2 This area involves the wetlands near the mouth of the Goromuru River along the southern shore of Arnhem Bay. The area was not surveyed on many occasions during the survey period, and never in order to do a total area count. The highest count was of 8 600 waterbirds in July 1998. This was a quick ground count done in one section of the area on route to an overnight stop. The particular site was numerically dominated by Magpie Goose at the time. It would be likely that a full count of this area (at this time of year at least) would total in excess of 20 000. Parts of the area were flown at other times of the year but large numbers of birds were not seen and the area not investigated in any detail. Consequently, the area is likely only to have these large numbers of waterbirds in the dry season as the water dries back. However, the presence of a fairly large waterbird colony may also mean good numbers of those species breeding in it during the wet and early dry season. This colony was only seen once. This was in June 1999 when it was dominated by Australian White Ibis. As they often breed

later than many of the other colony breeding species an earlier visit to this colony may have recorded higher numbers of the other species.

There were only three separate significant records for this area. All were from only the one ground count. The records were of Magpie Goose, Glossy Ibis and Whiskered Tern. There were also good numbers of Black-winged Stilt present at this time. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include egrets, Australian White Ibis, Black-necked Stork and Brolga.

This area is also reported to have some Brolga breeding in the wet season and as significant for this species in the dry season (S.C.R.S.R.).

Area A10.3 The most important of the three selected areas from this survey block involves the coast and wetlands associated with the small bays to the north of Blue Mud Bay and through to Lake Peterjohn further to the east. The areas to the north of three of these bays (Jalma, Grindal and Myoola Bays) have reasonably large (open and paperbark) freshwater wetlands that have many waterbirds of a number of different species in the later half of the year before they dry out. There are also large saline coast flats to the south of Jalma Bay, which have a different suite of waterbirds such as Black-winged Stilt and Gull-billed Tern present before they also dry out. These saline flats dry out quicker than the freshwater wetlands. The saline flats, for example, were dry in a late September survey while the wetlands still had plenty of water. The overall area has also seen a large increase in the numbers of buffalo and pigs over the period of the surveys.

The highest waterbird count for this area was in excess of 560 000 in September 1996. It was derived from ground and aerial surveys of sections of the area done over two days. Most, but not all of the area would be included in the total. This was the only time that this area was surveyed at this time of the year. The count was dominated by an (minimum) estimate of half a million Magpie Goose, along with at least 40 000 whistling-duck (most if not all Wandering Whistling-Duck). These were mostly on two of the wetlands, one to the north of Grindal Bay and the other to the north of Myoola Bay. There were also good numbers of Brolga, Nankeen Night Heron and all of the wetland terns at this time. The numbers of Magpie Goose are the largest I have seen in fifteen years of wetland surveys in the Top End. Video footage was taken of some of one of the wetlands, before a collision with a Magpie Goose forced an emergency landing. The subsequent impromptu ground survey also had to be prematurely abandoned after being chased by buffalo. (Not a good 15 minutes of surveying!!).

The next highest total count for this area was around 68 000 waterbirds seen in an aerial survey in July 1998. This was numerically dominated by Magpie Goose, ducks (mainly Pacific Black Duck), egrets, Glossy and Australian White Ibis, Brolga and Black-winged Stilt. This count was nowhere near a full area count but did cover the two wetlands with all the Magpie Goose and Wandering Whistling-Duck mentioned above. At this time the numbers of Magpie Goose were around 26 000 but there were few Wandering Whistling-Duck. Aerial surveys of parts of the wetlands of the three bays were also done in early April (1994) and mid May (1995), the latter survey showing around 100 active Magpie Goose nests in a section of the wetlands above Jalma Bay. During both of these surveys the areas were still very flooded, and there were few waterbirds (mostly egrets and ibis) present on each occasion. Further surveys in mid November (1993) and mid December (1998) showed more waterbirds than the April and May surveys but many fewer than the July and September surveys. All of these surveys cannot be directly compared but they still provide an insight into the movement of waterbirds into and out of these wetlands. Most species seem to move into this area in the later dry season when water levels are falling, then move out again when the wetlands dry, and/or when the main wet season rains come. They then stay away during the wet season, returning again as the wetlands begin to dry back again. This is actually a fairly regular scenario for many wetlands in the Top End.

Lake Peterjohn, a lake rather than a floodplain wetland, showed the same pattern. A mid November (1993) count as the lake dried totalled around 3 200 birds (dominated by Magpie Goose, Wandering Whistling-Duck and Brolga) while a mid July count (1996) totalled only 110 birds when the lake was very flooded.

There were 55 separate records of waterbirds in this area that have been classified as significant. They involved 16-19 species, depending on the individual species representation in the combined *egret spp.* and *duck spp.* records. These counts involved Magpie Goose, both whistling-duck species, Pacific Black Duck, Grey Teal, Nankeen Night Heron, Pied Heron, Intermediate Egret, Great Egret (and likely Little Egret), Glossy and Australian White Ibis, Royal Spoonbill, Black-necked Stork, Brolga, Black-winged Stilt, Red-necked Avocet and Whiskered Tern. Individual records varied between 300 000 (Magpie Goose) and 10 (Black-necked Stork). Records from this site were easily the largest single records for Magpie Goose, Wandering Whistling-Duck (40 000) and Nankeen Night Heron (3 000) recorded throughout the project. All significant records were between July and December. Surveys, other than those already mentioned, were also done in February and March. Neither of these surveys recorded large numbers of waterbirds in this area. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Little Egret, Osprey, White-bellied Sea-Eagle, Masked Lapwing and Gull-billed Tern.

The wetlands above Grindal and Jalma Bays are also reported to be a major Brolga breeding area in the wet season (S.C.R.S.R.).

Other Significant Single Records. There were three other specific significant records for this survey block (Figure 28). These were all close to the coast.

Record R10.1. This record was of over 1 000 Brolga on the mostly dry floodplains of the Peter John River on the eastern side of Arnhem Bay in July 1998. This area is also reported to be a major breeding area in the wet season (S.C.R.S.R.).

Record R10.2. This record was of over 900 Brolga in the mostly dry wetlands in behind Caledon Bay in November 1993.

Record R10.3. This record was of around 300 Little Black Cormorant on the coast in the Cape Grey area in September 1994.

SURVEY BLOCK 11

Location and Habitat

This survey block includes Groote Eylandt, Bickerton Island, the southern part of the Isle of Woodah and the many smaller islands associated with these bigger islands. The entire block is contained within Arnhem Land and is Aboriginal land. There are three main Aboriginal communities on Groote and one on Bickerton Island. There are also some small, seasonally used, outstations scattered around the survey block. Mining staff from the Gemco mine on Groote Eylandt are permitted to visit much of the northern and eastern parts of Groote Eylandt.

The survey block, which is all islands, has approximately 1 050 kilometres of coastline but only two square kilometres of wetland. There are no extensive coastal sections of intertidal mudflat in this survey block but there are small reef/mangrove areas and some intertidal-exposed sand areas, mainly around Bickerton and the western side of Groote Eylandt. Smaller islands are composed mostly of sparsely vegetated sandstone or granite outcrops (some quite high) or low sand and coral islands.

Survey Effort

This survey block received approximately 100 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 4.9% of the hours of survey in all survey blocks combined. These surveys were spread over only 25 separate days. April, June and August received no surveying but the other months all received at least some surveying (Figure 29). Increased survey effort in this block between September and December was again largely due to the amount of seabird breeding colony work done in this area. There were 75 separate ground surveys involving 60 different and well-spread sites.

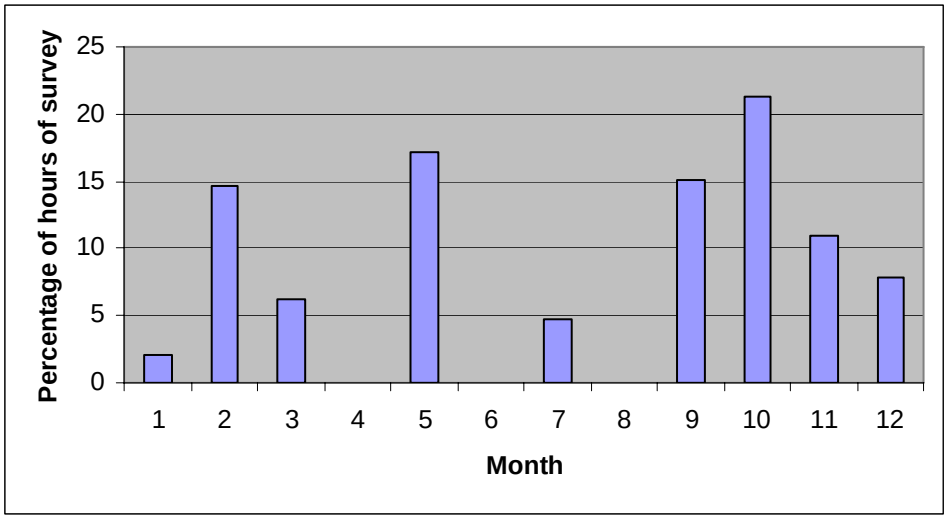

Figure 29. Approximate percentage of surveys hours relating to waterbirds for survey block 11.

Results and Discussion

During the full period of this project there were around 538 separate waterbird records made, totalling over 8 500 birds (Figure 30). These represented around 1.8% of the records and <1% of the total numbers of waterbirds recorded in the fifteen survey blocks. Twenty-five species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. There were twenty-four species recorded in aerial surveys. The species recorded in the greatest abundance from aerial surveys was Common Tern. This species was recorded in numbers that were more than 10 times those of the next most abundant species. This was primarily due to some very large roosting flocks located on the western side of Groote Eylandt. The next most abundant species were Little Black Cormorant, Osprey, egrets, Pied Cormorant White-bellied Sea-Eagle, Little Pied Cormorant and Australian Pelican.

There were only 10 species recorded in ground surveys. The species recorded in the greatest numbers from ground surveys was White-winged Black Tern. These were closely followed by Common Tern, then there was a large gap to the next species, the Osprey. The only other species to be recorded in total numbers greater than five was the White-bellied Sea-Eagle.

Species Recording Rates. The species recorded most frequently from aerial surveys was the Osprey. This survey block has a large number of Osprey spread around the island coastlines. They were recorded nearly three times as often as the next species, which were the egrets. (It is possible that some of the many white Eastern Reef Egret, which are not a species considered in this report, present in this survey block may have been included in aerial *egret spp.* records). The species recorded the next most frequently were the White-bellied Sea-Eagle, Black-necked Stork, Australian Darter, Pied Cormorant, Brahminy Kite and Australian Pelican.

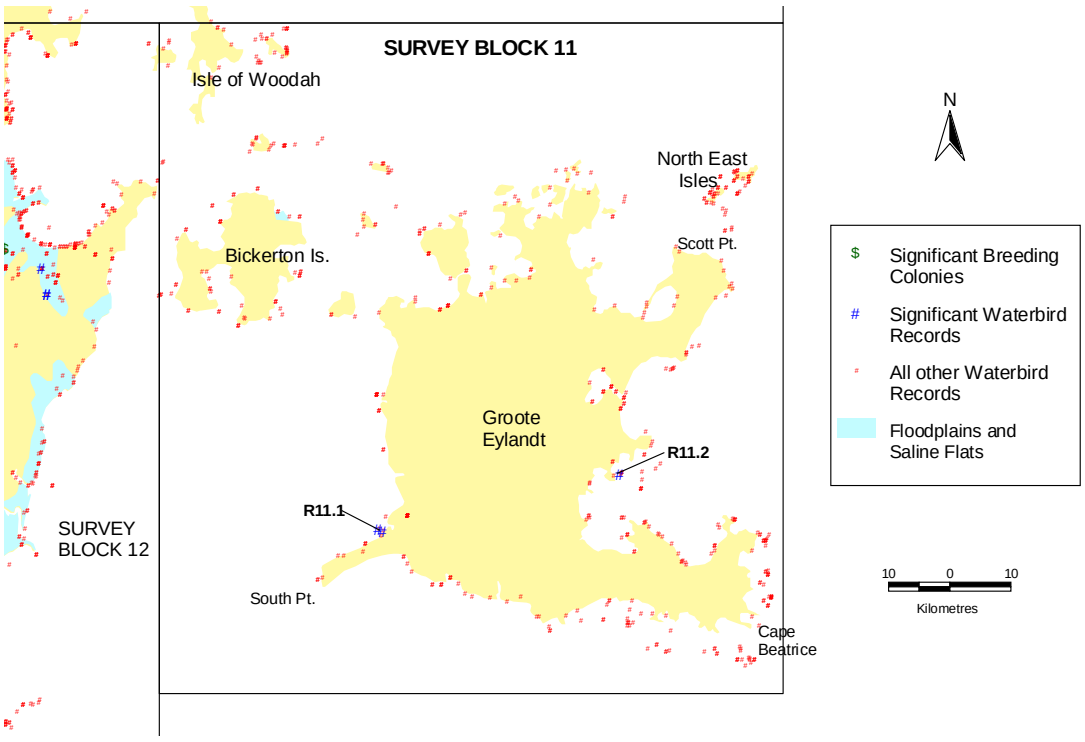

Figure 30. Distribution of waterbird records for survey block 11.

The species recorded on the greatest number of separate occasions from ground surveys was again the Osprey. It was recorded nearly twice as many times as the next species, which was the White-bellied Sea-Eagle, but neither was recorded on more than 20 occasions.

Important Areas.

Significant Waterbird Breeding Colonies. There were no waterbird breeding colonies located in this survey block. Given the lack of wetlands and predominant coastal nature of this block, it is unlikely that any would have been missed during these surveys.

Significant Waterbird Areas. Although this survey block had very significant numbers of the coastal raptors (Osprey, Brahminy Kite and White-bellied Sea-Eagle) it is clearly not one of much significance to the majority of species of waterbirds covered in this report. As such there were no significant waterbird areas identified.

Other Significant Single Records. There were three records, involving two sites, considered to be significant single waterbird records for this survey block (Figure 30).

Record R11.1. There were two records on the south west coast of Groote Eylandt that involved a total of 5 500 Common Tern roosting on the intertidal sand/mudflats in February 1996.

Record R11.2. The other record was of 300 Little Black Cormorant off the mid eastern coast during the same survey. Although not highly significant there were also three separate ground counts in this same area totalling over 800 White-winged Black Tern in December 1993.

Plate 7. One of few small swamps on Groote Eylandt, near Anguragu, March 1994. Photo R. Chatto.

SURVEY BLOCK 12

Location and Habitat

This survey block includes the central eastern coast of the Northern Territory. It covers the southern part of Blue Mud Bay and the coast southward to just north of the mouth of the Roper River. (The large area of wetland associated with this river is included within survey block 13). Survey block 12 also includes a small number of islands in the southern half of the block. The entire block is contained within Arnhem Land and is Aboriginal land. The single large Aboriginal community is Numbulwar, and there are a few smaller, seasonally used outstations along the northern coast of the survey block, but in general the majority of this survey block is relatively undisturbed by people. Buffalo numbers have increased markedly on the wetlands of the northern part of this block during this project.

The survey block has a short (approximately 300 kilometres) coastline and approximately 450 square kilometres of wetland. Except for Blue Mud Bay and sections of the southern coast of this block, there are no extensive areas of intertidal mudflat or mangroves. Most of the coastline consists of narrow sandy beaches backed by casuarinas and/or small dunes. Inland from the coast is mainly forest. Where wetlands occur along the coast they are mostly open and saline. There is not much freshwater wetland in the survey area of this block. There are a number of smaller creeks and rivers, mostly mangrove-lined, that run into the sea but the main two are the Walker River in the north and the Rose River in the south.

Survey Effort

This survey block received a relatively low survey effort with approximately 60 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 2.9% of the hours of survey in all survey blocks combined. The low number of hours is partly due to the relatively small size of the block. These surveys were done over 27 separate days. There were no surveys in January, June or August but all other months received between 2 and 12 hours. May, September and November received the most (Figure 31). There were 16 separate ground surveys involving 14 different and well-spread sites.

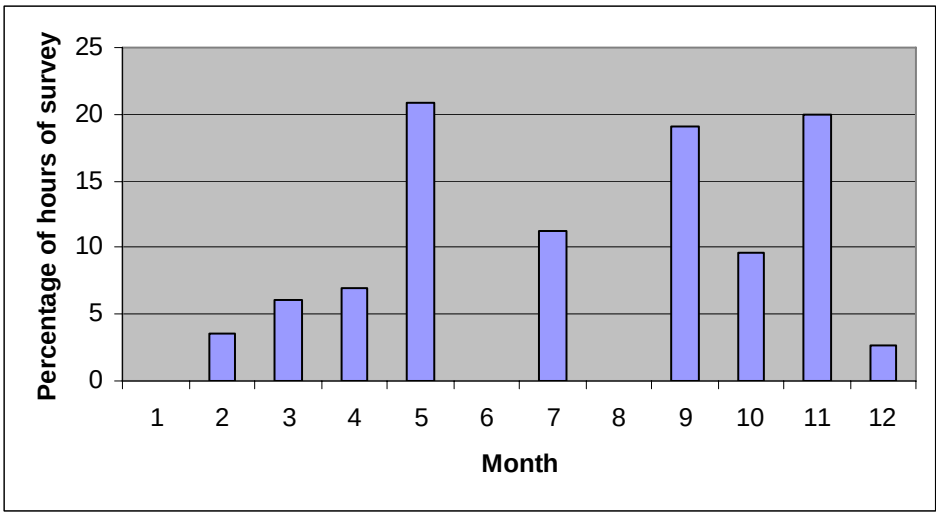

Figure 31. Approximate percentage of surveys hours relating to waterbirds for survey block 12.

Results and Discussion

During the full period of this project there were around 580 separate waterbird records made, totalling over 31 500 birds (Figure 32). These represented around 1.9% of the records and 1.2% of the total numbers of waterbirds recorded in the fifteen survey blocks. Thirty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. There were thirty-six species recorded in aerial surveys. The species recorded in the greatest abundance from aerial surveys was the Magpie Goose. These were recorded in more than twice the numbers of the next most abundant species, which was the Black-winged Stilt. There were higher numbers of *duck spp.* recorded than Black-winged Stilt and this may elevate Grey Teal and/or Wandering Whistling-Duck to the second most abundant species. Nevertheless, even without breaking down the *duck spp.* records based on individual percentages, confirmed records of both these ducks are still in the top few most abundant species during aerial surveys in the survey block. Also in the top few for most abundant species were egrets, Common Tern, Australian Pelican and *Marsh Tern spp.* (possibly mostly Whiskered Tern).

There were 17 species recorded in the limited number of ground surveys. The species recorded in the greatest numbers from ground surveys was Black-winged Stilt. They were recorded in more than twice the numbers of the next species which was Grey Teal. The next most frequently recorded species were cormorants (probably Pied Cormorant), Australian Pratincole, Masked Lapwing, Glossy Ibis, Pacific Black Duck and Whiskered Tern.

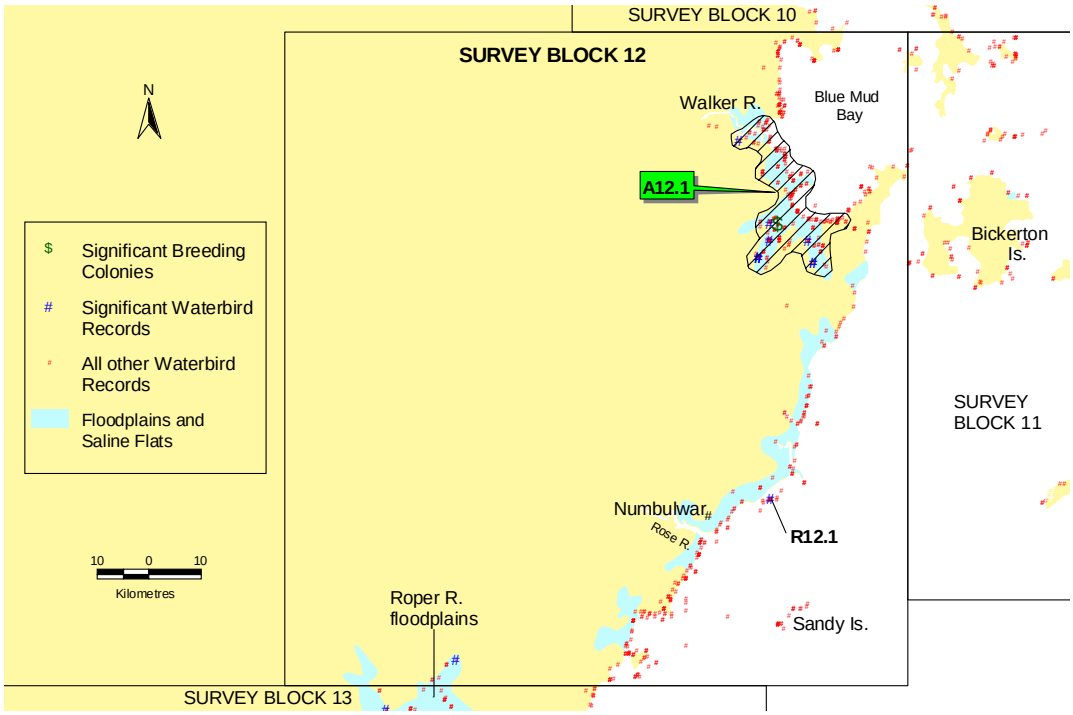

Figure 32. Distribution of waterbird records for survey block 12.

Species Recording Rates. The species recorded on the most number of separate occasions from aerial surveys were the egrets. All species of egrets were recorded in good numbers in this block but there were insufficient confirmed egret species identifications to suggest which were the most abundant. The next most frequently recorded species were the Black-necked Stork, Gull-billed Tern, Black-winged Stilt, Pied Cormorant, White-faced Heron, Australian Pelican, Osprey and White-bellied Sea-Eagle.

Due to the low number of ground surveys no species was recorded on more than five occasions. The species recorded on the most number of separate occasions from ground surveys was the Brahminy Kite. The next most frequently recorded species were the Black-winged Stilt, Black-necked Stork, Gull-billed Tern, White-bellied Sea-Eagle and Whiskered Tern.

Important Areas.

Significant Waterbird Breeding Colonies. Although there were some smaller colonies in this survey block, there was only one of significance (Figure 32). This was a mixed species colony and not exceptionally large in total, but was significant for Royal Spoonbill. See Chatto (2000b) for further details.

Significant Waterbird Areas. Only one area within survey block 12 was classed as a significant waterbird area (Figure 32). This area was around the southern part of Blue Mud Bay.

Area A12.1 This area involves the coast and wetlands associated with the southern part of Blue Mud Bay in the north of the survey block. The highest total waterbird count for this area was in excess of 9 000 in November 1999. This was an aerial survey which covered a reasonable percentage of the area, but it is doubtful whether in excess of 20 000 waterbirds would have been present in the area during this survey. The next highest total counts were around 5 500 waterbirds in both April 1994 and May 1995 surveys. These surveys covered much less of the area than the November survey, and recorded mostly Magpie Goose, ducks, egrets, Black-winged Stilt and terns. There was a very large amount of water around in the April 1994 survey and much of it was not surveyed in detail. Nevertheless, my notes include the comment that there appeared to be few waterbirds on these flooded wetlands, and that there were considerably fewer birds than on similar type wetlands nearer the Roper River (Area A13.1) which were surveyed on route to this site.

During the period of the project there were nine separate records of waterbirds that have been classified as significant. These involved at least seven species, (depending on the breakdown of the *duck spp.* record). Species recorded as significant in these records included Magpie Goose, Wandering Whistling-Duck, Grey Teal, Australian Pelican, Black-winged Stilt, Gull-billed Tern and Whiskered Tern. Records varied between 3 500 (*duck spp.*) and 100 (Gull-billed Tern). All significant records were in April, May or November. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include the egrets (all four species confirmed but individual abundances not known), Black-necked Stork and White-bellied Sea-Eagle.

Wetlands between the Walker River and Bennett Bay, some of which are to the north of this area, are also reported (S.C.R.S.R.) to be a major Brolga breeding area in the wet season, as well as a significant dry season refuge. Further south of this area, the coastal flats around the mouth of the Miyankala Creek (south of Numbulwar) are also reported (S.C.R.S.R.) to be a major Brolga breeding area in the wet season.

Other Significant Single Records. There was only one other significant record for this survey block (Figure 32).

Record R12.1. This record was of around 2 500 Common Tern roosting on the coast just north of Numbulwar in September 1994.

SURVEY BLOCK 13

Location and Habitat

This survey block includes another part of the mid eastern coast of the Northern Territory. It covers the coast from just north of the Roper River to the northern part of the large coastal delta system of the Limmen Bight River. It also extends inland along the Roper River for a considerable distance to account for the extensive upstream seasonal wetlands of this river. (Unfortunately only one aerial survey was done of the upper reaches of this river, and as it was at a time when most of the wetlands had dried, it did not reveal many waterbirds. In order to more clearly show the waterbird records in the eastern part of the survey block only this section has been included in Figure 34). The survey block also included Maria Island and another small island to the north, known as Low Rock.

The survey area of this block is Aboriginal land. The single main Aboriginal community of Ngukurr is well inland along the Roper River and away from the main survey area. However, there is regular boat access along the river to the coast and there is also access to the area from Numbulwar (survey block 12) to the north. There are also a few, small outstations along this section of coast and commercial fishing camps in the Roper and Limmen Bight Rivers. Commercial barramundi and crab fishing is quite intensive along much of this part of the coast.

The survey block has a relatively short 165 kilometres of coastline, but an extensive area (approximately 1 100 square kilometres) of wetland compared to other survey blocks. Most of the coast of this survey block has large amounts of intertidal mud or mud/sand flats. Some of this intertidal zone has a defined mangrove or low dune coast to separate it from the extensive areas of adjacent saline wetland, but in other areas the intertidal zone just merges with open saline mudflats which extend many kilometres inland in some places. Mangroves dominate the banks of the rivers and the many creeks that run into the coast along here. Further inland, particularly to the north, there are some quite extensive freshwater wetlands, but most of the wetlands in the survey area of this block are open shallow saline flats with little vegetation and not wet for long periods. These wetlands can have large numbers, but a low diversity, of waterbirds. They are usually dominated by stilt, avocet and terns, along with Red-capped Plovers and other small migratory waders. Maria Island is quite a large well-vegetated island, which has a mostly rock and/or mangrove coast.

Survey Effort

This survey block also received one of the lesser amounts of effort with approximately 40 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 2.1% of the hours of survey in all survey blocks combined. The low number of hours in this survey block is also partly due to the relatively small size of the block. These surveys were spread over 20 separate days. There were no surveys in January or August. July received most hours of surveys directed towards waterbirds (Figure 33).

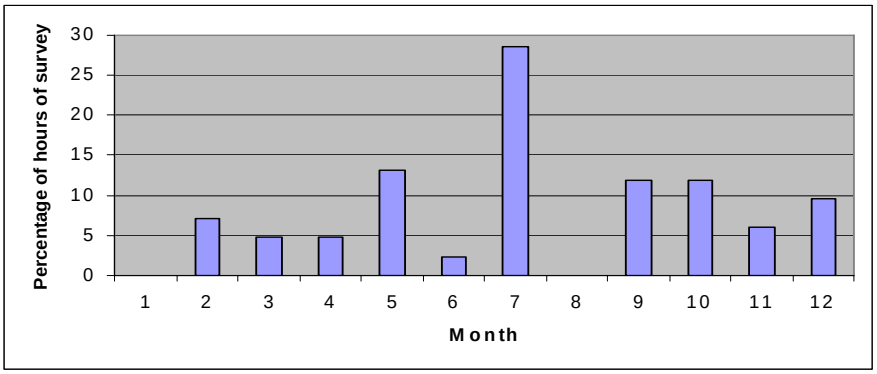

Figure 33. Approximate percentage of surveys hours relating to waterbirds for survey block 13.

There were 24 separate ground surveys involving 23 different and well-spread sites. Area coverage was taken as more important than repeat site surveys in this remote and poorly surveyed part of the coast.

Results and Discussion

Waterbirds were distributed throughout this small survey block, with coast and wetlands both well represented. During the full period of this project there were around 520 separate waterbird records made, totalling over 49 000 birds (Figure 34). These represented around 1.7% of the records and 1.9% of the total numbers of waterbirds recorded in the fifteen survey blocks. Thirty-eight species of waterbird from Tables 1 and 2 were recorded throughout the project in this survey block. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. There were thirty-eight species recorded in aerial surveys of this survey block. The species recorded in the greatest abundance from aerial surveys was clearly the Black-winged Stilt. This was recorded at nearly three times the numbers of the next most abundant species, the Magpie Goose. The next most abundant species recorded were egrets (with all four species being confirmed) Red-necked Avocet, Australian Pelican, Glossy Ibis, Grey Teal, Whiskered Tern and White-winged Black Tern.

There were 16 species recorded in ground surveys of this block. The species recorded in the greatest numbers from ground surveys were Red-necked Avocet, Black-winged Stilt, Grey Teal, Australian White Ibis, Gull-billed Tern, Pied Cormorant, Masked Lapwing and Australian Pelican.

Species Recording Rates. The species recorded on the most number of separate occasions from aerial surveys were easily the egrets (particularly Great Egret) followed by Black-winged Stilt, Black-necked Stork, Australian Pelican, Gull-billed Tern, Osprey, Brolga and Pied Cormorant.

No species was recorded more than nine times from ground surveys. The species recorded on the most number of separate occasions from these surveys was Gull-billed Tern. The next most frequently recorded species were Little Egret, Black-necked Stork, Australian Pelican and Whiskered Tern.

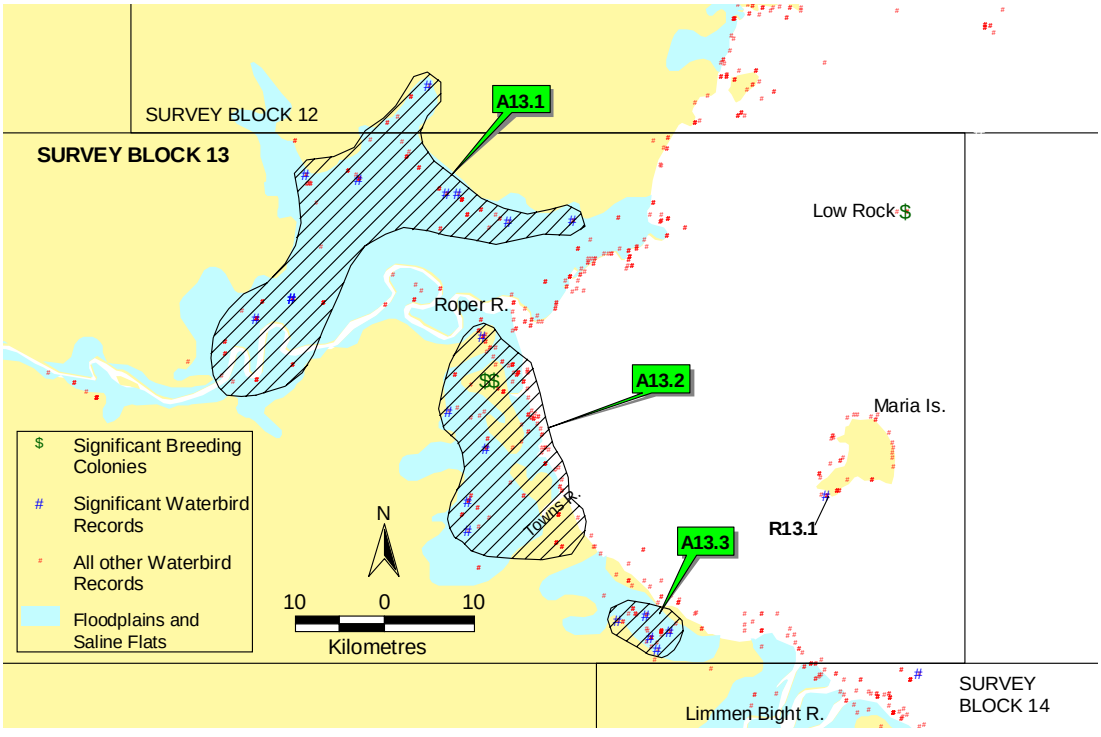

Figure 34. Distribution of waterbird records for survey block 13.

Important Areas.

Significant Waterbird Breeding Colonies. There were three significant colonies located during these surveys (Figure 34). One was located on the small offshore island called Low Rock. This island has a small Pied Cormorant colony but is of greater significance for seabird breeding (Chatto 2001). The other two colonies were along a creek south of the Roper River and were quite close together. The larger one had between 5 000 and 10 000 birds of eight species and was the largest colony along the east coast of the Top End. The combined colonies had especially significant numbers of Little Pied Cormorant, Pied Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Nankeen Night Heron and Australian White Ibis. See Chatto (2000b) for further details.

Significant Waterbird Areas. Three areas within survey block 13 have been classed as significant for waterbirds (Figure 34). These include the coast and wetlands on the northern side of the Roper River, the coast and wetlands on the south side of the Roper River including those associated with the Towns River, and the saline wetlands to the north of the Limmen Bight River.

Area A13.1 This first of the three selected areas involves the coast and wetlands north of the Roper River. Most of the waterbirds in this area were recorded around the northern and western parts of the floodplain, which is where most of the freshwater or brackish vegetated wetlands are located. Most of the rest of this significant area is dominated by large open saline flats. The highest total waterbird count for the area was just under 17 000, in April 1994. This was numerically dominated over most of the area by Black-winged Stilt and to a lesser extent, egrets. Over other parts of the area Whiskered and/or White-winged Black Tern and Magpie Goose were abundant. The April survey was an aerial survey which covered a reasonable percentage of the area but certainly not all, and it would be safe to conclude that the area would have held in excess of 20 000 waterbirds at the time.

There were nine separate records of waterbirds in this area that have been classified as significant. They involved six to seven species including Magpie Goose, Australian Pelican, Glossy Ibis, Black-necked Stork, Black-winged Stilt and either or both Whiskered and White-winged Black Tern. Records varied between 5 000 (Magpie Goose) and 12 (Black-necked Stork). All significant records were in April and May surveys, except one December record for Magpie Goose. The site of this latter Magpie Goose record also had quite a number of other waterbirds. This site was noted at the time as being the largest group of waterbirds seen on the coast and coastal wetlands between that position and Port McArthur to the south during that particular survey. At this time of the year when there are quite large amounts of water around, the better numbers, and greater diversities of waterbirds were seen on the (green) freshwater wetlands (which are on the inland side of the extensive open saline flats) and along the coast where the mangrove lined channels break up the open saline flats. Other species that have not been listed for the area from important single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include the egrets, with all species except Cattle Egret being confirmed.

The Roper River area is also reported to be a major Brolga breeding area in the wet season (S.C.R.S.R.).

Area A13.2 The second of the important waterbird areas in this survey block are the wetlands to the south of the Roper River and those associated with the Towns River. These are mostly open, saline wetlands which do not hold water for very long. The highest total waterbird count for this area was just under 12 500, from an aerial survey in April 1994. This was dominated by Black-winged Stilt, and to a lesser extent, egrets. The survey did not cover all of the area, but it cannot be said for certain that the area would have held in excess of 20 000 waterbirds at the time. Certainly, the addition of shorebird numbers in the area at the time would see this figure easily reached.

There were five separate records, involving two to four species, of waterbirds in this area that have been classified as significant. They involved egrets and Black-winged Stilt. Only Great Egret and Little Egret were confirmed in the area but Intermediate Egrets could also be present. Records varied

between 5 000 (Black-winged Stilt) and 600 (*egret spp.*). All significant records were in April and May surveys. In a December 1998 survey, when there was quite a lot of water around, it was noted that there were far fewer birds present than during the previous July survey when there was less water around. The main waterbird species present in the December survey were egrets and, to a lesser extent, Australian White Ibis. Other species that have not been listed for the area from significant single records, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area include Grey Teal, Australian Pelican and Gull-billed Tern.

Area A13.3 The third of the important waterbird areas in this survey block are the wetlands to the north of the Limmen Bight River. These are mostly open, saline wetlands which do not hold water for very long. The highest waterbird count for this area was just under 4 000 in April 1994. This was dominated by Red-necked Avocet. It was an aerial survey which did not cover all of the area but it is fairly certain that the area would not have held in excess of 20 000 waterbirds at the time. Again, with the addition of shorebird numbers this figure may come close to being reached.

There were four separate records of waterbirds in this area that have been classified as significant. They involved three counts of between 500 and 1 000 Red-necked Avocet and a count of 300 Royal Spoonbill. These records were in April and July surveys. As with the previous area, a December 1998 survey when there was quite a lot of water around revealed far fewer birds than the previous July survey of the area. Again, the main species in the December survey were egrets. Other species that have not been listed for the area from significant single counts, but are also significant because they have a large number of individual records and/or high cumulative total numbers from surveys in the area would include Little and Great Egret, Black-winged Stilt and Gull-billed Tern.

Other Significant Single Records. There was one other single significant record for the survey block (Figure 34).

Record R13.1. This record was of around 300 Pied Cormorant on the coast of Maria Island in July 1996.

An additional site that is likely to be of significance at times are the Lomarieum and Wadamunga Lagoons, which are located just to the south west of Area 13.1 along the south shore of the Roper River. These lagoons were flown over on one occasion during the surveys (June, 1996), and some records are shown in Figure 34, but relatively small numbers of waterbirds were seen in this survey. P. Hauser (*pers. comm.*) reports that large numbers of waterbirds, particularly ducks, can be seen there at times. There are also a large number of wetlands along the Roper River and the other creeks and rivers of its catchment, as they are followed further inland. This area was also flown on this occasion but it was too late in the year and most of the wetlands were totally dry. Surveys of the wetlands in this catchment before they dry out would likely reveal good numbers of waterbirds. Although this was not in the survey area for this project, it is likely to be one of the more important areas in the Top End for waterbirds outside of the survey area covered in this project.

SURVEY BLOCK 14

Location and Habitat

This survey block includes the relatively short length of coast and adjacent inland wetlands along the southern part of the eastern Northern Territory coast. It extends between the Limmen Bight River and Bing Bong, which is on the mainland just west of the Sir Edward Pellew Islands. The survey block also includes Beatrice Island, which is a small mangrove and rocky island just off the mouth of the Limmen Bight River.

Two pastoral properties make up the majority of the area of this survey block, but there are no towns, homesteads or outstations within the survey area. Consequently, it is very remote and most of the limited access to the area is by commercial or amateur fishermen.

The small survey block has the shortest length of coastline of all blocks, with approximately 130 kilometres, and one of the lesser amounts of wetland, having about 360 square kilometres. Like the previous survey block, virtually the entire coast in this survey block consists of intertidal mud or mud/sand flats. Some of this backs onto mangrove areas, which also dominate the banks of the rivers and many creeks that run into the coast. In other areas there is no clearly definable coastline as the sea merges in with open saline mudflats which may extend many kilometres inland. There are a small number of freshwater wetlands associated with the Limmen Bight River, but most of the wetlands in this survey block are open and saline, and dry for much of the year.

Survey Effort

This survey block also received one of the lesser amounts of survey effort with approximately 40 hours of waterbird/shorebird surveys spread over 19 separate days. This represented approximately 2.1% of the hours of survey in all survey blocks combined. The relatively low number of hours is partly due to the small size of the block. There were no surveys in January, June or August, and apart from May, July and September, no months received many hours of waterbird dominated surveys (Figure 35). There were eight separate ground surveys involving six different sites.

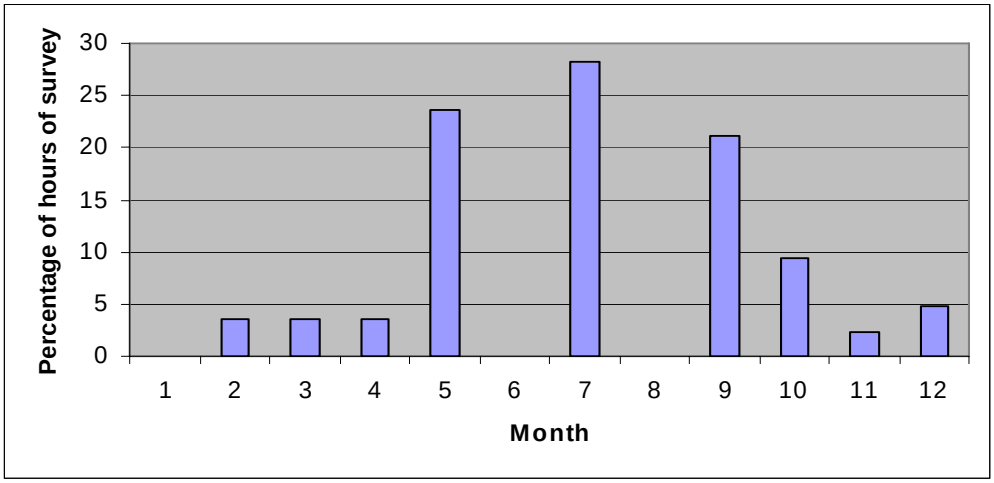

Figure 35. Approximate percentage of surveys hours relating to waterbirds for survey block 14.

Results and Discussion

During the full period of this project there were around 430 separate waterbird records made for this survey block (Figure 36). These totalled over 11 500 birds. These represented around 1.4% of the records but <1% of the total numbers of waterbirds recorded in the fifteen survey blocks. Twenty-seven species of waterbird from Tables 1 and 2 were recorded throughout the project. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. There were twenty-six species recorded in aerial surveys of this survey block. The species recorded in the greatest abundance from aerial surveys was easily the Pied Cormorant. The next most abundant species were the egrets (with only Little Egret and Great Egret confirmed to species level in this block), Grey Teal, Black-winged Stilt, Australian Pelican, the cormorant/darter group (probably dominated by Pied Cormorant but all other species also confirmed), Masked Lapwing, Black-necked Stork and Pacific Black Duck.

There were 13 species recorded in ground surveys of this block. The species recorded in the greatest numbers from ground surveys was the Common Tern. The next most frequently recorded species were Black-winged Stilt, Pied Cormorant and the egrets (probably mostly Little Egret).

Species Recording Rates. The species recorded on the most number of separate occasions from aerial surveys were easily the egrets. The species recorded the next most frequently were the Black-necked Stork, Pied Cormorant, Osprey, White-bellied Sea-Eagle, White-faced Heron, Australian Pelican, Masked Lapwing and Black-winged Stilt.

No species was recorded on more than three occasions in the small number of ground surveys done in this block. The species recorded on the most number of separate occasions from ground surveys were White-faced Heron, Osprey, Little Egret, Gull-billed Tern, Whiskered Tern, Common Tern, and Black-winged Stilt.

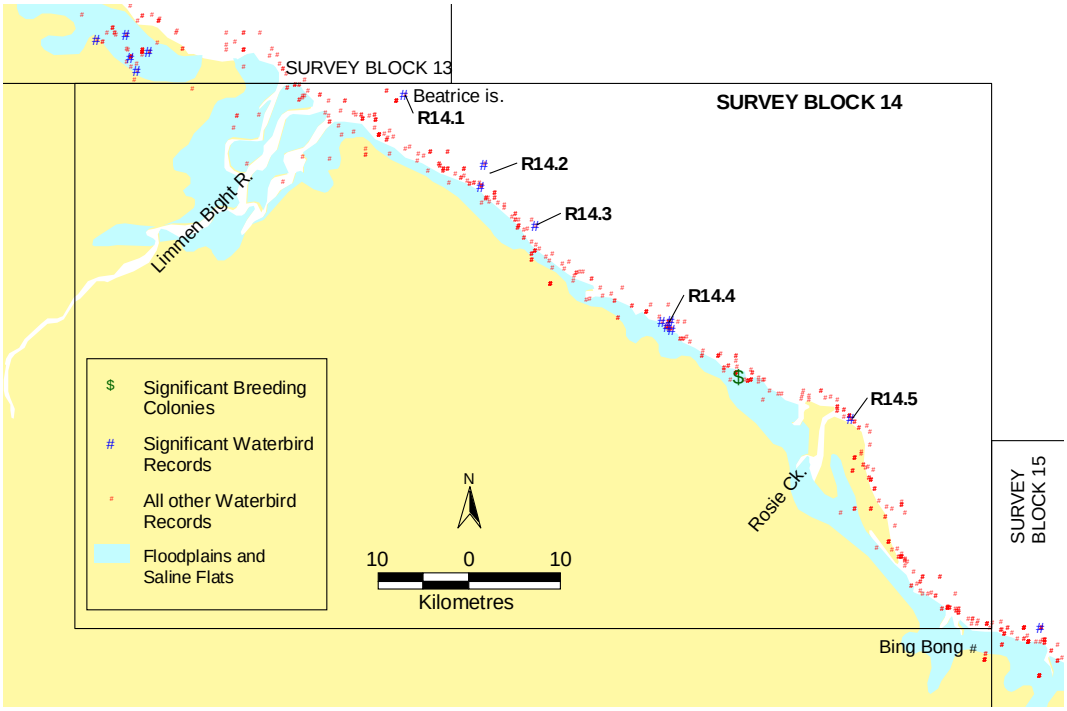

Figure 36. Distribution of waterbird records for survey block 14.

Important Areas.

Significant Waterbird Breeding Colonies. There was only one significant colony located in this survey block (Figure 36). This colony involved Pied Cormorant only, but was easily the largest Pied Cormorant breeding colony in the Top End. See Chatto (2000b) for further details.

Significant Waterbird Areas. Surveys of this block were only carried out along the coast and the wetlands immediately behind the coast. Although there may have been some small wetlands scattered well in from the coast which were not surveyed, it is doubtful that they would have supported sufficient waterbirds to register as a significant area. The entire section of coast and coastal wetlands of this block were very significant for shorebirds, but not so much for waterbirds. Consequently, this survey block will only be discussed in terms of the scattered separate significant single records.

The largest count for the entire survey block was less than 3 500 waterbirds. This was in July 1998. Most abundant in this count were Grey Teal, Pied Cormorant and Black-winged Stilt. The next largest count was just over 1 500, with Pied Cormorant and egrets dominating. Both of these surveys recorded a lot of birds coded as *tern spp.* (i.e. over 1 000 in the July survey and over 1 500 in the December survey). These are not included in these totals because they may include species of terns not covered in this report. Nevertheless, it was noted on both occasions that many of these records probably included Gull-billed Tern, particularly in the north of the survey block. Another point, relating to observations made during these two surveys, is that species such as egrets and Australian White Ibis move out to the coast (particularly where there are mangroves) during the later dry when the inland wetlands were dry. Further reference is made to the large numbers of White-faced Heron doing this in survey block 15.

Significant Single Records. There were eight single significant records from five sites along the coast of this survey block (Figure 36). All except one (of Common Tern) were of Pied Cormorant, in the mangroves or water along the coast. Many of these Pied Cormorant probably breed in the major colony along the coast in this survey block. These records are briefly mentioned starting from the north of the block and heading south. Although not being recorded in significant single records, Black-necked Stork and Gull-billed Tern (mainly the northern part) are species, additional to those mentioned below, that are also widespread and relatively abundant along this coast. There were also many nest sites of the latter species, with many recently fledged young in a late July survey.

Record R14.1. This record was of around 400 Pied Cormorant on Beatrice Island (a small mangrove island just off the mouth of the Limmen Bight River) in March 1994. There were also 200 recorded here in May 1999.

Record 14.2. This site had two separate significant records. One record was of around 500 Pied Cormorant in the mangroves along the coast in July 1996, and the other of around 400 Pied Cormorant in July 1998.

Record 14.3. This record was of around 300 Pied Cormorant in the mangroves along the coast in November 1999.

Record 14.4. This site had three significant records of Pied Cormorant. One was of 800 in December 1998, one of 750 in July 1998 and one of 750 in May 1994. There was also one of 200 in March 1994 at this site.

Record 14.5. This record was of around 680 Common Tern roosting on the beach in September 1994.

An additional record of note falls just outside this survey block boundary. This was of 212 Australian Grebe made by R. Jaensch on a small inland wetland in September 1993. The location of this record can be seen on the distribution map in the Australian Grebe section.

SURVEY BLOCK 15

Location and Habitat

This survey block extends from Bing Bong to the Northern Territory/Queensland border, and includes the many small and large islands associated with the Sir Edward Pellew Island Group. These islands have a wide range of habitats. Closer to the mainland coast the islands are dominated by mudflats and mangroves, while the outer islands are dominated by sand, coral and sandstone, and are surrounded by clear blue seas. Many of the bigger islands are well vegetated with forest and grasses and have a few outstations and tourist camps on them. Fishing/tourist camp usage greatly increased, particularly along the McArthur River, during the period of these surveys. The survey block also includes the town of Borroloola, but this is outside the main survey area of the block.

This survey block is a mixture of Aboriginal land and pastoral leases. However, most of the human population resides well inland from the main survey area. The McArthur River mine shipping dock at Bing Bong is on the coast in the western part of this block.

This survey block has a very diverse range of waterbird habitats. It has a fairly long coastline of approximately 900 kilometres and substantial wetland area totalling around 1 440 square kilometres. There are extensive sections of intertidal mudflat backed by mangroves all along the coast from the western boundary of the block, through the inner Pellew Islands to Pelican Spit on the eastern side of Port McArthur. From Pelican Spit to the Queensland border is a mixture of sand and mud with a reasonable intertidal area, sometimes backed by mangroves and sometimes by sand dunes. The entire length of coast in this block has numerous mangrove-lined creeks and rivers running to the sea. Most of the block has extensive wetlands adjacent to the coast. In some areas these wetlands extend inland for large distances (such as the Port McArthur area) but in other areas they are less extensive (such as much of the coast near the Queensland border). The majority of the huge expanses of wetland are open, bare, saline flats which dry out fairly soon after the wet season and are then dry for much of the year. They are among the most extensive coastal saline flats around the Northern Territory coast. Most of the better, though smallish, freshwater wetlands in the survey area of this block abut the coast towards the eastern end of the block. There are no large freshwater floodplains in this block.

Survey Effort

This survey block received approximately 155 hours of waterbird/shorebird surveys during the period of this project. This represented approximately 7.9% of the hours of survey in all survey blocks combined. These surveys were spread over 33 separate days. There was little or no surveying done in January, April or August (Figure 37). All other months had a reasonable amount, with May receiving the most. July, September and November were also well represented. There were 110 separate ground surveys involving 80 different and well-spread sites.

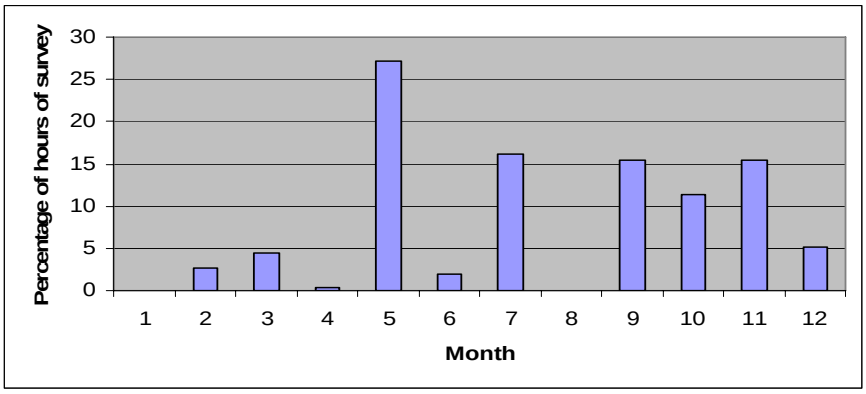

Figure 37. Approximate percentage of surveys hours relating to waterbirds for survey block 15.

Results and Discussion

During the full period of this project there were around 1 400 separate waterbird records made in this survey block (Figure 38). These totalled over 37 000 birds. These represented around 4.6% of the records and 1.4% of the total numbers of waterbirds recorded in the fifteen survey blocks. Forty-eight species of waterbird from Tables 1 and 2 were recorded throughout the project. Details of counts and the number of records for aerial and ground surveys can be found in Appendix A.

Species Relative Abundance. There were thirty-seven species recorded in aerial surveys. The species recorded in the greatest abundance from aerial surveys were the egrets, with all four species being confirmed as present. With the saline nature of much of the habitat in this block most egrets confirmed to species level were Great Egret and Little Egret. It was noted in a July (1998) survey that the coast and adjacent saline swamps south of the Roper River (i.e. survey block 14 and part of 13) had a higher percentage of Little Egret compared to the Port McArthur area (i.e. survey block 15) which had a higher percentage of Great Egret. The next most abundant species were the Black-winged Stilt, Australian Pelican, Pied Cormorant, Brolga, Grey Teal, the cormorant/darter group (dominated by Pied Cormorant but all other species also confirmed), White-faced Heron, White-winged Black Tern and Pacific Black Duck.

There were forty-nine species recorded in ground surveys. The species recorded most frequently from ground surveys was the Black-winged Stilt. The next most frequently recorded species were Common Tern, Grey Teal, Pacific Black Duck, Australian Pelican, Green Pygmy-goose, Wandering Whistling-Duck, Whiskered Tern, Plumed Whistling-Duck, Gull-billed Tern, Hardhead and Red-necked Avocet.

Species Recording Rates. The species recorded on the most number of separate occasions from aerial surveys were easily the egrets. The species recorded the next most frequently were the Australian Pelican, Black-necked Stork, Pied Cormorant, Osprey, White-bellied Sea-Eagle, White-faced Heron, the cormorant/darter group (probably dominated by Pied Cormorant but all other species also confirmed), Australian White Ibis and Brolga.

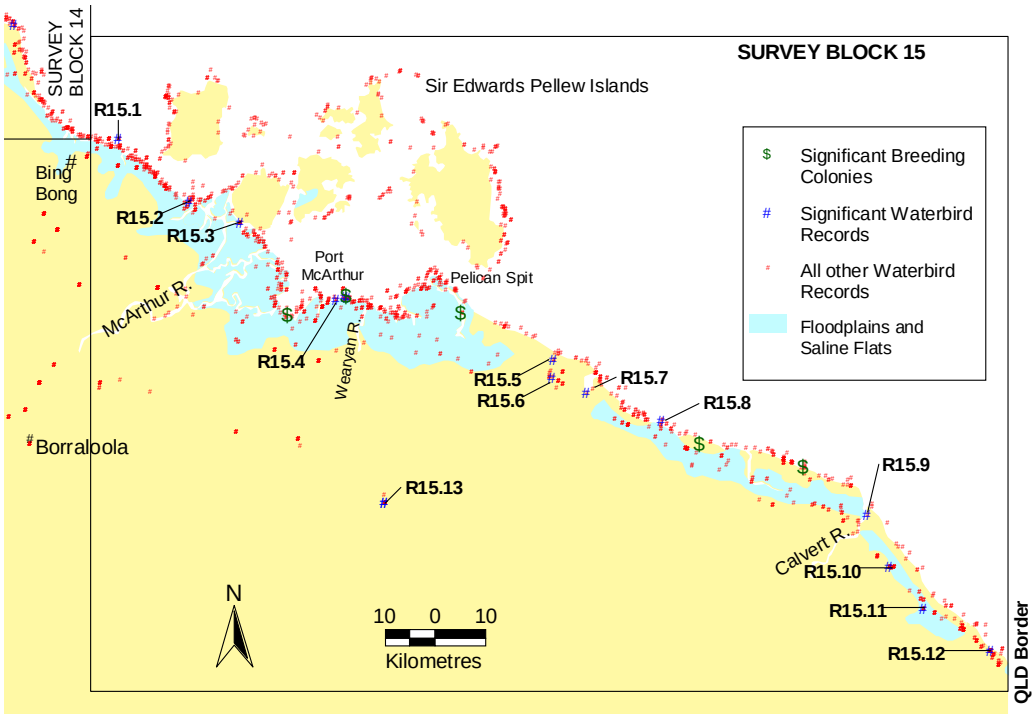

Figure 38. Distribution of waterbird records for survey block 15.

The species recorded on the most number of separate occasions from ground surveys were the Gull-billed Tern, Whiskered Tern, Great Egret, Australian Pelican, Black-winged Stilt, Pacific Black Duck, Grey Teal, Common Tern, Little Egret, Brolga and White-bellied Sea-Eagle.

Important Areas.

Significant Waterbird Breeding Colonies. There were five significant colonies spread along the coast of this survey block (Figure 38). None of these colonies were above the 1 000 to 5 000 bird range, but they involved most of the colonial waterbird breeding species. The colonies were most significant for Little Pied Cormorant, Little Black Cormorant, Pied Cormorant, Pied Heron, Little Egret, Great Egret, Intermediate Egret, Nankeen Night Heron, Australian White Ibis and Royal Spoonbill. See Chatto (2000b) for further details of these colonies and a number of other smaller ones.

Significant Waterbird Areas. There were a number of significant records. They were spread all along the coast and have been dealt with in the same manner as for survey block 14 because there were no specific areas with large numbers of waterbirds. The highest single count for this survey block was a partial area count of around 6 300 waterbirds in March 1994. This count was dominated by Black-winged Stilt and White-winged Black Tern. The next highest was of around 5 500 in December 1999. Most abundant in this count were egrets and Brolga.

Although not being recorded in significant single records, comment was made that White-bellied Sea-Eagle (including many young birds in a July 1998 survey), Australian White Ibis, Little Pied Cormorant and Australian Darter were species, additional to those mentioned below, that were also widespread and relatively abundant along the coast of the Port McArthur area of this survey block.

Other Significant Single Records. There were 15 single significant records involving nine species in this survey block. Most of these records were from either along the coast or on the small freshwater wetlands just in from the coast. There was also one site further inland. Most of the freshwater wetlands were in the eastern end of the block. There were also large areas of open saline flats in this area, but these rarely contained significant numbers of waterbirds, whether wet or dry. These records are briefly mentioned starting from the north west of the block and heading south east.

Record R15.1. This record was of around 800 Pied Cormorant in the mangroves along the coast in November 1998.

Record R15.2. This record was of 100 White-faced Heron in September 1993. It was one of a number of records of this species which is very abundant along the coast around the Port McArthur area during the dry season. There were no other records of note in this area in this survey, but records of note in this area from other surveys include 350 egrets and 300 Black-winged Stilt (September) and 100 Australian Pelican (July).

Record R15.3. This record was of 130 White-faced Heron in July 1998. Other records of note in this particular survey included 150 Australian Pelican, 100 Black-winged Stilt and reasonably good numbers of egrets.

Record R15.4. The next site had three significant records from three separate surveys. These included 350 White-faced Heron in July 1998, 100 White-faced Heron in May 1999 and 100 Royal Spoonbill in September 1999. The July 1998 survey also recorded over 700 Black-winged Stilt and 150 egrets (all Great Egret and Little Egret) at that site. Comment was made in a July (1998) survey that this part of the Port McArthur area had a higher percentage of Great Egret among the egrets along the coast and adjacent saline swamps, but the coast north towards the Roper River (i.e. survey block 14 and part of 13) had a higher percentage of Little Egret. The other two surveys also had good numbers of egrets at the same time.

The coast between, and including records A15.3 and A15.4, had over 1 000 White-faced Heron in the July 1998 survey. This is significant in two ways. Firstly, these dry season concentrations feeding along the coast in this Port McArthur area are easily the highest densities of this species seen anywhere

in the whole survey area. Secondly, it shows this species, along with species such as Little Egret, Great Egret and Australian White Ibis are using the coast in this area during the dry season when most of the adjacent wetlands are dry. Species feeding under the mangroves along the coast probably had aerial counts that were under their true numbers. A subsequent 1998 December survey of this area following good rains showed most White-faced Heron had left the area. Egrets and Australian White Ibis were still present in this coastal mangrove habitat but they were also then present on the large wetland areas in from the coast that by then had water back on them.

Record R15.5. This record was of 1 000 Australian Pelican in May 1995. There were also 200 egrets at this site at the same time.

Record R15.6. This record was of 3 000 Black-winged Stilt in March 1994. There were also 100 White-winged Black Tern at this site at the same time.

Record R15.7. This was an aerial record of 300 Whiskered and/or White-winged Black Tern in May 1995. Both species were confirmed in the area during other surveys but it is not known which was present in this record.

Record R15.8. This record was of 500 White-winged Black Tern in March 1994. There was also another nearby record of 100 White-winged Black Tern on this survey. Other records of some note from this site included 600 Grey Teal on two occasions and 200 Common Tern on one occasion. Each of the records were in the month of May.

Record R15.9 This record was of 500 Brolga in July 1996. There were no other records of any note from this site during this survey but 400 Pacific Black Duck were recorded there in a December survey.

Record R15.10 This record was of 800 Brolga in December 1998. There was also another nearby record of 300 in this area at the time. There were also, among other waterbirds, 500 egrets, 400 ducks (mostly Pacific Black Duck) and 100 Pied Cormorant at this site at the time. This record is representative of the 'greener' freshwater swamps along the coast as opposed to the bare open saline flats. At this time of year there is certainly a greater diversity of waterbirds on the vegetated freshwater swamps than the wet open saline flats. With the exception of the occasional big groups of species like Black-winged Stilt or the terns on the salt flats, the freshwater wetlands in this vicinity also have greater overall numbers of waterbirds.

Record R15.11 This record was of 40 White-necked Heron in May 1994. There were also 450 Brolga and 200 Magpie Goose at this site at the time, and 200 Australian Pelican and 100 egrets in a March survey of this site on another occasion.

Record 15.12 This record was of 40 White-necked Heron in May 1994. There were no other records of note for this area in this survey but there were some from other surveys. These included 200 Pacific Black Duck, 200 egrets, 130 Glossy Ibis and 100 Black-winged Stilt (December), 200 White-winged Black Tern and 100 Black-winged Stilt (March) and 75 Green Pygmy-goose (June).

Record 15.13 This record was of 300 Green Pygmy-goose on July 2004. There were 200 Hardhead present at the same time.

WATERBIRDS – BY SPECIES

MAGPIE GOOSE

Geographic Distribution

Magpie Goose were recorded throughout the survey area (Figure 39). The main Magpie Goose areas were the floodplains between the Moyle and Finniss Rivers to the south west of Darwin, the floodplains between the Adelaide River and Murgenella Creek to the east of Darwin and, at times, the Arafura Swamp and the floodplains to the north of Blue Mud Bay. Although the floodplains to the south west and to the east of Darwin received considerably more survey effort (due to the specific and extensive Magpie Goose aerial surveys of those areas that formed part of my surveys in the early 1990s) it is clear that many more Magpie Goose use these areas than other parts of the Top End. This is partly a reflection on the much greater area of wetland in both the wet and dry seasons, particularly compared to the east coast of the Top End where Magpie Goose are in smaller numbers, more dispersed and less regularly present.

Magpie Goose were not often recorded on islands around the Northern Territory coast. Part of the reason for this could also relate to the lack of large wetlands. One exception was Melville Island. Although Magpie Goose were only recorded at one site in the far north east of the island during the surveys, they certainly visit the larger swamps along the northern coast at least. Mathews (1914) reports them first being seen in late November, after which, flocks were regularly seen each evening. As there is little breeding on the island and most birds would have probably departed the islands by February. The lack of records of Magpie Goose on Melville Island during my surveys would be due to the fact that no surveys were done in this period. Magpie Goose may also occur on Melville Island in large numbers on occasions. The S.C.R.S.R. reports in excess of 6 000 on the wetlands associated with Andranangoo Creek along the north of Melville Island.

Magpie Goose recorded from the mainland opposite Groote Eylandt may also occasionally fly over to wetlands on that island, as was reported by Tindale (1922) and in Noske and Brennan (2002).

Magpie Goose preferred freshwater wetlands and were recorded from the upper floodplains through to near the coast, where they were also recorded on partially saline wetlands. In the late dry season they also come into rural and urban areas, such as irrigated pastures, parks, golf courses etc. In terms of rural and urban presence, and of increasing interest, is their arrival onto mango plantations in the late dry season. The large increase in the number of mango plantations near Darwin during the period of the project saw an ever increasing trend of Magpie Goose to move in from the adjacent wetlands to feed on fallen mangos and roost in the shade under the trees. This has been causing conflict with the mango farmers. Once the crops had finished and rains came the geese moved back out into the floodplains in preparation for breeding.

Numbers

Magpie Goose were easily the most abundantly recorded waterbird in either ground or aerial surveys throughout the project, and as such are likely the most abundant on average throughout the year of all the resident, or largely resident, species. However, they are not necessarily the most abundant waterbird at all times of the year (see discussion in methods relating to this issue).

Magpie Goose were recorded on 241 occasions from ground surveys, totalling around 124 000 birds. These equate to around 4% of all ground records for waterbirds but in excess of 20% of the total number of waterbirds counted during all ground surveys. Although Magpie Goose were clearly recorded in greater numbers than any of the other species over the survey period, they were not

recorded more frequently. Masked Lapwing, Intermediate and Great Egret, and Whiskered Tern were all recorded on a greater number of occasions indicating the greater range of wetland habitats these species are able to exploit.

Unlike many of the other waterbirds Magpie Goose were not often recorded as single birds or small groups. They were, when present, usually seen in medium to large groups. Some of the concentrations of Magpie Goose observed during these surveys were huge. The large numbers of Magpie Goose concentrating on parts of the major floodplains in the north west of the survey area (eg Kakadu) have been frequently filmed and reported in the past, but there are also other, previously un-reported sites which also have huge numbers of geese at times. One example is the late dry season numbers recorded on two relatively small wetlands to the north of Blue Mud Bay. Here, a minimum estimate of 500 000 Magpie Goose were recorded in September 1996.

Seasonality

Magpie Goose were recorded in large numbers in all months of the year. Although some birds may move out of the Top End to other feeding or breeding sites, these records suggest most remain as Top End residents throughout the year. However, there are clearly seasonal movements within the survey area. Some of these movements occur from floodplain to floodplain, such as the dry season congregations on some floodplains which far outnumber the number of birds in these same areas when they are breeding in the wet season. On other floodplains the reverse is the case – lots of birds breeding but few remaining in the following dry season. Other obvious, and regular, movements are from the large floodplains when they dry up to smaller permanent wetlands which include rural and urban areas mentioned above. This will not be further discussed here as it has been discussed in detail by many other authors (eg Whitehead, 1998; Saalfeld, 1990; Morton, 1991). Magpie Goose remain one of the few Top End waterbirds to have received a considerable amount of research.

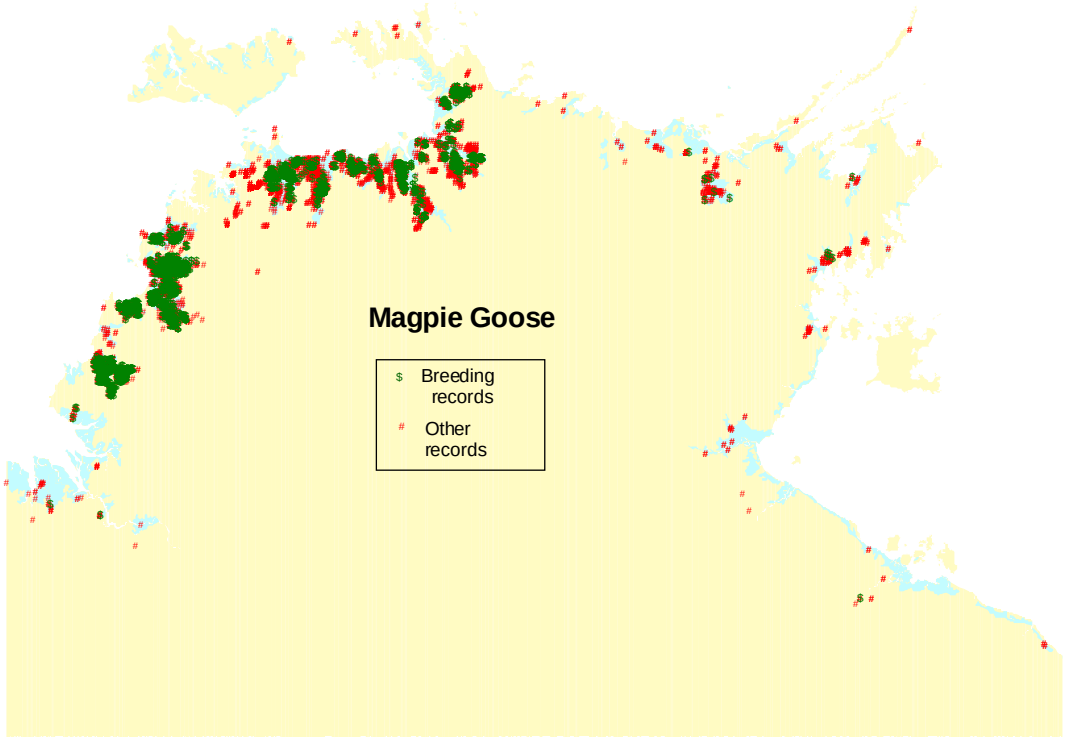

Figure 39. Distribution of all Magpie Goose records.

Breeding

Throughout all surveys the vast majority of breeding was observed on the floodplains to the south west and east of Darwin in the north west of the survey area. These floodplains were also previously mentioned as the main areas where Magpie Goose were recorded (Figure 39). There was some annual variation in nesting season due to the timing of the first good wet season rains, and/or having to re-nest following flooding, but over the years sitting birds were recorded from late January through to mid May in the main northern and western floodplain breeding sites. Survival of young from the later nesters was probably poor. Small numbers were also recorded nesting in the wetlands near Blue Mud Bay in mid July (1996). Surveys of the Daly River nesting areas in late January 1994 showed only the very few birds were nesting, but surveys in seven weeks later showed large numbers nesting. Unfortunately 9 out of 10 nests had been flooded and the eggs were floating nearby. Magpie Goose nesting in these major floodplains of the north west of the Top End has also been well documented by other authors, as mentioned above, and will not be discussed further in this report.

Outside this main nesting area, the only breeding recorded during my surveys was at a few sites in the north east and south west of the Top End. In the north east of the Top End, active nesting was found in mid June (1996) and completed nesting in late July (1998) on the Arafura Swamp; active nesting was found in mid May (1995) in the wetlands to the south of Arnhem Bay, and in mid May (1995) and late July (1996) in the wetlands to the north of Blue Mud Bay. This suggests nesting outside of the major floodplains in the north west is both later in the season and perhaps not as regular. Nesting in the Arafura Swamp is probably greater than suggested by Figure 39.

Plate 8. Family of Magpie Geese with the trio of parents. Photo F. Woerle.

In the south west of the survey area a small number of nests, not currently in use at the time, were seen on the wetlands to the north of Joseph Bonaparte Gulf in mid March 1999 and early July 1999. Surveys of the fairly extensive wetlands to the south of this Gulf at these same times located many geese but only one small breeding site was found in the March survey. This was on a swamp on the western side of the Victoria River near the junction with the Bullo River. A & S Keates *(pers. comm.)* also recorded hundreds breeding on the wetlands near Legune Station in late April 2004, and Jaensch (1994) also reported possible breeding in this area in April 1993. Perhaps breeding is not regular on wetlands in this area.

N. McCrie (*pers. comm.*) reports small numbers sometimes breed at Fogg Dam to the east of Darwin.

A & E Withers (*pers. comm.*) also report small numbers (30-40 pairs) occasionally breed in a swamp behind Danger Point on Cobourg Peninsula.

The S.C.R.S.R. reports a small amount of breeding in wetlands associated with the Blythe and Cadell Rivers and a significant amount on a swamp associated with Gudjerama Creek near Maningrida.

Breeding also occurs on Melville Island and possibly Bathurst Island, at least in some years, even though it was not recorded in my surveys. The S.C.R.S.R. reports breeding on a reed swamp adjacent to Shark Bay on the western end of the northern coast and in a swamp behind Cache Point on the mid-north coast of Melville Island, and behind Wangiti Swamp on Bathurst Island.

Plate 9. Magpie Geese at a drying waterhole on the Mary River floodplain. Photo F. Woerle.

PLUMED WHISTLING-DUCK

Geographic Distribution

Most of the confirmed Plumed Whistling-Duck records during my surveys were from the western half of the Top End, with the wetlands between the Adelaide River and Murgenalla Creek in the north-west being the areas where most were observed (Figure 40). All of the top 10% of records in terms of the largest group counts were also in the north west, along with one record in the Arafura Swamp and two in the far south-west.

Plumed Whistling-Duck would certainly also have been present at some of the sites where w*histling-duck spp.* and *duck spp.* were recorded. (*Duck spp.* records were mostly made up of 'brown' ducks that did not take to the air when flown over. Most of these records would have been made up of Whistling-Duck, Black Duck and Grey Teal.) The addition of such w*histling-duck spp.* and *duck spp.* records to the distribution map for Plumed-Whistling Ducks (Figure 40) adds a few more potential sites (eg the upstream Daly River area on the western side of the Top End) but does not greatly extend the broad potential distribution of Plumed Whistling-Duck within the overall survey area.

Unlike most other species of ducks, Plumed Whistling-Duck were rarely observed in the saline wetlands on or near the coast. Although large numbers can be seen on the large freshwater floodplains and adjacent wetlands, Plumed Whistling-Duck will also congregate around smaller isolated inland wetlands and farms dams. Their presence in these latter habitats occurs both within the survey area and further inland (pers. obs.). These sites were not well covered in my surveys and so the full distribution of this species is likely to be under-represented on Figure 40 in regard to their distribution on the inland parts of the survey area.

Plumed Whistling-Duck were not commonly recorded on Top End islands, and their appearance at such sites, with the possible exception of the Tiwi Islands, was found to be infrequent. This is supported by Mathews (1914) who reports this species to be rare on Melville Island, but is contradicted by Tindale (in Noske and Brennan, 2002) who records this species in large numbers on a lake on Groote Eylandt. The latter also reports them as being extremely common on the adjacent mainland. This was not the case in my surveys, although Wandering Whistling-Duck (which Tindale fails to mention) were abundant during my surveys of this area.

Numbers

Plumed Whistling-Duck were not one of the more frequently recorded species during the surveys, but they were fourth in regard to total numbers recorded during ground surveys. In these surveys there were 44 ground records of Plumed Whistling-Duck totalling over 40 000 birds. These equate to less than 0.7% of all waterbird records and approximately 6.6% of the total number of waterbirds counted during all ground surveys. The fact that at least some individuals of this species are likely to leave the survey area for part of the year is obviously going to affect such figures, and subsequent comparisons. Nevertheless, these figures still indicate that Plumed Whistling-Duck are one of the most abundant waterbirds in the survey area, when they are present.

Plumed Whistling-Duck were further confirmed on 75 occasions from aerial surveys. The number of aerial records for this species would undoubtedly be boosted by occurrences of this species within the 198 *whistling-duck spp.* records and 301 *duck spp.* records also made during aerial surveys.

Plumed Whistling-Duck were recorded in very large roosting flocks and also in small groups. The larger flocks were often daytime roosting birds that mostly disperse at night to feed. *Whistling-duck spp.*, along with Magpie Goose, can be frequently heard flying over my home near Darwin at night. The largest single flock recorded during my surveys was at least 15 000 birds. This was a single

daytime roosting flock on a wetland near the East Alligator River. About a quarter of all Plumed Whistling-Duck records were counts of more than 500 birds.

There were also 30 records of 1 000+ *whistling-duck spp.*, some of which would have included large numbers of Plumed Whistling-Duck. The distribution of these large w*histling-duck spp.* flocks was also within the area mentioned above for the highest 10% of counts for Plumed Whistling-Duck records. These large flocks within the w*histling-duck spp.* records are not shown by a larger symbol on Figure 40 because of the complexity of symbols already present on this map.

Seasonality

Records of Plumed Whistling-Duck were made in each month of the year except January. This is partly due to there being a lot less surveying done during this particular month over the period of the project. Plumed Whistling-Duck are certainly still around in small numbers at this time, at least until the larger rains come. Most Plumed Whistling-Duck records and the higher total monthly counts were made during the dry season between May and October. As Jaensch (1994) records Plumed Whistling-Duck to be in the top ten most frequently recorded waterbirds in his surveys of 145 wetlands in the sub-humid tropics just to the south of the Top End between March and September, they are obviously a widespread and abundant species in the northern half of the NT throughout the dry.

The fact that the vast majority of larger counts were recorded through the dry season, particularly in the late dry, suggests there is a certain amount of inland wet season dispersal, at least into wetlands further inland than covered in my survey area. This may be partly due to the occurrence of safer breeding locations, as discussed previously in the methods section.

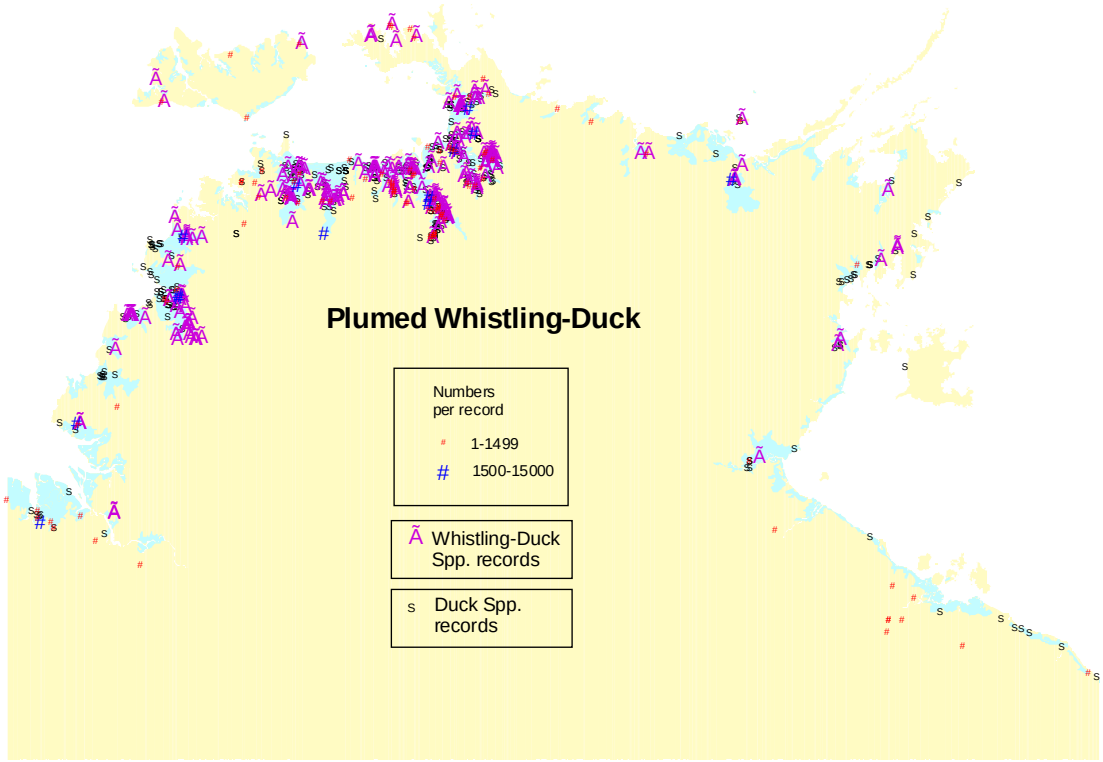

Figure 40. Distribution of all Plumed Whistling-Duck records.

Breeding

There were no confirmed breeding records of Plumed Whistling-Duck made by myself during these surveys. These surveys were not designed to search out nests but isolated pairs of whistling-ducks seen from the air during their breeding season, may have been breeding pairs.

Frith and Davies (1961) record clutches of Plumed Whistling-Duck beginning in the months between February and May on wetlands between Darwin and the western edge of Arnhem Land. Ron Stanton (*pers. comm.*) reported a pair with eight young on Batchelor Sewage Ponds (approximately 80 km south of Darwin) in April 2005.

Jaensch (1994) reported two clutches on a small inland wetland in the far south east of my survey area in late March 1993. Schultz (1989) and Morton *et. al.* (1991) also did not record Plumed Whistling-Duck breeding in the Alligator River wetlands system of Kakadu National Park. Schultz (1989) further suggests they only breed in coastal districts during exceptionally wet seasons, preferring to breed in inland areas. Jaensch (1994) supports this, documenting Plumed Whistling-Duck as the sixth most frequently recorded breeding waterbird in his surveys in Northern Territory wetlands south of the Top End.

A & E Withers *(pers. comm.)* reported seeing the odd clutches of small Plumed Whistling-Duck ducklings in most wet seasons near Smith Point on Cobourg Peninsula, but never actually found any nests. They do not report breeding by Wandering Whistling-Duck, which is the species I found breeding near the ranger station and on a small island near Smith Point during my surveys.

A & S Keates reported a pair of Plumed Whistling-Duck with ten ducklings on Legune Station in late April 2004 and McKean (1985) records this species breeding in Keep River National Park in February 1981. Both these areas are adjacent the WA/NT border in the south west of the Top End, the former being within my survey area and the latter just south of my survey area.

Plate 10. Part of a group of 15 000 mixed Whistling-Ducks (mostly Plumed) near the East Alligator River, August 1992. Photo R. Chatto.

WANDERING WHISTLING-DUCK

Geographic Distribution

Wandering Whistling-Duck were more frequently recorded and more widespread than Plumed Whistling-Duck. Wandering Whistling-Duck were recorded on wetlands throughout the survey area (Figure 41). Like the Plumed Whistling-Duck, the north west of the Top End was very important, but the top 10% of records in terms of the largest flock counts were still spread throughout the mainland survey area with the exception of the south east.

The addition of the w*histling-duck spp*. and *duck spp.* records (Figure 41), many of which would have included Wandering Whistling-Duck, does not extend the general broad distribution of this species, from that shown by the confirmed Wandering Whistling-Duck records. A & E Withers (*pers. comm.*) report that there are reasonable numbers around the Borroloola area in the south east of the survey area, but not as many as the Plumed Whistling-Duck in that area.

Wandering Whistling-Duck were more frequently recorded on islands than Plumed Whistling-Duck during my surveys. Wandering Whistling-Duck were not recorded on either the Goulburn Islands or Groote Eylandt in my surveys, although w*histling-duck spp.* were recorded on the latter. Other authors have recorded them as uncommon visitors on these sites (Thompson, 1983; Noske and Brennan, 2002).

Numbers

Wandering Whistling-Duck were also not one of the more frequently recorded species during the surveys, but they were third in regard to total numbers recorded in ground surveys. They were recorded more frequently than Plumed Whistling-Duck. Throughout all surveys there were 154 ground records of Wandering Whistling-Duck totalling around 59 000 birds. These equate to around 2.5% of all waterbird records and approximately 9.7% of the total number of waterbirds counted during all ground surveys. The fact that at least some individuals of this species are likely to leave the survey area for part of the year is obviously going to effect such figures, and subsequent comparisons. Nevertheless, these figures still indicate that Wandering Whistling-Duck are one of the most abundant waterbirds in the survey area when they are present.

Wandering Whistling-Duck were further confirmed on 149 occasions from aerial surveys. This number of records is again fairly well down the list of aerial records for each species, especially given they were one of the more abundant species recorded in ground surveys. However, the 198 *whistling-duck spp.* records and 301 *duck spp.* records also made during aerial surveys would undoubtedly include members of this species.

Wandering Whistling-Duck were recorded in aggregations varying from very large roosting flocks through to small groups. Throughout the surveys the average number of Wandering Whistling-Duck per record was around 750. The largest single flock recorded was at least 35 000 birds. This count was on one of the wetlands to the north of Blue Mud Bay in September 1996 and was previously discussed in the Magpie Goose section. There were also 30 records of 1 000 or more *whistling-duck spp.*, some of which would have included large numbers of Wandering Whistling-Duck. The distribution of these large *whistling-duck spp.* flocks was also within the area mentioned above for the large groups of Wandering Whistling-duck.

Morton *et. al.* (1991) estimates 400 000 Wandering Whistling-Duck in the wetlands of the Alligator Rivers regions. Although they say this is only very approximate, they suggest this species was second only to Magpie Goose in numbers in that area.

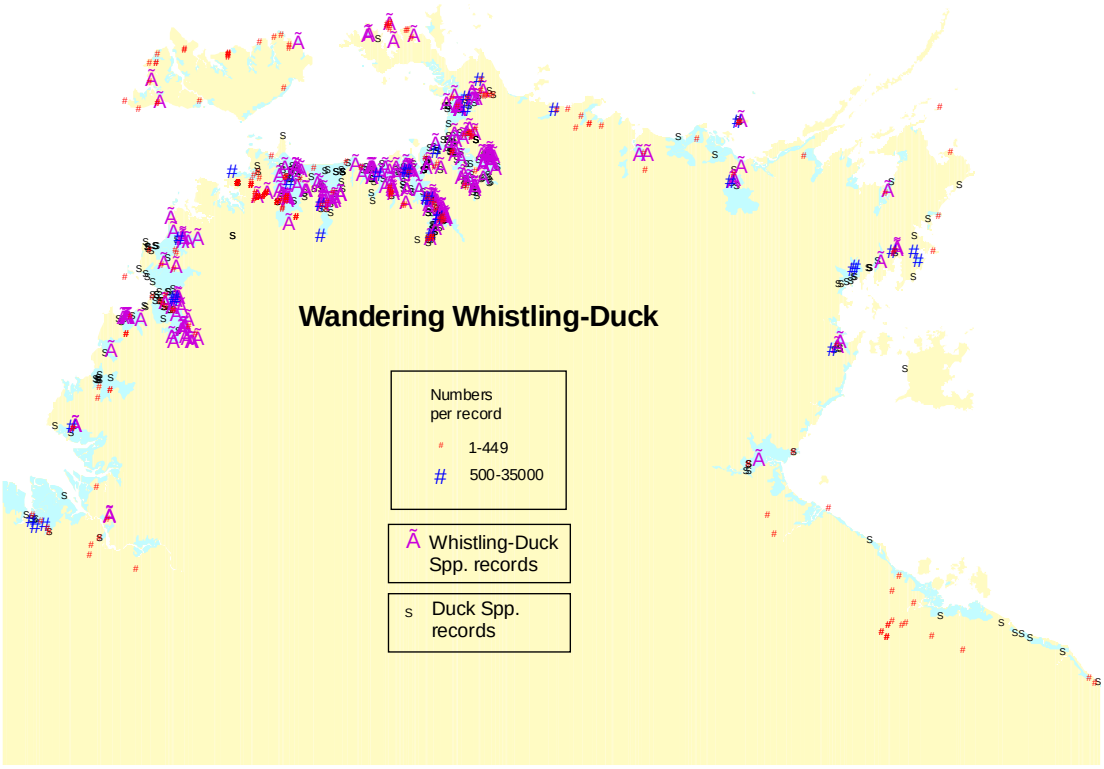

Figure 41. Distribution of all Wandering Whistling-Duck records.

Seasonality

Records of Wandering Whistling-Duck were made in each month of the year, with the highest numbers being recorded between April and November (especially between August and November) and the lowest numbers between January and March. As with Plumed Whistling-Duck the larger numbers are present in the survey area during the dry season, particularly the late dry. The larger numbers in the first part of the dry season possibly reflects the influx of young into the population, while the even higher numbers recorded in the latter part of the dry is probably a reflection of birds concentrating around drying wetlands and being more readily detected in my surveys. Lower numbers recorded between December and March may be due to departure from the area of some birds and dispersal within the area of others remaining to breed. The substantially lower number of birds recorded in this period suggest that many leave the survey area. However, there are certainly some that remain to breed. Birds dispersed into largely hidden breeding pairs in the survey area at this time of year, are less likely to have been seen in my surveys, particularly aerial surveys. Jaensch (1994) recorded Wandering Whistling-Duck at considerably fewer inland sites than Plumed Whistling-Duck in his surveys of wetlands to the south of the Top End between March and September.

Breeding

Wandering Whistling-Duck were recorded breeding on 16 occasions during my surveys. Due to the congestion of symbols on the distribution map (Figure 41) breeding records are shown on Figure 42. It appears that more of this species remain in the survey area to breed than Plumed Whistling-Duck. Records of confirmed Wandering Whistling-Duck breeding were scattered through the survey area, including on several islands. There were also a number of records throughout the survey area of pairs of whistling-ducks seen from the air during their breeding season. These are likely to have been breeding, but my surveys were not suited to detecting such nesting.

The most important breeding site located during my surveys was on a wetland on the western side of the downstream South Alligator River. An aerial survey in April 2004 recorded many separate crèches of many hundreds of pre-flying whistling-duck ducklings. Most, if not all were Wandering Whistling-Duck. They may have also been there, but not detected, in an April 1992 aerial survey that recorded many thousands of whistling-ducks at the same site. There were no ground surveys done there, but it is assumed the birds present did breed at this site. The S.C.R.S.R. also reported another site, Leichhardt's

Lagoon (adjacent to an upstream section of the South Alligator River) to have as many as 30 000 Wandering Whistling-Duck breeding there. It is possible that such breeding may be irregular as Schultz (1989) and Morton (1991) did not record much breeding in the Alligator Rivers wetlands of Kakadu. They suggested birds move into that area in the dry season after breeding elsewhere.

My survey records showed pre-flying young present between late March and early July, suggesting breeding between January and July at least. This is supported by a number of other authors. In the south west of the survey area McKean (1985) records this species breeding in Keep River National Park in March and April 1982 and A & S Keates *(pers. comm.)* reports a pair with 16 ducklings on Legune Station in late April 2004. Shurcliff and McKean (1990) noted newly hatched broods of Wandering Whistling-Duck in Darwin on the sewage ponds during March to May in their surveys of the 1970s and 1980s, while also in Darwin, N. McCrie *(pers. comm.)* reports ducklings are occasionally seen on Knuckey Lagoons. Frith and Davies (1961) report a nest in early January, but most clutches starting between the months of March and April on the wetlands to the east of Darwin. Frith and Davies also suggest Wandering Whistling-Duck breed earlier than Plumed Whistling-Duck. Boekel (1976) records clutches of ducklings in mid May on the sewage works in Nhulunbuy in the north east.

Of interest to note is the island nesting of this species seen during my surveys. One interesting series of nests was found on a small grass and sand island off Cobourg Peninsula in April 1994. There is no water on this island. Here, three nests of 17, 24 and 25 eggs were located hidden in the grass. Not only is this a high number of eggs, but the newly hatched young would have an ocean swim of over a kilometre to the mainland. They were also recorded breeding on other islands in Raffles Bay and Port Essington during my surveys.

On another island, Mooroogga Island (off the north coast of the eastern part of the Top End) a number of burnt out Whistling-Duck nests were found on the ground among the grass in November 2004. According to Traditional Owners there are lots of these nests on the island. Although not completely certain it appears highly likely these nests are of Wandering Whistling-Duck. This island is several kilometres off the mainland but there is a reasonable freshwater swamp on the island that holds water for most of the year.

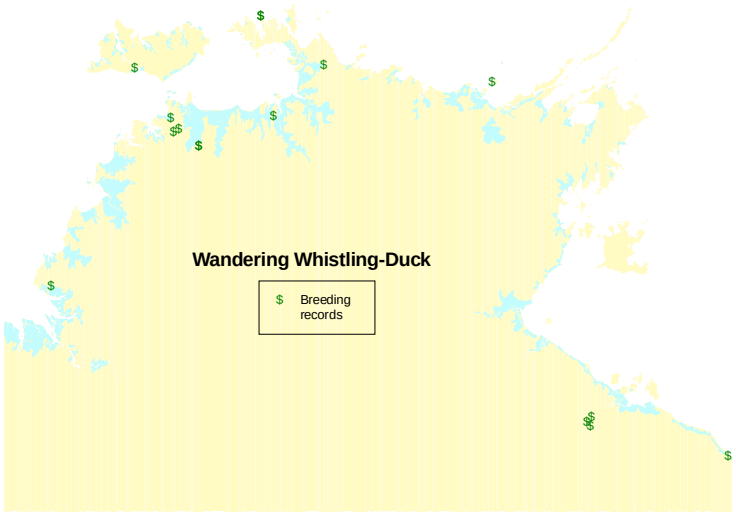

Figure 42. Wandering Whistling-Duck breeding records.

BLACK SWAN

Geographic Distribution

Although Black Swan were only recorded in three areas during my surveys this species is included in the main body of this report because they are a large and obvious waterbird for which my surveys do give a reasonable indication of their presence in the survey area. Other species for which I have few records, and that are not likely to be easily detected in my surveys are included in a latter section dealing with Table 2 species. Black Swan were recorded in the far south west and the far south east of the survey area. This is where they are more likely to appear given these areas are close to wetlands in the sub-humid tropics, just south of the Top End, where I have seen them each time I have done aerial surveys in that area. The other record was on a large wetland near the coast to the east of Darwin. Given this species is unlikely to be missed, and these northern Top End wetlands were extensively surveyed, it is clear that Black Swan are only a rare visitor to the northern part of the Top End. Other records include a single adult in Darwin (Shurcliff and McKean, 1990) and two near Marrakai Station on the Mary River system in October 1972 (Thompson, 1977).

Numbers

Even when recorded, Black Swan were only seen in small numbers. Throughout all surveys there were only three ground records of Black Swan totalling 10 birds. There were also a further two records totalling six birds made from the air. The largest single group was only five birds, on wetlands south of Joseph Bonaparte Gulf.

Seasonality

No comment can be made on the seasonality of Black Swans in the Top End from the low number of records in my surveys. The spread of months of these four records does suggest, however, that they are irregular vagrants to the Top End. A & E Withers *(pers. comm.)* report they are only occasional visitors to wetlands around Borroloola which are close to my records in the south east.

Breeding

No evidence of breeding was found in the survey area.

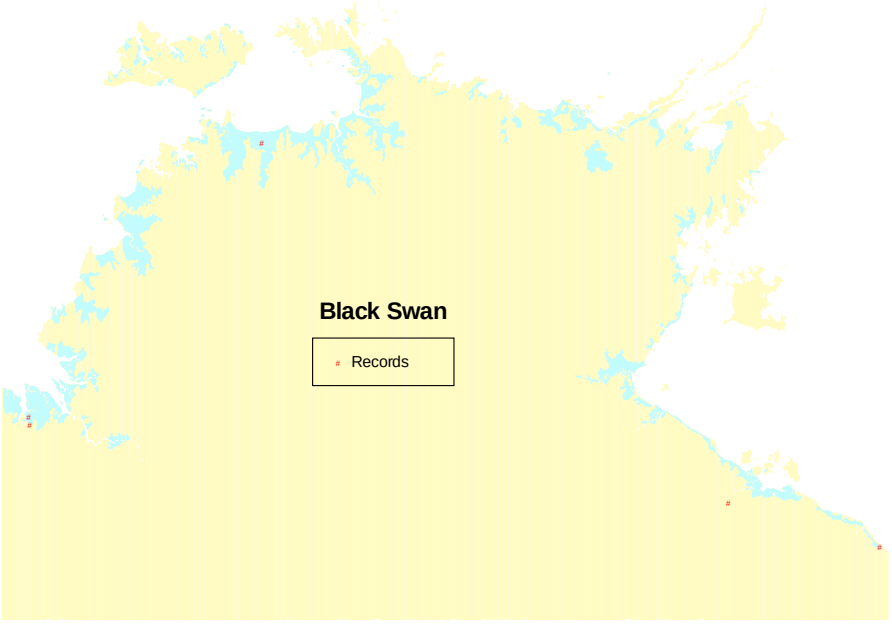

Figure 43. Distribution of all Black Swan records.

RADJAH SHELDUCK

Geographic Distribution

Radjah Shelduck were recorded throughout the survey area, with the north west being particularly important and the south east relatively less important (Figure 44). The distribution of the largest 10% of separate counts was similar to the total distributional records, suggesting this species usually occurs in good numbers wherever it was recorded. This species is fairly easy to identify from the air and so will have had few records associated with mixed species records, which was not the case with the whistling-ducks. Hence, the overall distribution of Radjah Shelduck within the survey area is likely to be fairly well represented here. This species was recorded from the freshwater wetlands of the upper floodplains through to saline wetlands, and even quite regularly on coastal beaches. They were seen on the smallest of wetlands, such as a bit of temporary flooding on a golf course, through to the large floodplains. They were recorded on several of the larger islands but not frequently and rarely in large numbers.

Numbers

Radjah Shelduck were the most frequently recorded duck in ground surveys but most of the other duck species were more abundant. Throughout all surveys there were 178 ground records totalling just over 7 000 Radjah Shelduck. These equate to around 2.9% of all waterbird records and just under 1.2% of the total number of waterbirds counted during all ground surveys. Radjah Shelduck were recorded a further 416 times during aerial surveys. They were also the most frequently recorded of all the ducks from this form of surveying, but ease of identification from the air would have been a factor here.

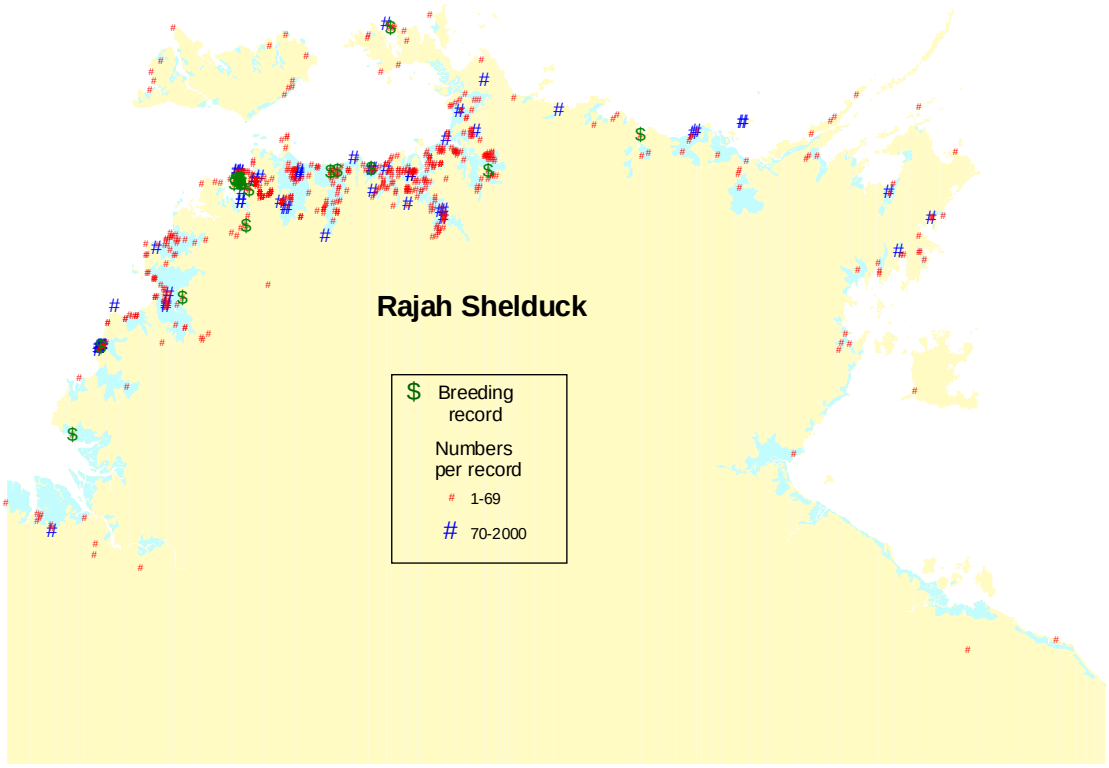

Figure 44. Distribution of all Radjah Shelduck records.

Radjah Shelduck were recorded in medium sized flocks through to small groups, and frequently in pairs. There were six single flock counts of in excess of 500 birds, the largest being 2 000. This large group of Radjah Shelduck was seen just to the east of Darwin in November 1994. Three other exceptionally large groups (of 1 000 to 1 500) were located at two sites on wetlands in the north west. Both were in late August (1992 and 1995); and on a wetland on Moorooggna Island (which is a few kilometres off the northeast coast of the Top End) in December 2004.

Seasonality

Records of Radjah Shelduck were made in each month of the year, with the highest number of records and number of birds per record being in the July to December period. As with many of the waterbirds the larger numbers in the first part of the dry season possibly reflects the influx of young into the population. Then, the even higher numbers recorded in the latter part of the dry is probably a reflection of birds concentrating around drying wetlands and being more readily detected in my surveys. For the other six months of the year the numbers per record were considerably lower, indicating more dispersed birds. The lower numbers could also suggest fewer birds in the survey area, although this could be due to breeding birds being less likely to be detected, particularly from the air. Any movement out of the survey area appears unlikely to involve significant inland movements, as Jaensch (1994) did not record these birds south of the Top End in his surveys.

Shurcliff and McKean (1990) report Radjah Shelduck as the only duck species to be recorded in every month of the year in Darwin, with numbers increasing up to the onset of the wet season, followed by a rapid decrease. Morton *et. al.* (1991) also found Radjah Shelduck numbers in the Alligators Rivers region to peak in the mid to late dry, but suggested that this species does not move out of the area to the degree shown by most other duck species.

Breeding

Radjah Shelduck were recorded breeding on 19 occasions during my surveys (Figure 44). Nests were recorded being started in November at the earliest, and young were still being observed through to July. No other references were found to suggest breeding in the survey area outside of this time period, although this would certainly not be impossible with unusual rainfall. Frith and Davies (1961) record breeding in the wetlands to the east of Darwin with clutches being observed in February, April and May. Within the general Darwin area Crawford (1972) reports flying young in May and downy young in July, while Shurcliff and McKean (1990) report newly hatched broods between February and July.

All of my breeding records were in the western half of the Top End, with most being in the north west. Many of these were in human populated places near Darwin and were from records picked up through the Parks and Wildlife Service's wildlife rescue section. However, as distribution records for adult Radjah Shelduck during the main breeding months (January to July) are similar to their distribution when all months are considered, it is likely that this species breeds over most of the survey area. Difficulties in detecting single breeding pairs in my surveys would have undoubtedly led to Radjah Shelduck breeding not being detected.

A number of other people have recorded Radjah Shelduck breeding in the survey area, some in locations not recorded in my surveys. A & S Keates *(pers. comm.)* reports a pair with four ducklings on Legune Station in the south west of the survey area in late April 2004. The S.C.R.S.R. reports significant wet season breeding in the mangrove lined channels between the Adelaide River and the western part of Chambers Bay. F. Woerle (*pers. comm.*) records Radjah Shelduck breeding at various locations between Murgenella and the East Alligator River from mid January to late August in the years between 1971 and 1976, while Morton *et. al.* (1991) report birds breeding in isolated pairs at the end of the wet season in the Alligators Rivers area of Kakadu. A & E Withers *(pers. comm.)* reports they breed on Cobourg Peninsula and the S.C.R.S.R. also reports part of this area, the mangroves around Ilamaryi Creek in the south east of the Peninsula, to be among the most important in Australia for Radjah Shelduck nesting. Noske and Brennan (2002) report a breeding record for Groote Eylandt.

GREEN PYGMY-GOOSE

Geographic Distribution

Green Pygmy-goose were recorded throughout the survey area (Figure 45). Like many other species the largest number of records, and numbers of birds, were recorded in the north west. Within this area, the wetlands between the Adelaide River and Murgenella Creek were the most important for this species. This bird was primarily recorded on smaller freshwater wetlands with floating aquatic vegetation and none were recorded in the saline wetlands closer to the coast. Except for the Tiwi Islands, and a single record on a small wetland on one of the outer Wessel Islands, they were not recorded on the islands off the Top End. However, they still may visit suitable wetlands on other larger islands such as Groote Eylandt (Higgins and Davies, 1996).

As Green Pygmy-goose were less inclined to take to the air than many of the other ducks when flown over, there will be some that will have been recorded as *duck spp*. and others that were missed. However, the addition of the *duck spp.* records (as shown in Figure 41) does not greatly increase the overall broad distribution of Green Pygmy-goose indicated by these surveys. One exception could be in the major wetlands to the south west of Darwin.

Numbers

Green Pygmy-goose were another of the more frequently recorded, and fairly abundant, waterbirds in ground surveys. Throughout all surveys there were 201 ground records totalling around 9 200 birds. These equate to around 3.3% of all waterbird records and 1.5% of the total number of waterbirds counted during all ground surveys. There were a further 102 aerial records for this species.

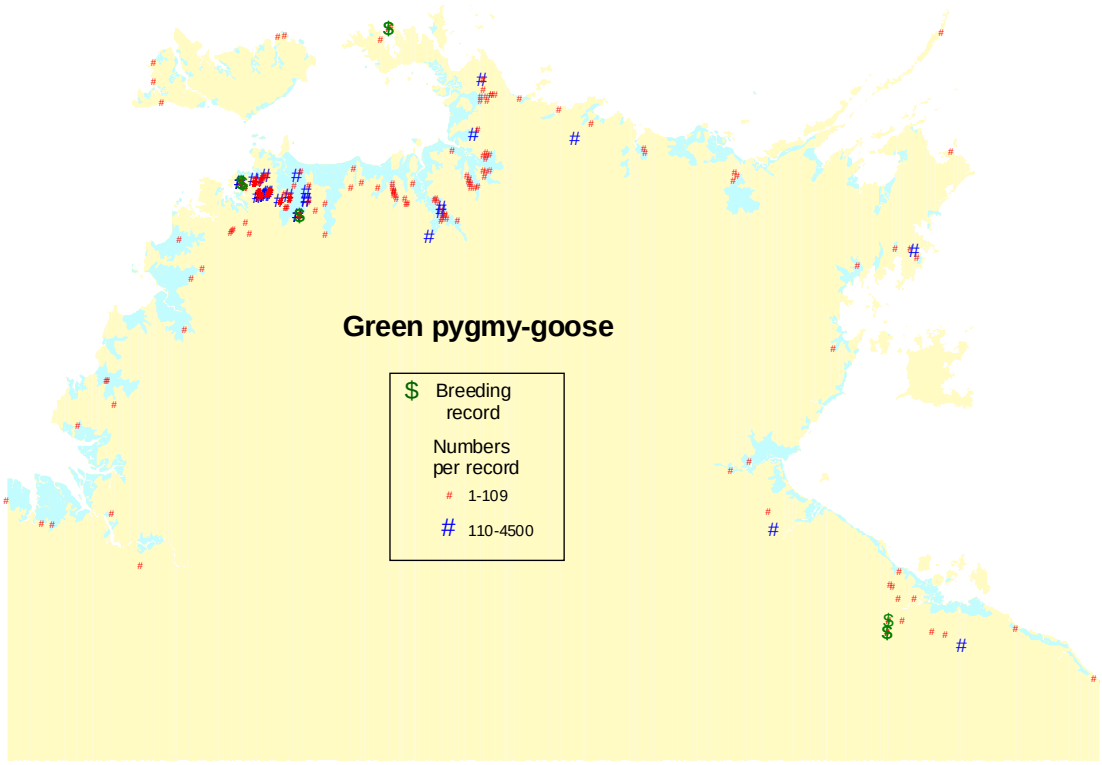

Figure 45. Distribution of all Green Pygmy-goose records.

The largest record for Green Pygmy-goose was 4 500. This count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. Other than that the largest flocks were in the vicinity of the high 300's of birds.

Seasonality

Green Pygmy-goose were recorded in all months of the year. The number of records and the numbers of birds counted was a little lower between December and April and highest between May and October but the monthly changes were relatively smaller than the other ducks so far discussed. This suggests there is not a great deal of movement out of the survey area as a whole. However, there is movement within the survey area, such as some dispersal in the wet season to smaller inland wetlands to breed and some concentrating onto the drying wetlands in the late dry. For example, Green Pygmy-goose are usually absent from suitable wetlands around Darwin from just after the onset of the first good wet season rains until the mid to late dry season.

Breeding

There were eight confirmed breeding records of Green Pygmy-goose during the surveys (Figure 45). These were all in the north west or the south east of the survey area. One wetland, Leaning Tree Lagoon, along the Arnhem Highway to the east of Darwin, was found to have a small number of pairs breeding. This was one of a number of small wetlands near Darwin that was regularly surveyed in the early 1990s but the only one to have multiple pairs breeding.

Nesting recorded throughout the survey period suggested breeding between January and July at least. These birds will often breed well away from water, which further lessened the chance of finding them breeding in my surveys. Frith and Davies (1961) record birds breeding in January and February, with ducklings dependent on lagoons from February to April.

Given their year round presence in the survey area and the un-suitability of my surveys for detecting their breeding, it is likely that Green Pygmy-goose would breed over much more of their range than recorded in this project. This is confirmed to a certain extent by records of others. F. Woerle (*pers. comm.*) for example, records small Green Pygmy-goose ducklings at various locations between Murgenella and the East Alligator River from mid February to late March in the years between 1974 and 1976, while the S.C.R.S.R. reports Fogg Dam to have significant breeding of this species. Hill (1913) also reports eggs given to him from a nest built in grass near a swamp in the Borroloola area in March were likely to be this species. He also reported several broods seen by late March in the same area.

Just outside of the survey area, McKean (1985) records this species breeding in Keep River National Park in February and March 1982. This area is adjacent the Western Australia/Northern Territory border and just south of my survey area in that region. In addition, Boekel (1980) records this species as a regular breeding visitor (April and May) in the Victoria River Downs area. This area is around 200 km south east of the south west part of my survey area. Given the relatively close proximity, in terms of waterbird movements, it is possible that further investigation of freshwater wetlands in this part of my survey area, which were not surveyed in much detail, may reveal this species breeding there as well.

R. Jaensch (*pers. comm.*) reported that he and C. Hempel recorded this species breeding at several small wetlands across the Sturt Plateau (to the south of the Top End) in May-June 2001 following a particularly good wet season.

PACIFIC BLACK DUCK

Geographic Distribution

Pacific Black Duck were recorded throughout the survey area, with concentrations of large numbers being seen at a number of places (Figure 46). As with many of the waterbirds covered in my surveys, there were more records and higher numbers in the area between the Adelaide River and Murgenella Creek but it was not quite as marked with Pacific Black Duck as it was with many of the other species. The addition of *duck spp*. records does not extend the range of this species as recorded in these surveys, even if some of those records would likely have included Pacific Black Duck.

Pacific Black Duck were found in a wide range of habitats. They were found from the small wetlands in the inland part of the survey area right through to the saline wetlands on the coast. However, they were less often found on these saline wetlands than Grey Teal, which is a species frequently associated with Pacific Black Duck. With the exception of the large Tiwi Islands and Groote Eylandt, Pacific Black Duck were not recorded on islands. However, there were some records of these ducks roosting on the coast and even sitting on the ocean just offshore.

Numbers

Pacific Black Duck were another of the more frequently recorded and abundant waterbirds observed in ground surveys. They were recorded on more occasions than other common ducks such as Grey Teal and the whistling-ducks, but Pacific Black Duck were considerably less abundant. Throughout all surveys there were 178 ground records totalling around 17 000 birds. These equate to around 2.9% of all waterbird records and around 2.8% of the total number of waterbirds counted during all ground surveys. Being relatively easy to identify from the air there were also an additional 156 records during aerial surveys. There were also 301 *duck spp.* records made during aerial surveys which could have included Pacific Black Duck.

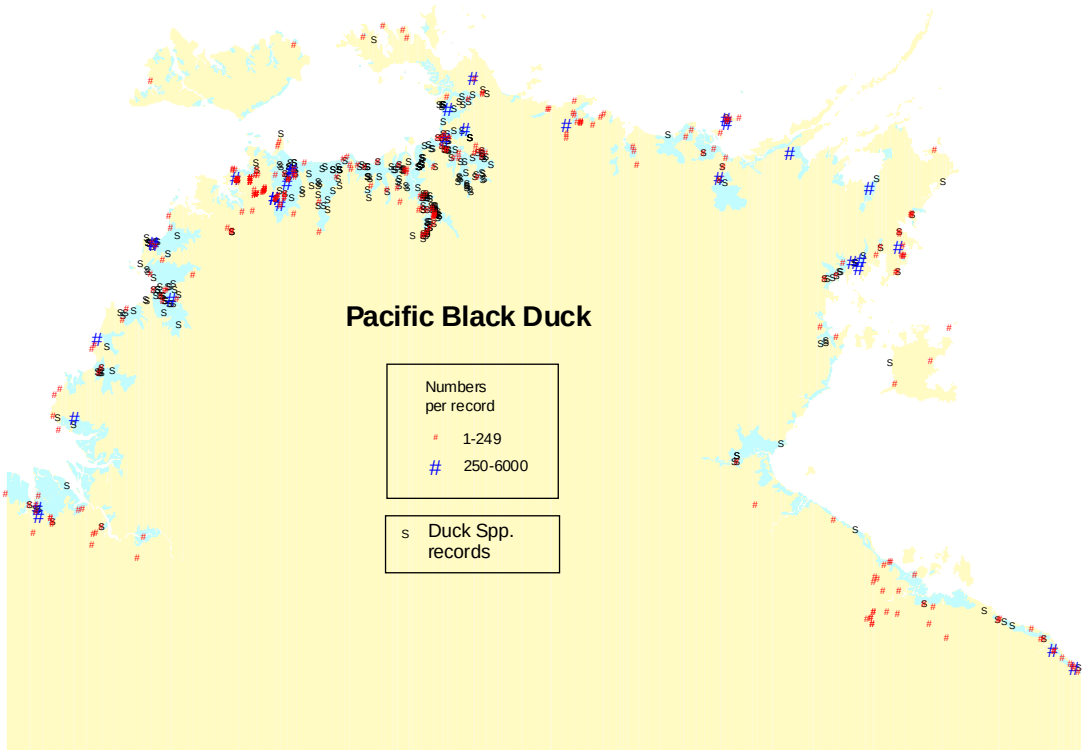

Figure 46. Distribution of all Pacific Black Duck records.

The largest individual record for Pacific Black Duck was 6 000. This count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, is discussed under the survey block 7 section of this report. The next largest flocks were around 2 000 birds. There were four separate records of counts of this size. All were in the late dry season and they were well spread within the survey area.

Seasonality

Pacific Black Duck were recorded in all months of the year. January and February had considerably fewer records, and numbers of birds per record, while the highest numbers were recorded in June through to December. The greatest numbers of birds were recorded in July and August, while the highest number of separate records was in October. This suggests that many, but not all, birds leave the survey area, especially the northern parts, following the onset of good wet season rains.

Breeding

The only confirmed Pacific Black Duck breeding records made in the survey area during the project period were made in separate surveys by R. Jaensch (*pers. comm.)*. These were only of one clutch in the far south west (in his September surveys) and a small number of clutches in the far south east (in his March surveys). However, there are a few other documented breeding records within my survey area to suggest a small percentage of birds do breed at scattered locations. Noske and Brennan (2002) suspected a nest of eggs found on Groote Eylandt in April was probably of this species, while Boekel (1976) records separate groups of duckling on May 5 and June 8 on the sewage ponds in Nhulunbuy. Frith and Hitchcock (1974) reports them breeding on Cobourg Peninsula in July, and A & E Withers *(pers. comm.)* also confirm a small percentage of the Pacific Black Duck seen on Cobourg stay to breed there. In the wetlands to the east of Darwin F. Woerle (*pers. comm.*) reports a few clutches of ducklings from January to May in the East Alligator River area in the early 1970s, while Shurcliff and McKean (1990) records ducklings, on one ocassion in Darwin. This was in the month of March.

These observations suggest that Pacific Black Duck are mostly a non-breeding nomadic visitor over most of the survey area.

Plate 11. Group of mixed ducks including Black Duck. Photo F. Woerle.

GREY TEAL

Geographic Distribution

Although not recorded quite as frequently as some of the other ducks, Grey Teal still had a broad distribution in the survey area (Figure 47). They were recorded throughout the survey area, with concentrations of large flocks being seen at a number of places in the west, north west and north east parts of the survey area. The number of records and number of birds were greater in the area between the Adelaide River and Murgenella Creek. There were also more records for this species in the south east of the survey area than other duck species, but no large flocks were recorded in this region. The addition of *duck spp*. records does not extend the range of this species as recorded in these surveys, even if some of those records would likely have included Grey Teal.

Grey Teal were found in a wide range of habitats, from small wetlands in the inland part of the survey area through to the saline wetlands on the coast. They were more frequently seen in these saline wetlands than the Pacific Black Duck, which is a species that frequently associates with Grey Teal. Grey Teal were found on a number of small islands but strangely not on the larger ones such as the Tiwi Islands or Groote Eylandt. However, it is still likely that they would visit some of these islands. Noske and Brennan (2002) recorded them as an uncommon resident on Groote Eylandt. Like Pacific Black Duck and Radjah Shelduck, Grey Teal were also recorded roosting on the coast.

Numbers

Grey Teal were recorded in high numbers at times, but their presence in the survey area was a little more erratic than most of the other ducks. They were second only to Magpie Goose in terms of the total numbers recorded in all ground surveys, but fairly well down the complete waterbird species list in terms of the number of times they were recorded. Throughout the surveys there were 121 ground records of Grey Teal totalling over 60 000 birds. These equate to around 2% of all waterbird records over

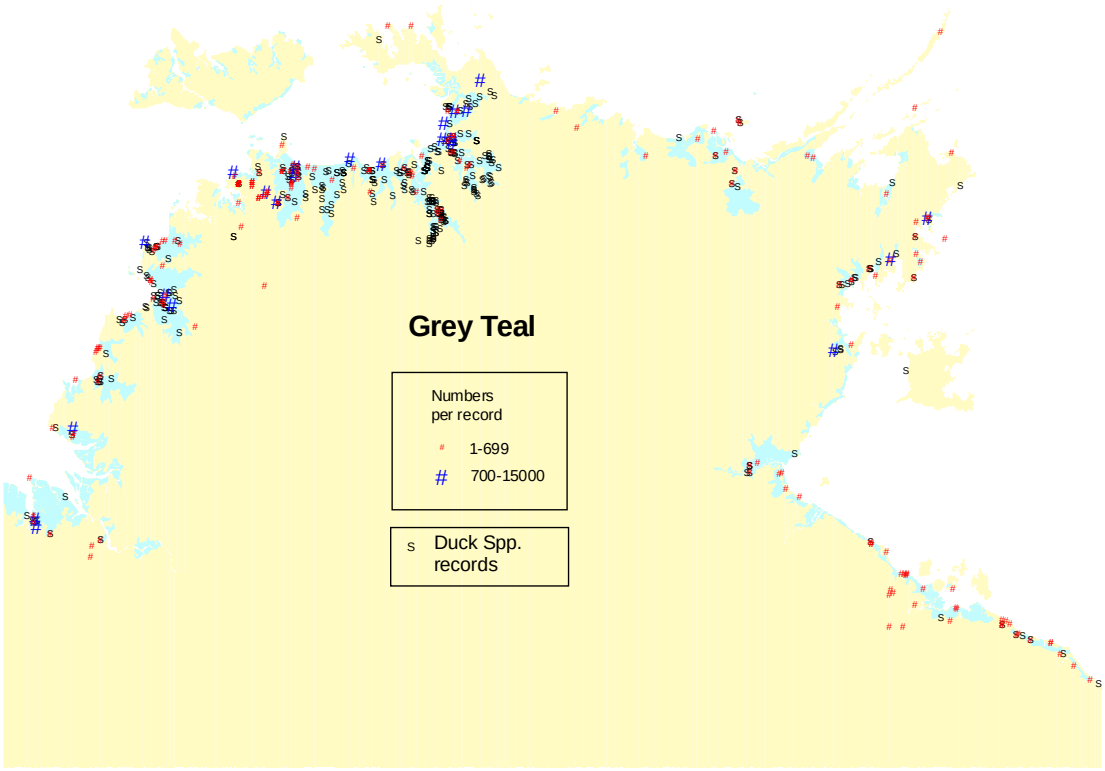

Figure 47. Distribution of all Grey Teal records.

9.9% of the total number of waterbirds counted during all ground surveys. Grey Teal were recorded a further 107 times during aerial surveys, which is about the middle of the list of all species, however, the 301 *duck spp.* records made during aerial surveys would likely increase this figure.

The largest record for Grey Teal was 15 000. This count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. Another six counts of 3 000 to 9 900 birds in a flock were made. All were on the north west and western parts of the survey area and all were in the early dry season. Four of these counts in the East Alligator to Murgenella Creek coastal wetlands in April 1992 totalled nearly 20 000 Grey Teal. These counts were from a partial survey of the area only, and it is likely that there were many more also present at this time on similar wetlands not surveyed in the area.

Seasonality

Grey Teal were recorded in all months of the year, but there were only two records for the month of January and one for February. For the rest of the year monthly Grey Teal records fluctuated up and down, with the greatest number of records being in March, May, July and October. Total numbers counted in each month is affected by the domination of the top few counts, but seems to be highest from March through to August. This suggests that Grey Teal, like Pacific Black Duck, can be found in the survey area in any month of the year, but are in their greatest numbers in the dry season. Grey Teal are also more irregular with their presence in the survey area than Pacific Black Duck. Of the approximately 84 000 Grey Teal recorded throughout all surveys, over 62% (52 000) were recorded in 1992 and 17% (14 500) in 1999. The 1992 counts may be influenced by dry conditions elsewhere in Australia at this time.

Breeding

There were no confirmed breeding records made in my surveys for Grey Teal. The only record during this period was of a clutch of nine new ducklings seen on McMinns Lagoon near Darwin on 12 May 2004, (D. Binns *pers. comm.).* Outside of this time period, Storr (1977) records the large numbers that visited the wetlands to the east of Darwin during 1957 remained to breed. Hence, it appears that Grey Teal are only a very occasional breeding species in the survey area.

Jaensch (1994) recorded them as the second most frequently observed breeding waterbird in his surveys of the sub-humid tropics just south of the Top End.

GARGANEY

Geographic Distribution

All Garganey located during these surveys were found in the north west of the survey area (Figure 48). This is where the highest numbers of most waterbird species were found but it is still possible that Garganey may occur in parts of the survey area if they were present among flocks recorded as *duck spp.* during aerial surveys. Though reasonably frequently recorded in small numbers on wetlands around Darwin during the wet season by bird observers, no other Top End references from other authors were found that recorded this species in this north west area. Jaensch (2003b) records them at only a single inland wetland in his surveys of the sub-humid tropics to the south of the Top End.

Numbers

Garganey were recorded on nine occasions totalling over 66 birds. They were only recorded during ground surveys. The largest record for this species was 20, which was recorded on two occasions in April 1992. (This coincided with the year that large numbers of Grey Teal were recorded, as discussed with the previous species). The two largest Garganey records were in the East Alligator to Murgenella Creek coastal wetlands and the Daly River wetlands. Both records were from areas where large numbers of Grey Teal were recorded in aerial surveys at the same time. It is possible that some of these Grey Teal records could have included Garganey.

Seasonality

The earliest record of this wet season migrant to the survey area was October 19 and the latest record was April 24, although with such a small number recorded these dates have limited value. The highest numbers were recorded in mid to late April, presumably just before they migrated north. Other authors record their presence in the Darwin area between October and January (Crawford, 1972) and between October and April (McCrie and Watson, 2003).

Breeding

This species is not known to breed in Australia, but do breed in Asia. R. Jaensch (*pers. comm.*) feels that the Top End is likely to be one of the principal destinations for Garganey that reach Australia, and that substantially larger numbers may occur than have been reflected in scientific survey results. This can be supported by N. McCrie (*pers. comm.*) who recorded in excess 120 birds on the Darwin Sewage Ponds in March/April 1991.

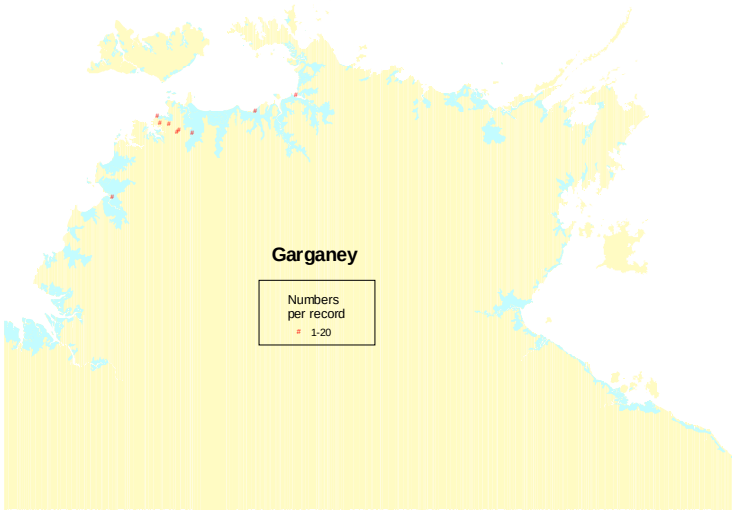

Figure 48. Distribution of all Garganey records.

PINK-EARED DUCK

Geographic Distribution

Pink-eared Duck were recorded from widely scattered locations throughout the survey area (Figure 49). Again, they were a species that was most abundant in the north west, particularly wetlands close to the coast between Darwin and Murgenella. There was also a significant flock of around 500 recorded in the far south west of the survey area. In other areas Pink-eared Duck were mainly recorded from wetlands near the coast. They were not recorded on any of the islands in my surveys, nor could I find any reference by other authors of this species being recorded on any of the islands. I did not record them on Cobourg Peninsula, but A & E Withers *(pers. comm.)* report them as occasionally present in that area.

The addition of *duck spp.* records could potentially increase the distribution of Pink-eared Duck.

Numbers

Pink-eared Duck were neither a frequently recorded nor abundant visitor to the survey area. Throughout all ground surveys there were only 20 records of Pink-eared Duck totalling over 3 900 birds. These equate to around 0.3% of all waterbird records and around 0.6% of the total number of waterbirds counted during all ground surveys. There were an additional seven records of this species, confirmed during aerial surveys. There were also 301 *duck spp.* records made during aerial surveys which could have included Pink-eared Duck.

Nearly half of the records of Pink-eared Duck were in flocks of at least 100 birds suggesting that when this nomadic bird comes into the survey area, unless they aggregate together after they arrive, they do so in reasonable sized groups rather than small groups. There were five single flock counts of in excess of 500 birds, the largest being 900. The latter record was part of that large number of waterbirds that were attracted to the Murgenella area in August 1992. This area has been mentioned on several previous occasions.

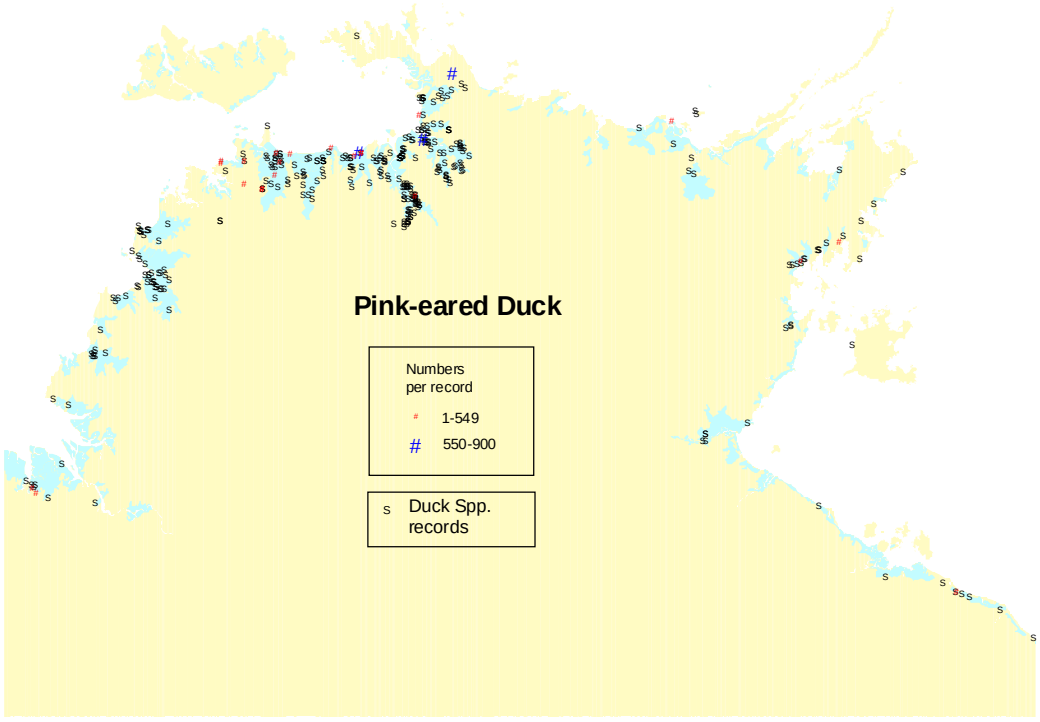

Figure 49. Distribution of all Pink-eared Duck records.

Seasonality

Pink-eared Duck were recorded in all months between April and December except September. This is supported by McCrie and Watson (2003) who reported Pink-eared Duck to be a moderate to common visitor to the Northern Territory between April and November. Numbers and records were very low in November and December suggesting few birds in the survey area from November to March, which are the main wet season months. The highest number of records and number of birds were recorded in April. It is further likely that the numbers of Pink-eared Duck visiting the survey area may vary significantly from year to year. For example, over half of the Pink-eared Duck recorded during my surveys were in the dry season of 1992. This may be partly a reflection of dry conditions elsewhere in the Northern Territory or Australia, but this would require further investigation to state confidently.

Breeding

I did not confirm Pink-eared Duck breeding during my surveys, and have only located one other reference to suggest that they may occasionally breed in the survey area. R. Stanton (*pers. comm.*) observed a clutch of ducklings on the Batchelor Sewage Ponds, about 80 km south of Darwin, in February/March 2005. However, R. Jaensch (*pers. comm.*) has observed Pink-eared Duck breeding in substantial numbers in on wetlands in the Barkly Tablelands, south of the Top End.

Plate 12. Leanyer Sewage Ponds, Darwin, a habitat sometimes used by Pink-eared Ducks.. Photo R. Chatto.

HARDHEAD

Geographic Distribution

Hardhead were recorded from widely scattered locations throughout the survey area (Figure 50). As they prefer the smaller wetlands (usually in from the coast) that were not well surveyed during my surveys, it is probable that their distribution could be more extensive than shown on the distribution map. It is also possible that the *duck spp*. records could include Hardheads, and further increase the recorded distribution.

The recently created small artificial wetlands on a housing estate and golf course near Darwin have seen this species (along with other species such as Eurasian Coot) begin to take up regular residence in the late dry season. Sometimes they are the most numerous duck present on some of these wetlands.

Hardhead were not recorded on any of the islands during these surveys. Such areas are probably only going to have occasional visits from this species, for example Groote Eylandt (Noske and Brennan, 2002) and Melville Island (Mathews, 1914). A & E Withers *(pers. comm.)* report them to be occasionally seen on Cobourg Peninsula.

Jaensch (1994) reports them as the seventh most widespread waterbird in wetlands to the south of the Top End, so they seem to prefer these inland wetlands rather than the Top End coastal wetlands of my survey area. R. Jaensch (*pers. comm.*) also suggests that some of the largest concentrations in Australia are in the temporary lakes of the tropical savannahs.

Numbers

Although recorded more frequently than Pink-eared Duck, Hardhead were still one of the less frequently recorded ducks in the survey area. Throughout all surveys there were 45 ground records of Hardhead totalling just over 4 200 birds. These equate to just over 0.7% of all waterbird records and just

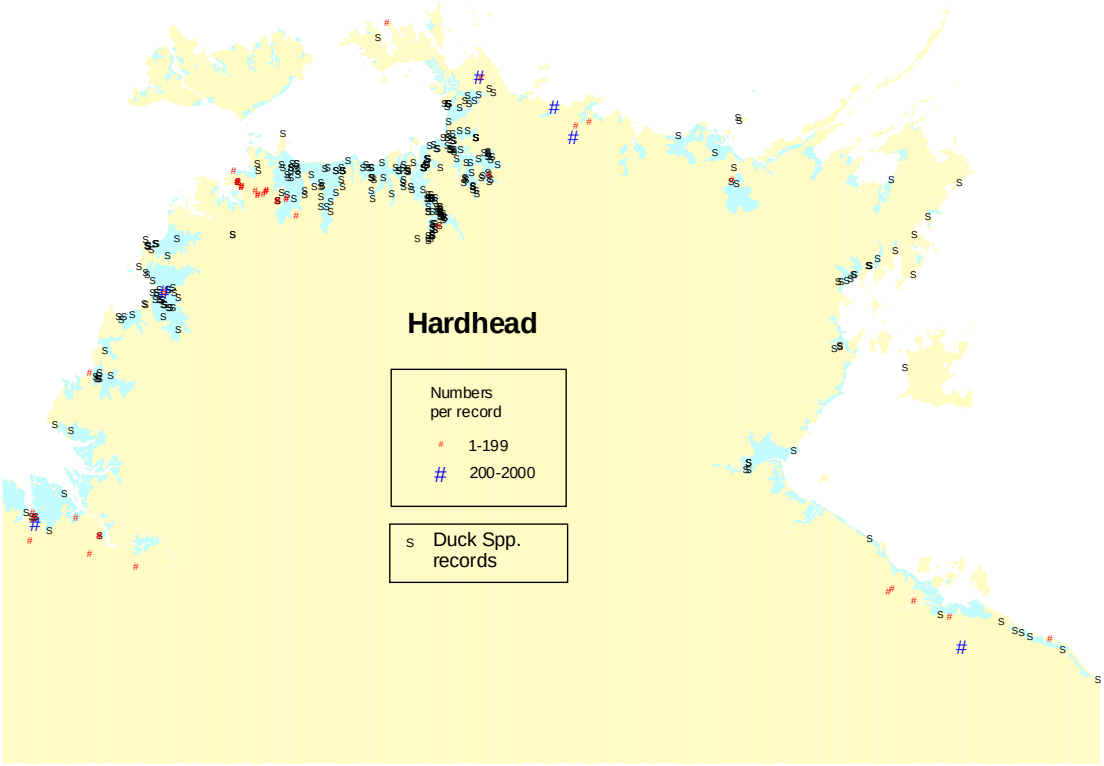

Figure 50. Distribution of all Hardhead records.

under 0.7% for the total number of waterbirds counted during all ground surveys. There were also a further eight records from aerial surveys. There were also 301 *duck spp*. records made during aerial surveys, some of which could have included Hardheads. Most records of Hardhead were in flocks of greater then 50 birds suggesting a similar situation to that referred to for Pink-eared Duck. The largest single flock count of Hardhead was around 2 000 birds. This was recorded in the far south west of the survey area in late June 1999.

Seasonality

Hardhead were recorded in all months of the year. The highest numbers were recorded between April and October and the lowest from December to February. This does suggest birds arriving in the dry season and then departing (at least in the northern parts of the survey area) at the onset of the first good wet season rains. The total number of records is not very high and did not vary greatly, so it is hard to deduce any confident seasonal pattern over the entire survey area from these records. However, this movement pattern has clearly been the case for the low hundreds of Hardhead that have commenced visiting the artificially created wetlands mentioned above near Darwin over the last few years. As further evidence of the seasonality of this species (at least in the Darwin area) Crawford (1972) records 11 out 13 records in the August to December period, while McCrie and Watson (2003) report Hardhead to be a moderate to common visitor between April and November.

Breeding

There was no confirmed breeding of Hardhead recorded during my surveys. R. Jaensch (*pers. comm.*) has observed this species breeding in substantial numbers in the Barkly wetlands south of the Top End.

Plate 13. Young Australian Grebe (see next). Photo. G. Miles.

AUSTRALIAN GREBE

Geographic Distribution

Australian Grebe were recorded from scattered locations throughout the survey area (Figure 51). Most records were concentrated in the north west, particularly the Darwin area. The reason for the latter is partly due to the higher number of ground surveys of small waterholes and wetlands (their preferred habitat) in this area. The numerous small wetlands upstream of the main floodplains in much of the remainder of the survey area were not surveyed intensely. Australian Grebe may well have been present at such sites. Consequently, the true distributional range of this species over the full survey area is likely to be more extensive than shown in the distribution map in this report. Noske and Brennan (2002) report them as an uncommon but local resident on Groote Eylandt for example, and these authors also mention others to have recorded them from mainland areas adjacent to Groote Eylandt. Australian Grebe were seen in neither of these areas during my surveys but could have been missed as the majority of surveys in this area were from the air. The distribution map in Marchant and Higgins (1990) shows them in the area (and breeding) near the northern part of Blue Mud Bay, but do not provide details in the text.

Numbers

Throughout the surveys there were 120 ground records of Australian Grebe totalling just over 1 700 birds. These equate to around 2% of all waterbird records and around 0.3% of the total number of waterbirds counted during all ground surveys. This suggests they are not very abundant in the survey area, but as mentioned above in relation to their overall distribution, they are likely to have also been under-reported in terms of their numbers as well. Not as readily seen or confirmed from the air, they were only recorded a further nine times from aerial surveys.

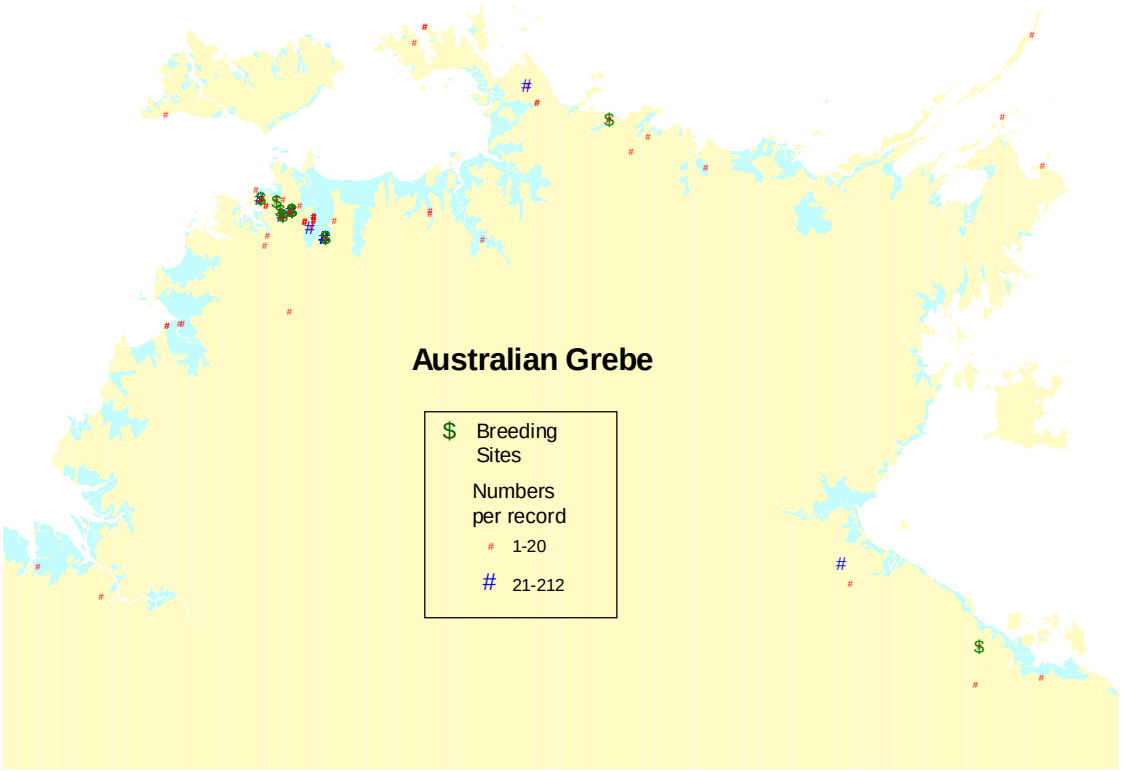

Figure 51. Distribution of all Australian Grebe records.

Australian Grebe were generally recorded in small groups. However, there were some relatively high concentrations at times on some swamps. There were five single flock counts of in excess of 100 birds, the largest being 212. This large group, along with six out of the seven next highest counts, were all recorded from the same wetland, just to the east of Darwin, in counts between May and October 1991.

Seasonality

Australian Grebe were recorded during each month of the year. However, the number of birds and the number of records were higher in the May to November dry season period. This is also supported by others, for example McCrie and Watson (2003) report them in the Darwin area from April to November, and Crawford (1972) reports them in this area from May to January. In the Alligator Rivers area Shurcliff and McKean (1990) report them as a dry season bird and in the Gove area Boekel (1976) reported them from May to October. Whether Australian Grebe disperse over the large areas of wet floodplain in the survey area during the wet season or whether most depart this sort of habitat for the many smaller inland wetlands during this time is not known for sure, but the latter is suspected.

Breeding

Australian Grebe were confirmed breeding on 11 occasions during these surveys, so if most birds do actually depart the survey area, there are at least some that remain and breed (Figure 51). These records show most breeding from February to June. However, there was one record of half grown young in late November, suggesting on occasions they may breed at other times of the year. Frith and Davies (1961) recorded clutches in the wetlands to the east of Darwin commencing in January, March and April. D. Binns (*pers. comm.*) reported a pair with three young on McMinns Lagoon near Darwin on 20 April 2004. N. McCrie (*pers. comm.*) has recorded irregular breeding at Knuckey Lagoons in Darwin, e.g. March 2005.

Apart from one breeding record in the south east and one in from the mid north coast, all of my breeding records were in the wetlands just to the east of Darwin. One wetland, Leaning Tree Lagoon, along the Arnhem Highway to the east of Darwin, regularly had a number of breeding pairs. This was one of number of small wetlands near Darwin that was regularly surveyed in the early 1990s but the only one to have multiple pairs breeding. Other reports of breeding include, Cobourg Peninsula (A & E Withers, *pers. comm.)*, eggs in a nest in January in the King River area (White, 1917), breeding on Groote Eylandt (Noske and Brennan, 2002) and eggs in February in the Borroloola area (Hill, 1913). This is not an easy species to find breeding in my surveys, so it is likely they would breed in other areas in the survey area.

Boekel (1980) also has two records (March and May) of this species breeding in the Victoria River Downs area, which is around 200 km south east of the south west part of my survey area. Given the relatively close proximity, in terms or waterbird movements, it is possible that further investigation of freshwater wetlands in this part of my survey area, which were not surveyed in much detail, may reveal this species breeding there as well.

AUSTRALIAN DARTER

Geographic Distribution

Australian Darter were recorded throughout the survey area, although parts of the south west and north east have few records (Figure 52). They were recorded from the small wetlands in the upper floodplain areas through to the saline coastal wetlands. They were also frequently recorded around the coastline, particularly where mangroves were present. In the wetlands they were often recorded with cormorants but in places around the coast they were more often on their own. Australian Darter were also recorded on most islands. They were fairly commonly recorded on Melville Island during my surveys, yet they were recorded as very rare there by Mathews (1914) in the early 1900s. Perhaps this species has increased in numbers over the years.

Records of *cormorants and/or darter spp.* would certainly contain Australian Darter, but the addition of these combined *spp.* records has little effect on the overall distributional range of Australian Darter as recorded during these surveys (Figure 52). However, the addition of these combined *spp.* records could increase the density of records.

Numbers

Throughout all surveys there were 105 ground records of Australian Darter totalling over 800 birds. The figures equate to around 1.7% of all waterbird records and around 0.1% of the total number of waterbirds counted during all ground surveys. Hence, Australian Darter were relatively infrequently recorded in ground surveys and they were even lower on the list of abundance.
There are two factors that could influence these relative figures. Firstly, many Australian Darter would have been involved in breeding colonies for part of the year, and may not have been included in ground counts. Secondly, this species is often present along creeks, rivers and deeper channels which do not generally have large aggregations of waterbirds which was often the basis for landing and doing ground counts. This latter point is reflected in the much higher relative number of times (380) Australian Darter were recorded from aerial surveys.

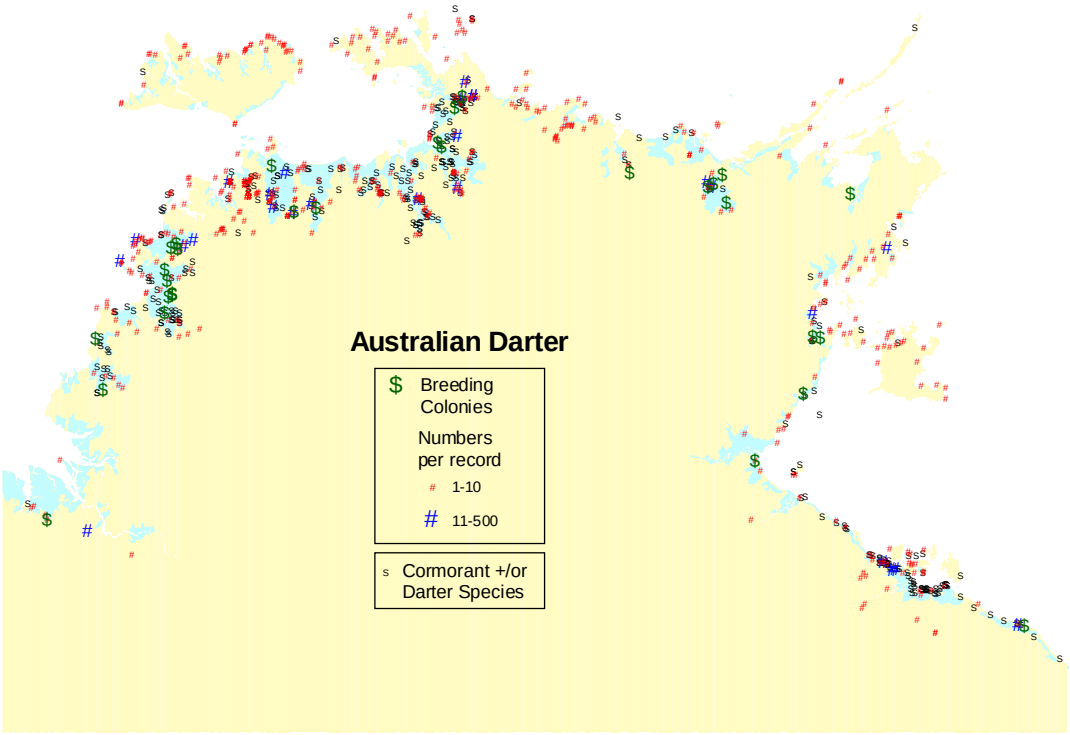

Figure 52. Distribution of all Australian Darter records.

There were also around 300 *cormorant and/or darter spp.* records totalling nearly 6 000 birds made during aerial surveys which would have included Australian Darter. Although these combined *spp.* records did not greatly change the recorded overall distribution of Australian Darter, they have the potential to influence the numbers of Darters (and/or cormorants) to a greater extent because of the large number of birds involved. Away from breeding colonies, Australian Darter were usually recorded in small groups, with only 5% of records being of more than 10 birds. The largest single record was 500. This count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. Other than this record the only other count above 75 birds was of around 300 in mid July 1995 from around the same area.

Seasonality

Australian Darter were recorded in all months of the year. There were slightly lower numbers of records and birds in the month of January, but this is likely to be due to the low survey effort. There were also slightly lower figures in May and June, but this could be explained by birds being in breeding colonies and not recorded on the database used for this report. An increase in records and numbers in July through to October could be due to the influx of fledged young into the population.

Breeding

Australian Darter were confirmed nesting in 27 colonies (Figure 52). Although there were some large Darter colonies (up to 1 600 birds) most of the colonies were smaller than 100 birds, sometimes only one or two pairs. As scattered small colonies are much harder to find than large colonies, it is likely that some such colonies were not found during the surveys. Nevertheless, the majority of the confirmed colonies are used every year and involve thousands of breeding Darters. Whether these colonies account for all the Darters using the survey area in the non-breeding season cannot be said for certain at this stage. It is possible that, even though the colonies are used every season, some birds may not breed every year. It is also possible that some birds may move out of the survey area to breed. Only future banding studies will confirm this, but at this stage it appears that at least a high percentage of Darters are a resident breeding waterbirds in the survey area.

Even though Australian Darter frequented coastal mangroves, and some breed in mixed colonies in this area, most Australian Darter breeding was in paperbarks in freshwater swamps. Confirmed colonies were spread fairly well throughout the survey area, although there were some areas where many records of non-breeding Darters suggested a colony should have been nearby but was not found. Given the small size of some ‘colonies’ of Darters this could be the case. It is also likely that small numbers of breeding Darters among other mixed species colonies, especially those with cormorants, could also have been missed. There were cormorant colonies in some of these areas where Australian Darter colonies were expected but not found.

Like most of the colonial breeding species discussed in subsequent parts of this report, the floodplains between the Daly and Finniss Rivers and between the Adelaide River and Murgenella Creek (particularly the former area) had many breeding colonies.

The breeding season for Darters was mainly between the beginning of March and the end of July, though there was a little variation either side of these dates.

LITTLE PIED CORMORANT

Geographic Distribution

Little Pied Cormorant were recorded throughout most of the survey area, though they were more frequently recorded in the extensive wetlands of the north west of the survey area (Figure 53). Little Pied Cormorant were recorded from the small wetlands in the upper floodplain areas through to the saline coastal wetlands. They were also recorded on many of the islands. They were often recorded with Australian Darter and other species of cormorants. Although they would utilize the coast in some areas, they tended to be more tied to freshwater wetlands than the Australian Darter. Even in areas where they bred in mixed species colonies in the mangroves along the coast, they usually went inland to feed.

Records of *cormorant/darter spp.* would certainly contain Little Pied Cormorant. The addition of these combined *spp.* records (Figure 53) would not increase the broad distributional range of Little Pied Cormorant as recorded during these surveys (except possibly the offshore islands off the mid east coast of the Top End but these records were more likely to be Pied Cormorant), but it would increase the density of records with the confirmed Little Pied Cormorant range.

Numbers

Little Pied Cormorant were the most frequently recorded of the cormorant/darter group in ground surveys, and second to Little Black Cormorant in terms of total numbers recorded. However, none of this cormorant/darter group rated highly compared with many other species of waterbird in terms of ground counts. Throughout all surveys there were 172 ground records of Little Pied Cormorant totalling over 1 400 birds. The figures equate to around 2.8% of all waterbird records and around 0.2% of the total number of waterbirds counted during all ground surveys. Being one of the colonial nesting species covered in this report, these figures only represent counts made away from breeding colonies.

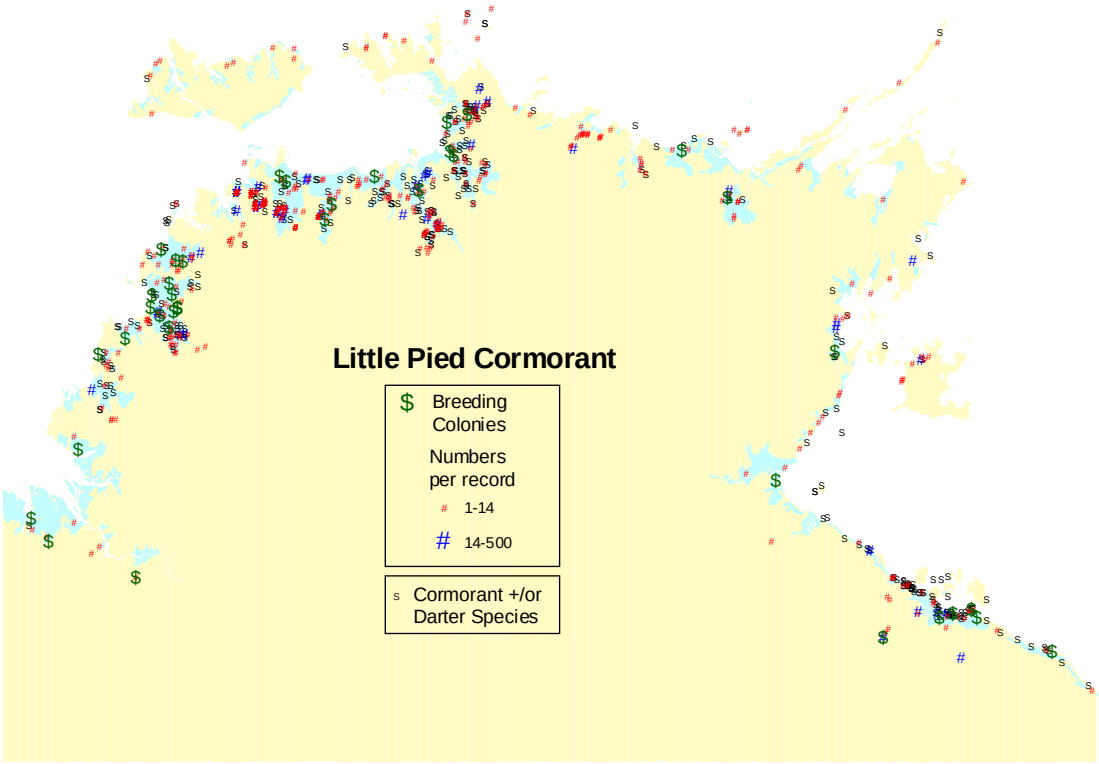

Figure 53. Distribution of all Little Pied Cormorant records.

Also influencing the ground counts of Little Pied Cormorant is the fact that this species is often present along creeks, rivers and deeper channels. These areas do not generally have large aggregations of waterbirds which was often the basis for landing and doing ground counts. There were also a further 287 confirmed Little Pied Cormorant records and over 300 *cormorant/darter spp.* records (which could have included Little Pied Cormorant) made during aerial surveys.

Away from breeding colonies, Little Pied Cormorant were usually recorded in small groups, with only 11% of records being of more than 10 birds. The largest single record was 500. This was a total count for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. Other than this record, the only other count above 100 birds was of around 300 in mid July 1995 from around the same area.

Seasonality

Little Pied Cormorant were recorded in all months of the year. There were slightly lower numbers of records and birds between December and February. This may be affected by the fewer surveys done in January compared to the other months, but it could also be due to some dispersal into small wetlands further inland of the survey area that fill up in the wet season. It is also possible that a small percentage of Little Pied Cormorant leave the survey area to breed elsewhere in summer colonies south of the Top End. Slightly fewer records and lower numbers in June could be explained by birds being in breeding colonies and not recorded on the database used for this report. An increase in the figures in July and August could be due to an influx of fledged young into the population.

Breeding

Little Pied Cormorant were confirmed nesting in 36 colonies (Figure 53). Numbers of Little Pied Cormorant in these colonies ranged in size from tens of birds through to low thousands. Most Little Pied Cormorant breed as part of mixed species waterbird colonies. Little Pied Cormorant were less likely to form 'colonies' of only a few pairs than Australian Darter so fewer colonies are likely to have been missed in the surveys. Most confirmed Little Pied Cormorant colonies are used every year and involve many thousands of birds breeding in them. Whether these colonies account for all the Little Pied Cormorant using the survey area in the non-breeding season cannot be said for certain at this stage. It is possible that, even though the colonies are used every season, some birds may not breed every year. It is also possible that some birds may move out of the survey area to breed. Only future banding studies will confirm this, but at this stage it appears at least a high percentage of Little Pied Cormorant are breeding residents in the survey area.

Little Pied Cormorant mostly bred in colonies in mangroves along the coast or rivers, or in paperbarks in freshwater swamps. Confirmed colonies were spread throughout the survey area. With the possible exception of the upstream areas of some of the rivers to the east of Darwin, Little Pied Cormorant colonies basically matched their non-breeding distribution records.

Like most of the colonial breeding species discussed in this report, the floodplains between the Daly and Finniss Rivers and between the Adelaide River and Murgenella Creek, particularly the former area, had many Little Pied Cormorant colonies. The breeding season for Little Pied Cormorant was mainly between the beginning of February and the end of June though there was a little variation either side of these dates.

Further information on the breeding of this species, including details of other reported Northern Territory breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

LITTLE BLACK CORMORANT

Geographic Distribution

Little Black Cormorant were recorded throughout most of the survey area, though not quite as extensively as the Little Pied Cormorant (Figure 54). Little Black Cormorant were also more frequently recorded in the extensive wetlands of the north west of the survey area, although the top 10% of counts were spread all along the northern and eastern coasts of the Top End. They were also recorded on many of the islands and were often recorded with Australian Darter and other species of cormorants.

Little Black Cormorant utilised coastal waters along parts of the northern coast and in the Gulf of Carpentaria but over most of the remainder of their range they were primarily freshwater wetland birds. Little Black Cormorant bred in mixed species colonies in the mangroves along the coast, but they usually went inland to feed. They were recorded from the small wetlands in the upper floodplain areas right through to the saline coastal wetlands.

Records of *cormorant/darter spp.* (Figure 54) would certainly contain Little Black Cormorant. The addition of these combined *spp.* records does not increase the broad distributional range of Little Black Cormorant as recorded during these surveys (except possibly the offshore islands off the mid east coast of the Top End but these records were more likely to be Pied Cormorant), but their inclusion may increase the density of records within the confirmed Little Black Cormorant range.

Numbers

Little Black Cormorant were not recorded as often as Little Pied Cormorant but were recorded in greater total numbers. Throughout all surveys there were 114 ground records of Little Black Cormorant totalling over 3 000 birds. The figures equate to around 1.9% of all waterbird records and around 0.5% of the total number of waterbirds counted during all ground surveys. Being one of the colonial nesting species covered in this report, these figures only represent counts made away from breeding colonies.

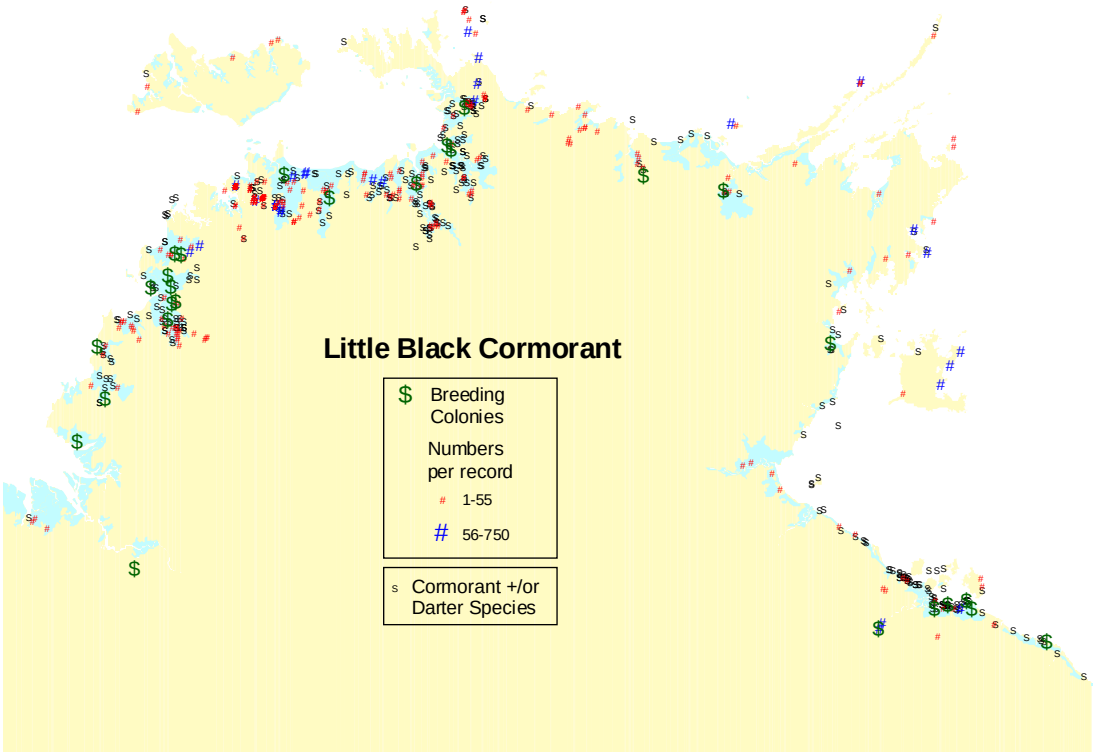

Figure 54. Distribution of all Little Black Cormorant records.

Also influencing the ground counts of Little Black Cormorant is the fact that this species is often present along creeks, rivers and deeper channels. These areas do not generally have large aggregations of waterbirds which was often the basis for landing and doing ground counts. There were also a further 157 confirmed Little Black Cormorant records and over 300 *cormorant/darter spp.* records (which could have included Little Black Cormorant) made during aerial surveys.

Away from breeding colonies, Little Black Cormorant were recorded in varying sized groups from single birds through to the largest group of 750. This was recorded on the upper Adelaide River floodplain in mid July 1995. The next highest count was 600. This was a total count for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report.

There were fewer records of non-breeding Little Black Cormorant than Little Pied Cormorant, but when recorded Little Black Cormorant were often in larger groups. The average number of birds per record for Little Black Cormorant was just over 24 while for Little Pied Cormorant it was just under seven. There were 19 records of groups of 100+ Little Black Cormorant but only four for Little Pied Cormorant.

Seasonality

Little Black Cormorant were recorded in all months of the year. There were slightly fewer records and/or birds between December and February. This may be affected by the fewer surveys done in January compared to the other months, but it could also be due to some dispersal into small wetlands further inland of the survey area that fill up in the wet season. It is also possible that a small percentage of Little Black Cormorant leave the survey area to breed elsewhere in summer colonies south of the Top End. A much lower figure in June could be explained by birds being in breeding colonies and not recorded on the database used for this report. An increase in the figures in July and October could be explained by the influx of fledged young into the population.

Breeding

Little Black Cormorant were confirmed nesting in 18 colonies, although there were nearly as many colonies again that could have included Little Blacks Cormorant observed during aerial surveys (Figure 54). Little Black Cormorant mostly bred in large mixed species waterbird colonies. Numbers of Little Black Cormorant in colonies ranged from tens of birds through to low thousands, but most were of fewer than 500 birds. Little Black Cormorant were less likely to form ‘colonies’ of only a few pairs than Australian Darter so fewer colonies are likely to have been missed in the surveys. Most confirmed Little Black Cormorant colonies are used every year and involved thousands of birds breeding in them. Whether these colonies account for all the Little Black Cormorant using the survey area in the non-breeding season cannot be said for certain at this stage. It is possible that, even though the colonies are used every season, some birds may not breed every year. It is also possible that some birds may move out of the survey area to breed. Only future banding studies will confirm such but at this stage it appears a high percentage of Little Black Cormorant are breeding residents in the survey area.

Although Little Black Cormorant were often seen in larger non-breeding flocks than Little Pied Cormorant, the reverse was generally true in relation to the size of their breeding colonies, with the exception of a couple of very large Little Black Cormorant colonies. The overall higher numbers of non-breeding Little Back Cormorant to Little Pied Cormorant and the reverse regarding numbers of breeding birds recorded for each species may indicate some/more Little Black Cormorant leave the survey area to breed than Little Pied Cormorant. Again, this would need to be confirmed by banding/tracking projects.

Most Little Black Cormorant bred in colonies in mangroves along the coast or rivers, or in paperbarks in freshwater swamps. Larger colonies tend to be in the latter habitat. Confirmed colonies were spread

fairly well throughout the survey area, and matching of colony location with non-breeding records was reasonable for most, but not all, areas. The possibility of a colony existing in the north east Arnhem Land area, particularly to the north of Blue Mud Bay is again suggested with Little Black Cormorant. Also the number of colonies compared to the number of non-breeding records in the far south west might indicate that birds may be coming from outside of the survey area to breed at these sites.

The floodplains between the Daly and Finniss Rivers and between the Adelaide River and Murgenella Creek, particularly the former area, had large numbers of Little Black Cormorant colonies.

The breeding season for Little Black Cormorant was mainly between the beginning of February and the end of June. This tended to be about a month later on average compared to Little Pied Cormorant.

Further information on the breeding of this species, including details of other reported NT breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

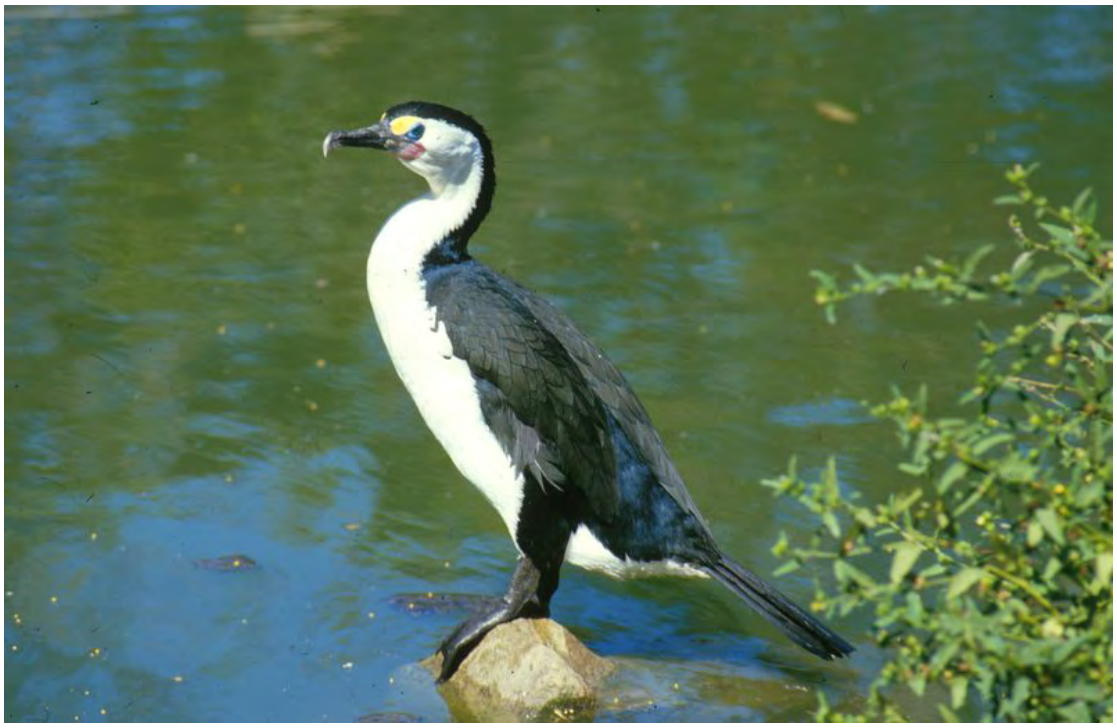

Plate 14. Pied Cormorant (see over). Photo. F. Woerle.

PIED CORMORANT

Geographic Distribution

Although Pied Cormorant were recorded throughout most of the survey area (with the exception of the far south west) the majority of the larger groups were recorded in the south east (Figure 55). All but two of the top 10% of the records by numbers were along the coast and offshore islands in this area. With the exception of birds found on the bigger floodplains, Pied Cormorant were predominantly a coastal and inshore marine waters bird.

The addition of *cormorant/darter spp.* records would certainly increase the potential range of Pied Cormorant (Figure 55). However, as any extension outside of the confirmed Pied Cormorant range is predominantly on inland wetlands, particularly in the north west, it is probable that most of these *spp.* records are of the other cormorant/darter species.

Numbers

Away from breeding colonies, Pied Cormorant were one of the less frequently recorded and abundant waterbirds in ground surveys. There were only 29 ground records of Pied Cormorant totalling around 400 birds. The figures equate to around 0.5% of all waterbird records and around 0.1% of the total number of waterbirds counted during all ground surveys. Being one of the colonial nesting species covered in this report, these figures only represent counts made away from breeding colonies. Pied Cormorant are another of the species that, because of their distribution, were probably not well represented by ground counts alone. Being spread around the coast and more prone to feed offshore than the other cormorants they were much more frequently recorded from aerial surveys. There were a further 301 records from aerial surveys, putting them in the top 20 waterbirds in term of total number of aerial records. There were also a further 300 *cormorant/darter spp.* records (which could have included Pied Cormorant) made during aerial surveys.

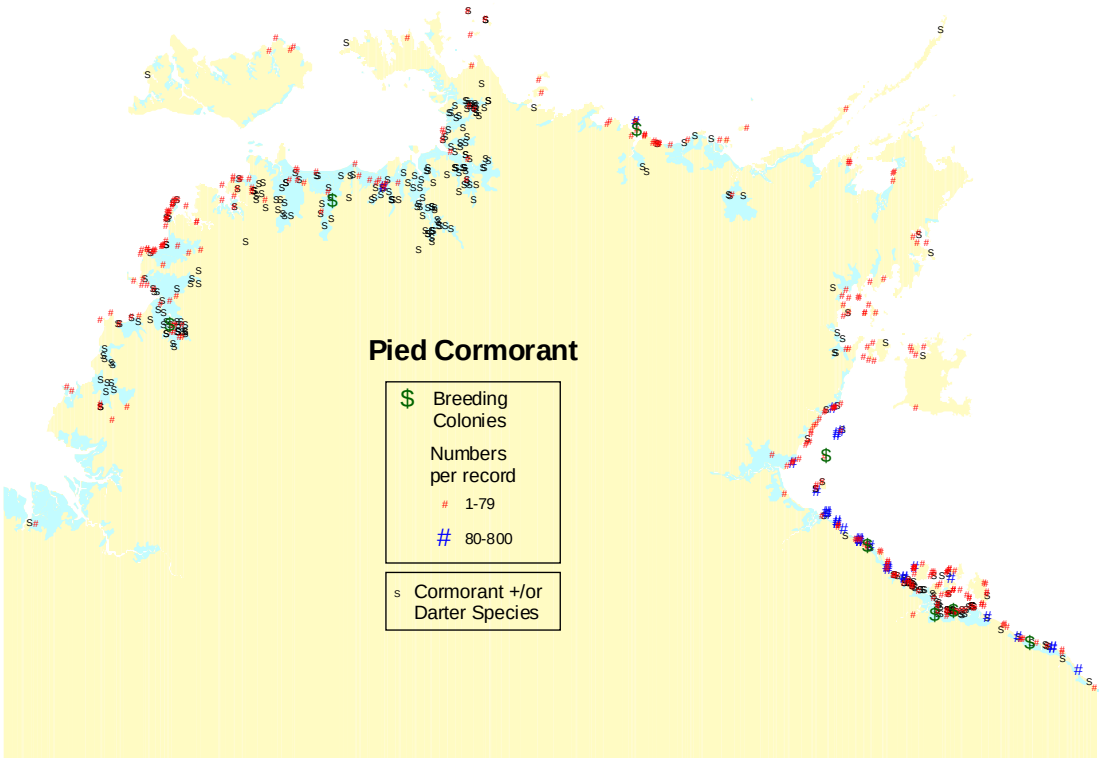

Figure 55. Distribution of all Pied Cormorant records.

Away from breeding colonies, Pied Cormorant were recorded in group sizes ranging from single birds to 800. This record, along with nearly all the large flocks, was recorded in the south east. It was recorded in mid December (1998), but other large records in this area were made in all months of the year.

Seasonality

Pied Cormorant were recorded in all months of the year, suggesting that at least some of the population remains in the survey area all year. Figures for total counts do vary a bit between the months, but this is more likely to be influenced by whether the south east of the survey area was surveyed or not in the different months. This is where most of the survey area's Pied Cormorant reside. A lower number of records in January and August probably reflects a lack of surveying in the main Pied Cormorant locations.

Breeding

Pied Cormorant were confirmed nesting in only eight colonies (Figure 55). However, it is possible Pied Cormorant may have been missed among mixed species colonies involving Little Pied Cormorant. Four of the eight Pied Cormorant breeding sites involved them breeding with Little Pied Cormorant, while at the other four sites, Pied Cormorant bred on their own. All Pied Cormorant colonies supported fewer than 400 birds except one colony. This colony, in mangroves on the coast between the Limmen Bight River and Port McArthur in the south east, supported the majority of the Pied Cormorant breeding located in the survey area. With at least 5 000 birds breeding in the colony, it is obviously attracting birds from throughout the south east. It may well be attracting birds from much further afield given the small number of colonies located and the wide distribution (though mostly of small numbers of Pied Cormorant) in the survey area. The regularity of use of mixed species colonies by Pied Cormorant is not known, but the single species breeding sites were active each in year that they were checked.

Pied Cormorant were the only species of colonial breeding waterbird to breed on islands. Pied Cormorant regularly bred in a colony on Haul Round Island off Maningrida and on Low Rock, a small island about 30 km offshore from the coast in the vicinity of the Roper River mouth. They were also formerly recorded breeding on a small island in Darwin Harbour (J. McKean, *pers. comm.*). They had stopped breeding there prior to the commencement of my surveys in the early 1990s and the island no longer exists, being incorporated into Darwin Harbour's East Arm Port development in the late 1990s.

The distribution of confirmed Pied Cormorant colonies does not fit well with the distribution of the non-breeding records. As well as the possibility of birds moving over to the large colony in the south east to breed as mentioned above, it is also possible that more Pied Cormorant breeding could have occurred among Little Pied Cormorant breeding sites. It is further possible that other small colonies, either on small islands or in coastal mangroves, may have been missed during the surveys. The colony that was formerly in Darwin Harbour, as mentioned above, was only of a few pairs and was also not used every year.

Further information on the breeding of this species, including details of other reported NT breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

AUSTRALIAN PELICAN

Geographic Distribution

Australian Pelican were regularly recorded throughout the survey area (Figure 56). They were recorded in all areas from the upper reaches of the major floodplains and inland swamps though to the coast and around offshore islands. They were also recorded around 70 km north of the central Arnhem Land coast on at least two occasions during the 2003/04 wet season and 15 km north of the Melville Island coast in February 2005 (Coast Watch, post-flight reports). Although Coast Watch do not mention if they were flying or feeding, the records, particularly the former, may suggest movement between Australia and countries to the north.

The top 10% of records in terms of numbers were spread throughout the distributional range of Australian Pelican recorded in these surveys, except for the far south west and north east.

Numbers

Australian Pelican were reasonably frequently recorded during ground surveys. In terms of the highest to lowest list of all waterbirds recorded in ground surveys, Australian Pelican were about the middle of both the number of records and total numbers. Throughout all surveys there were 101 ground records of Australian Pelican totalling around 5 200 birds. The figures equate to around 1.7% of all waterbird records and around 0.9% of the total number of waterbirds counted during all ground surveys. Being one of the colonial nesting species covered in this report, these figures only represent counts made away from the one breeding colony on the west coast. Being easily seen and identified Australian Pelican were much more frequently recorded from the aerial surveys. They were recorded 608 times from the air.

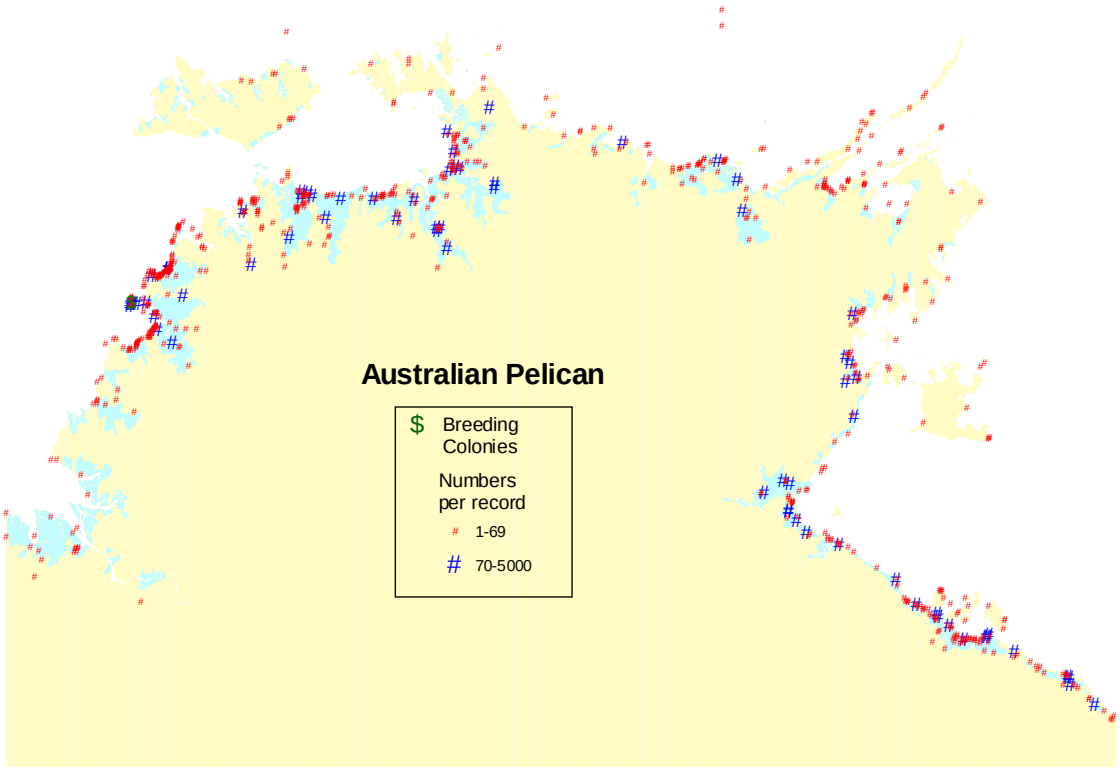

Figure 56. Distribution of all Australian Pelican records.

Away from breeding colonies, Australian Pelican were recorded in groups from lone birds through to groups of around 1 000, but the majority of records were of flocks of less than 50. There was also one record of exceptionally high numbers for the survey area (other than associated with the breeding colony discussed below). This was a count of 5 000 birds over a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report.

Seasonality

Australian Pelican were recorded fairly consistently in each month of the year, although there were slightly lower numbers in January and February. This may result from fewer surveys in January, and wet season dispersal to the inland. Morton *et. al*. (1991) found the large numbers of Australian Pelican present in the dry season on the Alligator Rivers wetlands to the east of Darwin were largely absent in the wet season.

Breeding

Australian Pelican were recorded breeding in only one colony during the surveys. This was a large colony (up to 2 500 pairs) on North Perron Island off the west coast of the Top End. This colony was used in most dry seasons and involved low thousands of birds on most occasions. This colony is further documented in the first report in this series which deals with colonial nesting waterbirds in the survey area (Chatto, 2000b) and also in Chatto (1995).

The numbers of Australian Pelican using the survey area is much greater than then numbers using this colony, and so many birds must breed outside the survey region. This movement may be to colonies that breed on inland sites which are used irregularly depending on rainfall. One such colony that may draw birds from the survey area is on Lake Tarrabool in the Barkly Tablelands, south of the Top End. This colony was active between May and September in 1993 and involved 5 000 pairs (Jaensch, 1994).

Plate 15. Pelican colony on North Perron Island, May 1995. Photo R. Chatto.

WHITE-FACED HERON

Geographic Distribution

White-faced Heron were recorded throughout the survey area (Figure 57). They were seen in all habitats, from the upstream wetlands, around the edges of the larger floodplains and through to coastal wetlands, including the mangroves and on the beaches. There seemed to be some movement towards the coast and coastal wetlands for this species during the dry season, particularly in the south east.

The distribution of the largest groups was near the coast in the south east and along the west coast of the survey area. They were recorded on many of the islands, both large and small.

Numbers

Throughout all surveys there were 97 ground records of White-faced Heron totalling 340 birds. These equate to around 1.6% of all waterbird records but under 0.1% of the total number of waterbirds counted during all ground surveys. White-faced Heron were, coincidentally, recorded the same number of times from all ground surveys as White-necked Heron. White-necked Heron were slightly more abundant in these ground surveys, but neither species were among the most frequently recorded or abundant of all waterbirds. These figures would be influenced by most individuals of both species leaving the survey area over the wet season. Also none of the larger counts of White-faced Heron from the coastal influx to the south east of the survey area were represented in ground counts.
Relatively easy to see and identify from the air, White-faced Heron were recorded a further 289 times from aerial surveys. This is considerably higher than the 157 aerial records of the similarly easily identifiable White-necked Heron. If the total counts from aerial surveys of the two species are considered, White-faced Heron reverse the ground count situation, being over four times that of White-necked Heron.

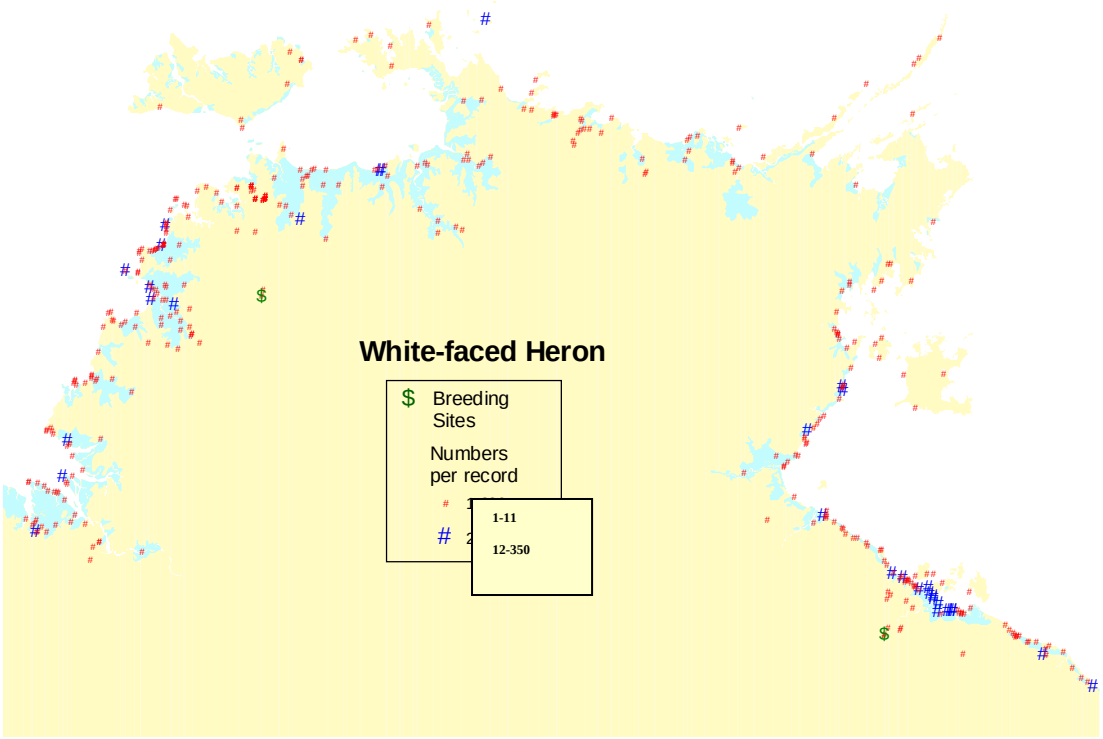

Figure 57. Distribution of all White-faced Heron records.

The majority of records of White-faced Heron were of small groups. Eighty percent of the records were of 5 birds or fewer. Nevertheless, there were also some very large groups of White-faced Heron recorded, with four records of between 100 and 350 birds. These were all in the far south east of the survey area during the dry season where large numbers of White-faced Heron are seen in the mangroves along the coast.

Seasonality

White-faced Heron were recorded in all months of the year. The number of records began to increase markedly in March but this may have been influenced by the increased survey effort related to the annual Magpie-goose aerial surveys in the north west. Most of the records for the months of March and April were of single birds and it was in May that the numbers of birds and the number of birds per record began to rise sharply. Both the number of records and the total number of birds then dropped markedly in December and stayed low through January and February, suggesting departure of most, but not all, from the survey area.

Breeding

White-faced Heron appear to be another of the species of waterbirds that have a small percentage of their numbers remaining in the survey area to breed, with the majority leaving. Although my surveys were not particularly good at targeting single nesting birds, the nests of this species, usually being stick nests in trees, are more easily located than the hidden nests of ground nesting birds. Hence, if a reasonable percentage of the large numbers of White-faced Heron present in the dry season remained to breed in the survey area then it is likely that some of these nests would have been seen, particularly while birds were sitting on them. No breeding records were made for White-faced Heron during the surveys. This also included extensive checks among the many waterbird breeding colonies that were well surveyed during the period of the project. However, there are scattered records of this species breeding in the survey area.

There were two breeding records that I was aware of during the survey period. One was reported by N. McCrie (*pers. comm.)* in an electricity tower along the Stuart Highway near the Adelaide River township in April 2003. The other was reported in late March by R. Jaensch (*pers. comm.)* in the far south east of the survey area. Other authors record some breeding of this species prior to my surveys. Frith and Davies (1961) recorded several nests found in the wetlands to the east of Darwin during the month of January (1957), Shurcliff and McKean (1990) report a few nests in the Alligator Rivers area and A & E Withers *(pers. comm.)* reports single nests seen in mid December on Cobourg Peninsula. Hill (1913) reported eggs at an advanced stage of incubation on 30 December (1911) from a nest in the topmost branches of a dead Eucalyptus tree in the Borroloola area.

Outside of my survey area Boekel (1980) has two records (April and May) of this species breeding in the Victoria River Downs area, about 200 km south east of the south west part of my survey area. Given the relatively close proximity, in terms or waterbird movements, it is possible that further investigation of freshwater wetlands in this part of my survey area, which were not surveyed in much detail, may reveal this species breeding there as well.

LITTLE EGRET

Geographic Distribution

The egrets are one of the most widespread groups of waterbirds in the survey area. Confirmed records of all individual species (with the exception of Cattle Egret in the east) were also very widespread. Little Egret were regularly recorded throughout the survey area (Figure 58). As with all egret species detailed in this report, the number of Little Egret records shown on this map is much lower than is actually the case. In aerial surveys the vast majority of egrets were recorded as *egret spp.* (Figure 58). Many of this large number of *egret spp.* records would include Little Egret. This would extend both the overall distribution of Little Egret within the survey area, and even more so, the density of records within the current confirmed area of Little Egret records.

The top 10% of records in terms of the largest group counts were also fairly well spread, but seemed to be concentrated in certain areas, particularly the wetlands to the east of Darwin.

Little Egret were recorded throughout all habitats within the survey area. These included smaller inland wetlands, through the large freshwater floodplains and saline coastal wetlands, and onto the coast. Like Great Egret (but unlike Intermediate and Cattle Egret) Little Egret were also frequently seen on the coast and islands. On the coast, Little Egret were more commonly seen at creek or inlet mouths or in areas where extensive intertidal zones were exposed at low tide. On freshwater wetlands Little Egret were more likely than the other egrets to concentrate in groups around channels (particularly running water) and on open water, especially when drying and exposing prey. In areas where all four egret species were present they would often mix with the other egret species.

Numbers

Not only are the egrets, as a combined group, one of the most frequently recorded resident waterbirds in the survey area, they are also among the most abundant. However, they do not form the large dense flocks of the other highly abundant waterbirds. Individually, each of the four species is also very abundant, though Little Egret (and Great Egret) are less abundant than either of the other two species (Intermediate and Cattle Egret). Throughout all surveys there were 241 ground records of Little Egret totalling over 8 200 birds. The figures equate to around 4% of all waterbird records and around 1.4% of the total number of waterbirds counted during all ground surveys. Even though Little Egret are one of the colonial nesting species and therefore only counted away from breeding colonies, they were still the sixth most frequently recorded waterbird in ground surveys. They were not one of the most abundant in these surveys, however the relatively low percentage of total numbers of Little Egret recorded in ground surveys is not a true reflection of the comparative abundance of this species. Being one of the species dispersed at lower densities over large areas meant that they were not well represented in ground counts which largely targeted high density aggregations of waterbirds. Hence their numbers and range may be considerably increased when the 8317 *egret spp.* (most of which were aerial records) made during aerial surveys are considered. The number of aerial records for *egret spp.* (without adding the individual species records) is nearly four times that of Magpie Goose, the next most frequently recorded waterbird. The total number of *egret spp.* counted in aerial surveys is second only to Magpie Goose. Given the difficulty of separating Little Egret from other egrets in aerial surveys, there were only 201 aerial records of this species.

Numbers of Little Egret associated with breeding colonies are detailed in Chatto (2000b). Away from breeding colonies, Little Egret were recorded in flocks of all sizes from single birds to the largest group of 630. This record, in May 1993, was on the coastal, saline Adelaide River wetlands. The next largest single record, of 500 in August 1995, was also made in this area. Even though Little Egret were recorded in some quite large groups, the majority of the records were of small groups. More than 75% of Little Egret records were of less than 10 birds.

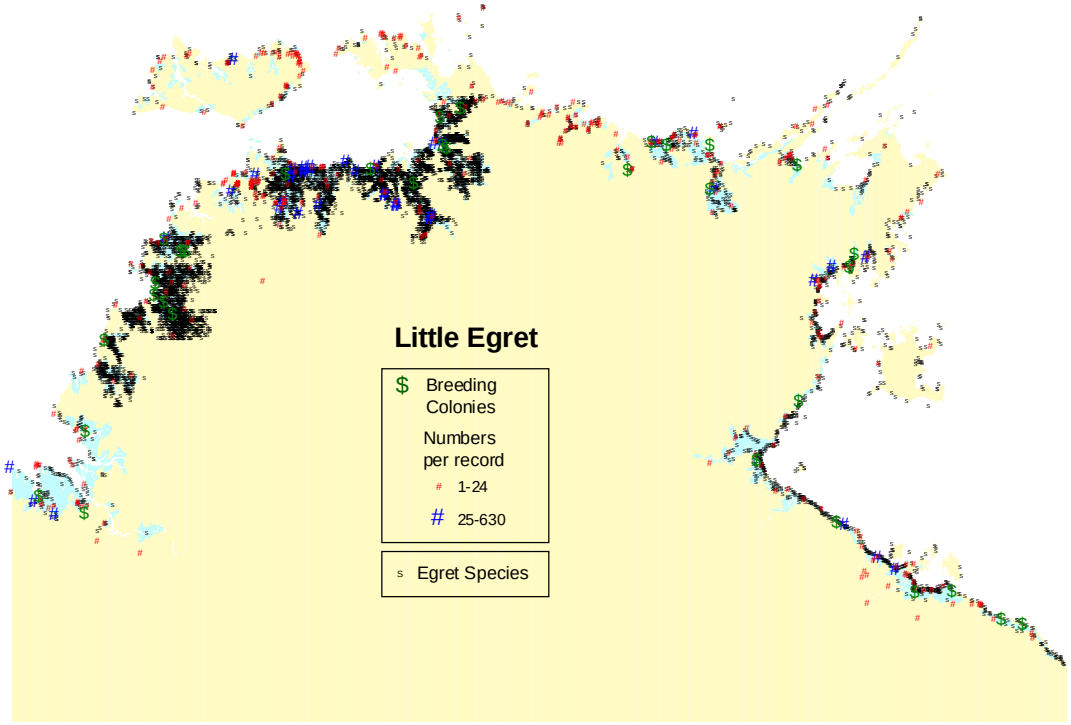

Figure 58. Distribution of all Little Egret records.

Seasonality

Little Egret were recorded in all months of the year. There is no indication from the monthly total numbers to suggest any major departure of Little Egret from the survey area at any stage of the year. This conclusion is also supported by the large numbers seen in breeding colonies within the survey area. This is also the case with the *egret spp.* records, but with four species involved it is not possible to confidently speak of any one species from these particular records. There were fewer Little Egret in total counts for the months of January and February. This would have been influenced by many birds being in breeding colonies and not counted in the survey data used for this report.

Breeding

Little Egret were always recorded breeding in mixed species waterbird colonies, which were often numerically dominated by egrets. Little Egret were confirmed breeding in 26 out of 34 colonies involving egrets (Figure 58). Little Egret were also likely to have been present in most of the eight colonies where they were not actually confirmed breeding. The majority of these colonies are used every year and have many thousands of Little Egret breeding in them. There was no indication from these surveys that large numbers of Little Egret left the survey area to breed but it is possible that some individuals may not breed every season. Neither of these points can be confirmed until banding/tracking studies are done.

The vast majority of Little Egret colonies were in mangroves along the coast or rivers. There was little breeding in paperbark trees on the freshwater floodplains where a number of other species of colonial nesting waterbirds often bred. Colonies in which Little Egret bred were recorded throughout the survey area and seemed to provide a good spread to cover the non-breeding records of Little Egret made during these surveys. The breeding season for Little Egret was mainly between the beginning of January and the end of May. Egret breeding seasons were fairly similar in timing each year and there was less variation in timing for egret breeding than for other colonial breeding waterbirds such as cormorants and ibis.

WHITE-NECKED HERON

Geographic Distribution

Although not quite as widely distributed as the White-faced Heron, the White-necked Heron was still recorded throughout most of the survey area (Figure 59). Records of the largest 10% of individual counts were well spread throughout this overall distribution. The White-necked Heron preferred the inland freshwater wetlands and was rarely observed in the more saline wetlands near the coast which were often frequented by White-faced Heron. White-necked Heron were not recorded on any of the islands in these surveys. Their presence there is likely to be occasional and only on the larger islands. For example Noske and Brennan (2002) reports them as a rare dry season visitor on Groote Eylandt. They were also not recorded on Cobourg Peninsula during my surveys but A & E Withers *(pers. comm.)* reports small numbers occasionally visit that area.

Numbers

White-necked Heron were neither one of the more frequently recorded nor abundant waterbirds in these surveys. However, the absence of most White-necked Heron from the survey area over the wet season would influence any comparisons with species present in the survey area for the entire year. Throughout all surveys there were 97 ground records of White-necked Heron totalling 435 birds. These equate to around 1.6% of all waterbird records but under 0.1% of the total number of waterbirds counted during all ground surveys. Another of the species easily seen and identified from the air, there were a further 157 records from aerial surveys.

They majority of White-necked Heron records were of small groups. Less than 10% of the records were of more than 10 birds, and the largest record was 40 birds. The average number of birds per record was around 4.

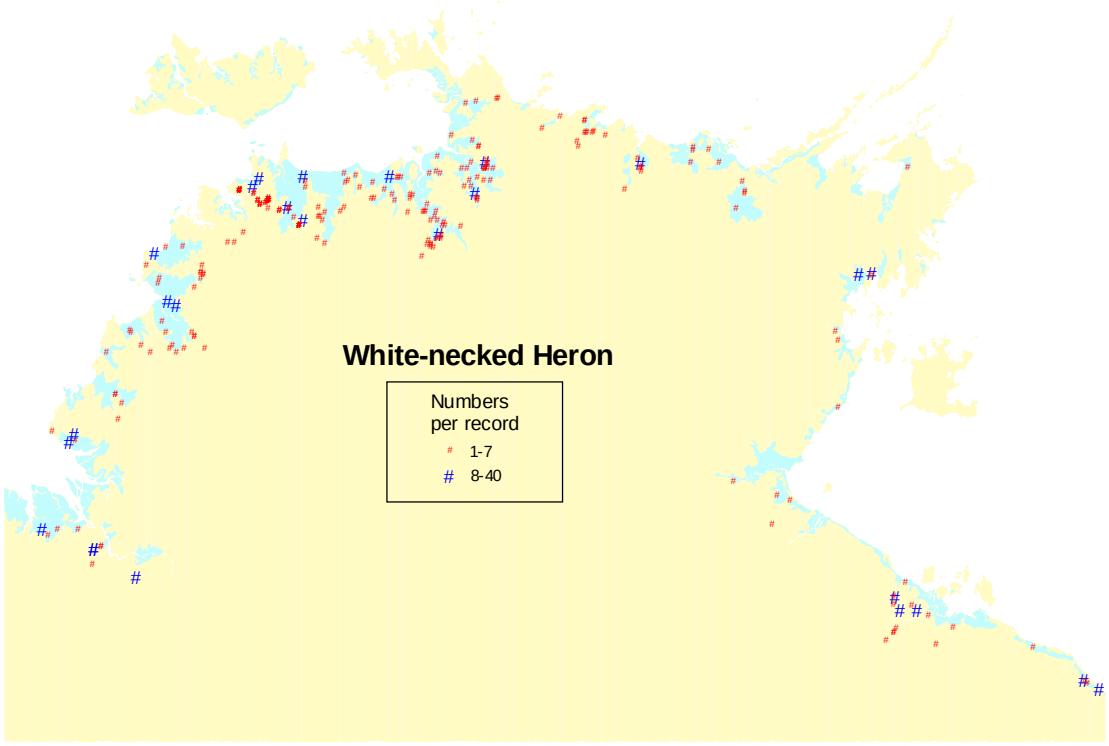

Figure 59. Distribution of all White-necked Heron records.

Seasonality

The seasonal presence in the survey area for this species was similar to that of White-faced Heron. White-necked Heron were recorded in all months except January and December. With the number of birds recorded in February and November being low compared to the other months, this species, like the White-faced Heron, was more frequently recorded in the survey area during the dry season. There were also a very high number of records for this species in the month of April. This could be due to the large number of surveys done on the floodplains of the north west during the annual Magpie Goose surveys, but could also be indicating birds arriving into the area after breeding further south of the survey area. A lower number of birds and records in September is also more likely to be due to survey biases rather than a sudden short term exodus of this species from the survey area. The need to do more coastal surveying because of emphasis on other species in this project in this month meant that inland wetlands were not as well covered. Species such as White-necked Heron which rarely venture to the coast were less likely to be reported than White-faced Heron that utilize coastal and freshwater wetlands.

Breeding

No breeding records were confirmed for White-necked Heron during my surveys. The lack of other reports suggests this species is even less likely than the White-faced Heron to remain in the survey area to breed. The only record of White-necked Heron breeding in the survey area is a single pair in the wetlands to the east of Darwin in the month of January (Frith and Davies, 1961). As this species nests in a similar fashion to the White-faced Heron it is unlikely that significant numbers of this species nesting in the survey area would have been missed during my surveys.

R. Jaensch (*pers. comm.*) has observed this species breeding in substantial numbers in the Barkly wetlands south of the Top End.

Plate 16. White-faced Heron (see previous species). Photo. F. Woerle.

GREAT-BILLED HERON

Geographic Distribution

Great-billed Heron were recorded throughout most of the coast and coastal wetlands of the survey area (Figure 60). They were also recorded on a number of islands. Here Great-billed Heron were primarily associated with mangrove areas. They were not recorded on Groote Eylandt in my surveys but Noske and Brennan (2002) report them as a rare visitor. They were not recorded far from the coast during my surveys but this species is also sometimes seen on inland freshwater systems of larger rivers not covered in these surveys eg Katherine Gorge (Chatto, *pers. obs.*).

Numbers

Great-billed Heron were one of the less frequently recorded waterbirds during the surveys. Throughout all surveys there were only 21 ground records of Great-billed Heron totalling only 28 birds. These equate to around 0.3% of records but well under 0.1% of total numbers of waterbirds counted during the surveys.

Great-billed Heron were recorded on 106 occasions from aerial surveys. It is possible that a few Great-billed Heron may have been mixed in with grey Eastern Reef Egret records from these aerial surveys, but this would not be many, and hence Great-billed Heron are in relatively low abundance in the survey area. The majority of records were of single birds, occasionally two and rarely three. As such, and not often being found with other large groups of waterbirds (which was often the reason for landing and doing ground counts) most of the Great-billed Heron recorded were from aerial surveys.

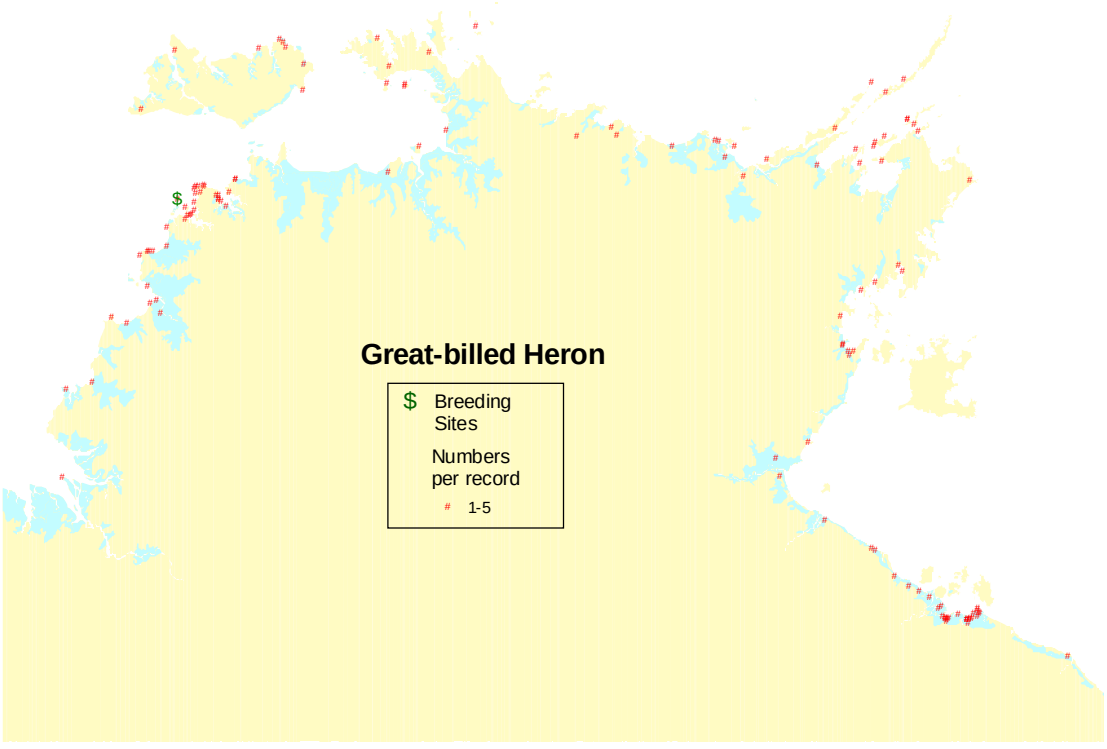

Figure 60. Distribution of all Great-billed Heron records.

Seasonality

Great-billed Heron were recorded in every month of the year. There were more records in the separate months of March and May, with lower numbers in the months either side of each of these two months. There was a small increase in the number of birds seen from September through to November. With the relatively small number of records for this species, these changes are difficult to confidently explain. However, a lack of any relatively large pattern of increase and decrease in numbers suggests that there appears to be no obvious seasonal movements into or out of the survey area. A possible explanation for the number changes recorded in the March to May period can perhaps be related to breeding, if, as suggested below from these surveys, Great-billed Heron nest around April/May. Birds preparing to nest in March would be more readily seen (due to courting, collecting nest material etc.), but as they nest under the mangroves in single nest situations, sitting birds would have been difficult to see in April. Then as young hatched and adults began feeding birds would have become more obvious again in May. The subsequent increase a little later in the year could then have been due to young birds entering the population.

Breeding

Great-billed Heron were not confirmed as breeding during my surveys, but aerial observations in May 1994 suggested possible breeding in extensive network of mangrove-lined creeks and channels in the McArthur River area in the south east of the survey area. This is supported by White (1917) who reports a fully-fledged young bird on a nest in this area in early July 1915, and T. Hertog (*pers. comm.*) who observed an adult on a nest in May 1981 at the junction of the Mary and McKinley Rivers, which is also within my survey area. Other authors suggest this species breeds in December (Frith and Davies, 1961), December and January (Storr, 1977) and October to February (Goodfellow and Scott, 2001). Frith and Hitchcock (1974) found what they thought was a Great-billed Heron nest on Cobourg Peninsula but do not say when.

Plate 17. Juvenile Pied Heron (see over). Photo G. Miles.

PIED HERON

Geographic Distribution

Pied Heron were regularly recorded throughout the survey area (Figure 61). The top 10% of records in terms of the largest group counts were also fairly well spread, but the majority were in the northern half of the survey area. Pied Heron were not frequently recorded on islands or in the north east of the survey area. Records in the south east and south west were usually of smaller numbers.

Pied Heron were recorded throughout all habitats within the survey area. They were recorded on the smaller inland wetlands, through the large freshwater floodplains to the saline coastal wetlands, but they were not often recorded on the actual coast. Pied Heron also frequented garbage dumps around Darwin and other towns.

Numbers

Both the number of records and the total numbers of Pied Heron recorded in ground surveys were among the upper part of the list of all waterbirds. Although not recorded as leaving the survey area, they are one of the colonial nesting species and so overall ground survey counts would not have included the birds involved in breeding colonies during the breeding season. Throughout all surveys there were 179 ground records of Pied Heron totalling over 15 800 birds. The figures equate to around 2.9% of all waterbird records and 2.6% of the total number of waterbirds counted during all ground surveys. Pied Heron were also recorded a further 465 times from aerial surveys.

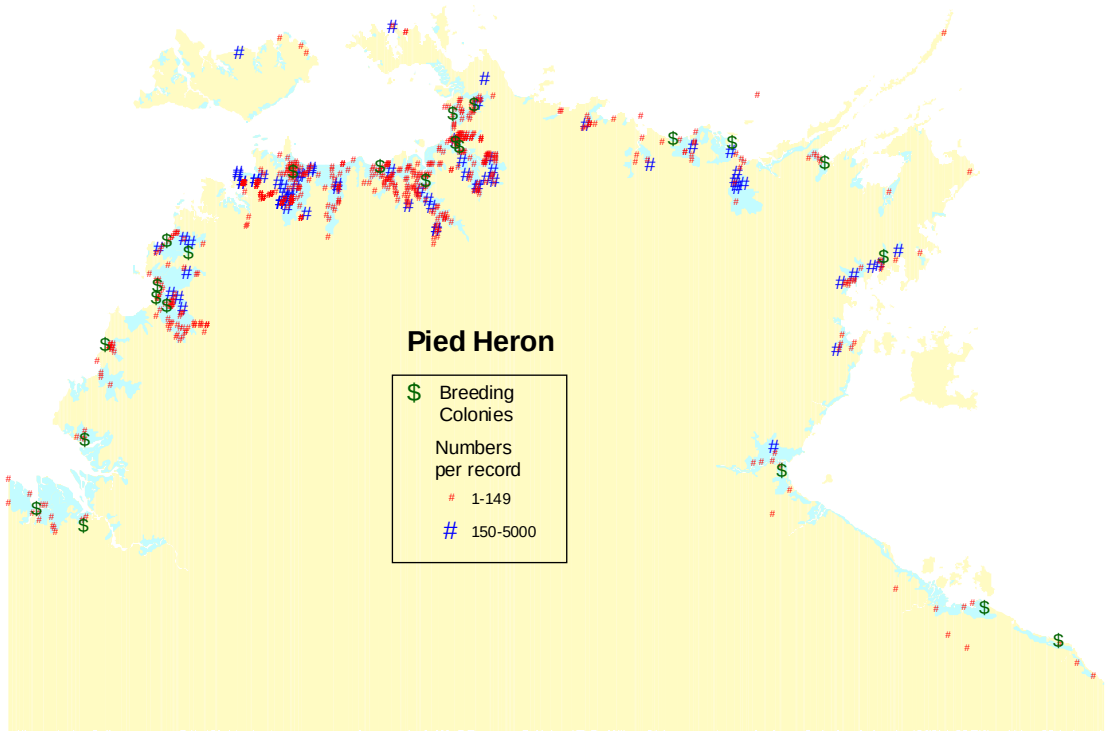

Figure 61. Distribution of all Pied Heron records.

Away from breeding colonies, Pied Heron were recorded in groups of varying sizes from a few birds though to low thousands. The largest record was of 5 000 birds. This was a total count for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. There were five other large groups of in excess of 1 000 birds recorded. These were well spread throughout the wetlands of the north west. They were all in the dry season of 1995 and all included fledged young from the recently completed breeding season.

Seasonality

Pied Heron were recorded in all months of the year. Although the figures vary, there is nothing to suggest any major departure of birds from the survey area at any stage of the year. There were slightly lower numbers in January and February, and in June, November and December. The lower numbers in the earlier part of the year could be because of birds being in breeding colonies and not counted in the survey data used for this report. Although Pied Heron, like some of the other mixed breeding colonies species, did not show an overall exodus from the survey area, they do have seasonal absences from some areas (e.g. the Darwin area because there are no breeding colonies in the immediate vicinity) in the January/February period. Lower figures for the other months can be related to fewer surveys in Pied Heron areas over the period of the project.

Breeding

Pied Heron always bred in mixed species waterbird colonies. They were confirmed breeding in 23 colonies (Figure 61). The majority of these colonies were used every year and involved many thousands of Pied Heron. Whether these breeding aggregations account for most of the Pied Heron using the survey area cannot be said for certain at this stage. Nothing in these surveys suggested many, if any, Pied Heron left the survey area to breed but this cannot be confirmed until banding/tracking studies are done. It is possible, however, that not all Pied Heron breed every year but still remain in the survey area during the breeding season.

The vast majority of Pied Heron colonies were in mangroves along the coast or rivers. There was little breeding in paperbark trees on the freshwater floodplains where a number of other species of colonial nesting waterbird often bred. Colonies in which Pied Heron nested were recorded throughout the survey area and seemed to be well spread throughout the non-breeding distribution summarized here. The breeding season for Pied Heron was mainly between the beginning of January and the end of May. Pied Heron breeding seasons were fairly similar in timing each year and there was less variation in their timing than for other colonial breeding waterbirds such as cormorants and ibis.

Further information on the breeding of this species, including details of other reported Northern Territory breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

GREAT EGRET

Geographic Distribution

The egrets, as a combined group, are one of the most widespread species of waterbirds in the survey area. Individually, confirmed records of all species (with the exception of Cattle Egret in the east) were also very widespread. Great Egret were regularly recorded throughout the survey area (Figure 62). As with all egret species detailed in this report, the number of Great Egret records shown on this map is much less than is actually the case. The vast majority of egrets were recorded as *egret spp.* in aerial surveys (Figure 62). Many of this large number of *egret spp.* records would be Great Egret. This would extend both the overall distribution of Great Egret within the survey area and the density of records within the current confirmed distributional range of Great Egret records.

The top 10% of records, in terms of the largest group counts, were also fairly well spread, with the exception of the western side of the Top End. The majority of the larger groups were in the wetlands to the east of Darwin, as was the case for Little Egret.

Great Egret were recorded throughout all habitats within the survey area, from smaller inland wetlands, through the large freshwater floodplains to the saline coastal wetlands. Great Egret had the largest range of habitats utilized of all the egrets. Like Little Egret (but unlike Intermediate and Cattle Egret) Great Egret were also frequently seen on the coast and islands. On the coast Great Egret were more commonly seen at creek or inlet mouths or in areas where considerable intertidal zones were exposed at low tide. They were sometimes also seen feeding in shallow water some distance from the shore. On freshwater wetlands Great Egret would be found with Little Egret concentrating in groups around channels or drying pools of open water, or they would be found with Intermediate Egret, spread mostly as birds foraging individually over large areas of vegetated floodplain.

Numbers

The egrets, as a combined group, are one of the most frequently recorded resident waterbirds in the survey area. They are also among the most abundant species; even given they do not form the large dense flocks of the other highly abundant waterbirds. Individually, each of the four species is also very abundant, though Great Egret (and Little Egret) are not as abundant as either of the other two species (Intermediate and Cattle Egret). Throughout all surveys there were 278 ground records of Great Egret totalling around 6 900 birds. Being one of the colonial nesting species covered in this report, these figures only represent counts made away from breeding colonies. The figures equate to around 4.5% of all waterbird records and around 1.1% of the total number of waterbirds counted during all ground surveys. Great Egret were the third most frequently recorded waterbird in ground surveys. The low percentage of total numbers of Great Egret recorded in ground surveys is not a true reflection of the comparative abundance of this species. As one of the main aims of the survey was to locate and detail significant waterbird sites, many of the locations landed at to count were of small areas of high density numbers. Species such as Great Egret whose high overall abundance was often due to lower densities over large areas tended to be under-represented in this sort of analysis. This conclusion is supported by the 8317 *egret spp.* records (which would have included many Great Egret) made during aerial surveys. The number of aerial records for *egret spp.* (without adding the individual species records) is nearly four times that of Magpie Goose, the next most frequently recorded waterbird. The total number of *egret spp.* counted in aerial surveys is second only to Magpie Goose. That there were only 354 confirmed Great Egret records from this large number of aerial sightings highlights the difficulty of separating the species during relatively brief and/or distant sightings.

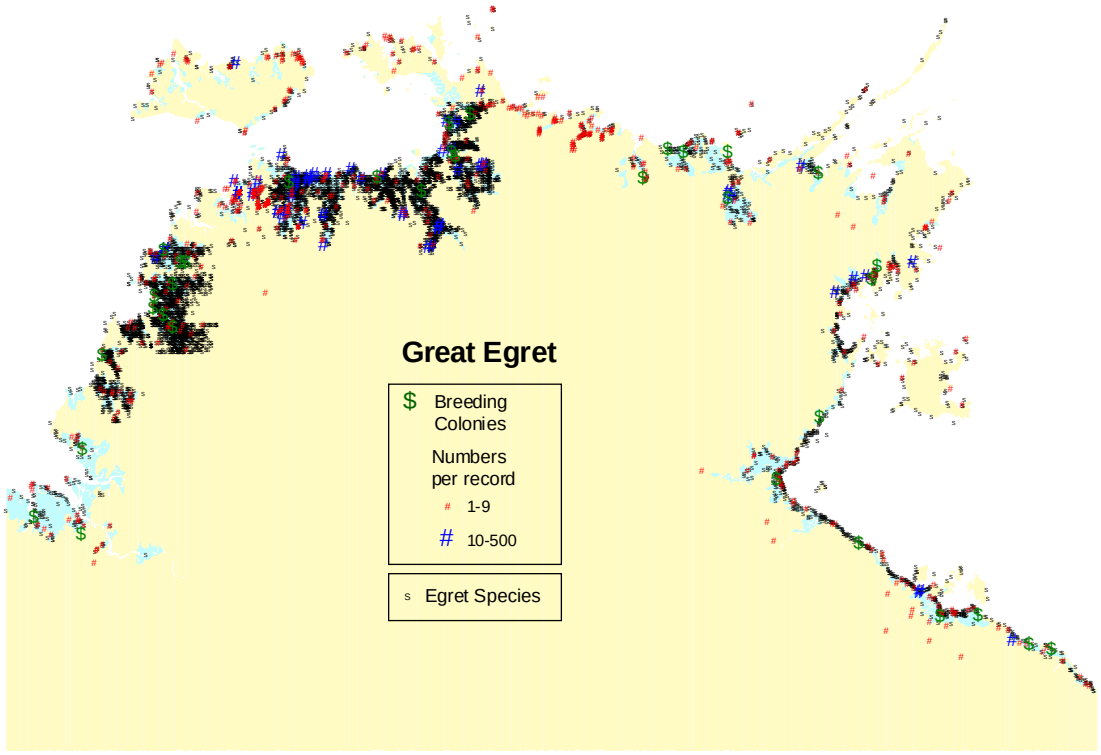

Figure 62. Distribution of all Great Egret records.

Away from breeding colonies, Great Egret were recorded in flocks of all sizes from single birds through to the largest group of 500. This record was in the northern part of the Arafura Swamp in July 1998. The next largest record was of 350 in October 1991 and was on a wetland on the eastern side of the Adelaide River. Even though Great Egret were recorded in some quite large groups, the majority of the observations were of small groups. More than 80% of Great Egret records were of less than 10 birds.

Seasonality

Great Egret were recorded in all months of the year. There is no indication from the monthly total numbers to suggest any major departure of Great Egret form the survey area at any stage of the year. This is also supported by the large numbers seen in breeding colonies. This is also the case with the *egret spp.* records, but with four species involved it is not possible to confidently speak of any one species from these particular records. There were slightly lower numbers of Great Egret in total counts for the months of January and February. This would have been influenced by many birds being in breeding colonies and not counted in the survey data used for this report.

Breeding

Great Egret, like the other egrets, always bred in mixed species waterbird colonies. These colonies were usually dominated by egrets, and Great Egret were confirmed breeding in 29 out of 34 colonies involving egrets (Figure 62). Great Egret were also likely to have been present in most of the five egret colonies where they were not actually confirmed breeding. The majority of these colonies are used every year and involve many thousands of Great Egret. Whether the colonies are the breeding sites for all Great Egret using the survey area cannot be said for certain. There was no indication from these surveys that large numbers of Great Egret left the survey area to breed but it is possible that some individuals may not breed every season. Neither of these points can be confirmed until planned future banding/tracking studies are done.

The vast majority of Great Egret colonies were in mangroves along the coast or rivers. There was little breeding in paperbark trees on the freshwater floodplains where a number of other species of colonial nesting waterbirds often bred. Colonies in which Great Egret bred were dispersed through the survey area and the spread of non-breeding records of Great Egret made during these surveys. Great Egret usually started breeding a few weeks before either Little Egret or Intermediate Egret. Great Egret breeding was mainly between December and the end of April. Egret breeding seasons were fairly similar in timing each year and there was less variation in timing than for other colonial breeding waterbirds such as cormorants and ibis.

Further information on the breeding of this species, including details of other reported NT breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b.)

Plate 18. Mixed egrets, including Great Egret, Kakadu area. Photo G. Miles.

INTERMEDIATE EGRET

Geographic Distribution

The egrets, as a combined group, are among the most widespread waterbirds in the survey area. Individually, confirmed records of each species (with the exception of Cattle Egret in the east) were also very widespread. Intermediate Egret were regularly recorded throughout the survey area (Figure 63). As with all egret species detailed in this report, the number of Intermediate Egret records shown on this map is much less than is actually the case. The majority of egrets were recorded as *egret spp.* from the air (Figure 63). Many of this large number of *egret spp.* records would be of Intermediate Egret. (This is even more so with Intermediate Egret, as both Great Egret and Little Egret could be picked out from the air a little more often than Intermediate Egret). Consideration of the *egret spp.* records would extend both the overall distribution of Intermediate Egret within the survey area, and also the density of records within the current confirmed area of Intermediate Egret records.

Unlike the Great and Little Egret, the top 10% of records in terms of the largest group counts were more restricted to the northern part of the Top End but the majority were still in the wetlands to the east of Darwin, as was the case for Little and Great Egret.

Intermediate Egret were recorded throughout most wetland habitats but not often in saline wetlands. Also unlike Great and Little Egret, Intermediate Egret were never seen on the coast or islands except larger islands such as the Tiwi Islands. On freshwater wetlands Intermediate Egret were usually seen as birds hunting individually and spread over very large areas of wetland.

Numbers

Intermediate Egret were the most frequently recorded and most abundant of all the egrets in ground surveys. It is possible that the number of Cattle Egret in the survey area may be higher but they were not as well covered in ground surveys because they were often on drier, elevated areas with stock that were not well sampled. Intermediate Egret were also the second most frequently recorded of all waterbird species in ground surveys and the ninth most abundant. Throughout all surveys there were 317 ground records of Intermediate Egret totalling over 19 800 birds.

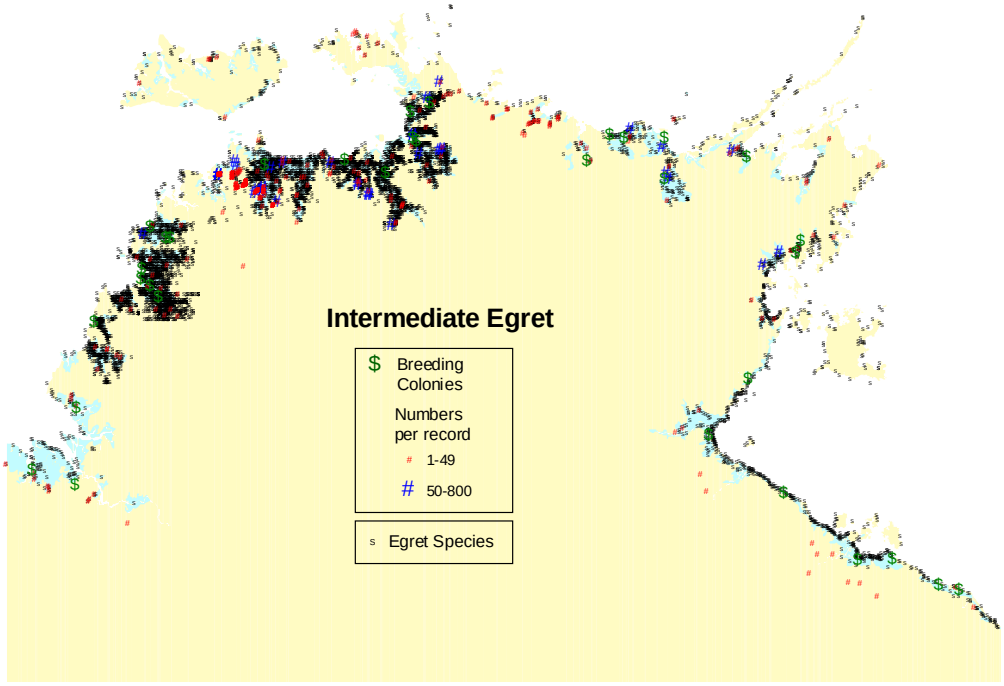

Figure 63. Distribution of all Intermediate Egret records.

Being one of the colonial nesting species covered in this report, these figures only represent counts made away from breeding colonies. The figures equate to around 5.2% of all waterbird records and around 3.3% of the total number of waterbirds counted during all ground surveys. As with the previous egret species there is a relatively low percentage of total numbers of Intermediate Egret recorded in ground surveys. This is influenced by the habit of this species to spread in low densities over large areas, while ground counts usually targeted high density waterbird areas. There were 113 confirmed Intermediate Egret records from aerial surveys but this species and the two previous egret species are not easy to separate from the air.

Away from breeding colonies, Intermediate Egret were recorded in flocks of all sizes from single birds through to the largest group of 800. This record was in the northern part of the Arafura Swamp in July 1998. The next largest record was of 765 in October 1991. This was on a wetland on the eastern side of the Adelaide River. Even though Intermediate Egret were recorded in some quite large groups, the majority of the observations were of small groups. More than 80% of Intermediate Egret records were of fewer than 15 birds.

Seasonality

The seasonal use of wetlands in the survey area was very similar for each of the egrets. All species, including Intermediate Egret, were recorded in all months of the year and there was no suggestion from the monthly records and totals to suggest any major departure of birds form the survey area at any stage of the year. As with the other egrets, there were slightly fewer records and numbers of Intermediate Egret in the December to February period because birds sitting on eggs in colonies were not included in the observations used for this report.

Breeding

Intermediate Egret always nested in mixed species waterbird colonies. These colonies were usually dominated by egrets. Intermediate Egret were usually the most numerically dominant of the egrets in the colonies. They were confirmed breeding in 26 out of 34 colonies involving egrets (Figure 63), but were also likely to have been present in most of the eight egret colonies where they were not actually confirmed breeding. The majority of these colonies are used every year and involve many thousands of Intermediate Egret. There was no indication from these surveys that large numbers of Intermediate Egret left the survey area to breed but it is possible that some individuals may not breed every season. Neither of these points can be confirmed until banding/tracking studies are done.

Even though this species mostly feeds in freshwater wetlands, the vast majority of Intermediate Egret colonies were in mangroves along the coast or downstream sections of rivers. There was little breeding in paperbark trees on the freshwater floodplains where a number of other species of colonial nesting waterbird often nested.

Colonies in which Intermediate Egret bred were recorded throughout the survey area and seemed to provide a good spread to cover the non-breeding records of Intermediate Egret made during these surveys. Intermediate Egret breeding was mainly between January and the end of April. Egret breeding seasons were fairly similar in timing each year and there was less variation in timing than for other colonial breeding waterbirds such as cormorants and ibis.

Further information on the breeding of this species, including details of other reported NT breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

CATTLE EGRET

Geographic Distribution

Cattle Egret distribution in the survey area is quite different to the other egret species. Cattle Egret were much more widely distributed in the western half of the survey area, particularly in the north west of the Top End. (Figure 64). In the eastern half of the survey area Cattle Egret were much more sparsely recorded, although their numbers and range were possibly increasing along the northern half of the eastern side of the Top End during the surveys. This may relate to a similar increase in the range and numbers of water buffalo and pigs in this area. Records in the far south east may also be relatively recent. An Aboriginal who had been a resident drover in the area for 60 years told me in 1998 that he was not aware of this species in the area.

The most important areas for Cattle Egret, apart from the large wetlands of the north west, were the wetlands between the Liverpool and Blythe Rivers in the central north, the Arafura Swamp and some of the wetlands around Blue Mud Bay. All these areas also had large numbers of stock present.

The distribution of Cattle Egret also differed from other egrets in terms of their habitat preference within the survey area. Cattle Egret, as expected, were primarily found in grasslands and shallow or drying wetlands that were being grazed by stock or feral animals such as pigs. Cattle Egret would generally move from these dry areas to wet areas to drink or roost.

Numbers

Cattle Egret often fed among stock in dry paddocks and therefore are not well represented in ground counts which concentrated on wet areas. Even with this constraint they were still in the top third of all waterbird species with regard to comparisons of the number of records and total numbers counted. These figures did not include numbers in the breeding colonies between November and April. Throughout all surveys there were 135 ground records of Cattle Egret totalling over 13 300 birds. The figures equate to around 2.2% of all waterbird records and around 2.2% of the total number of waterbirds

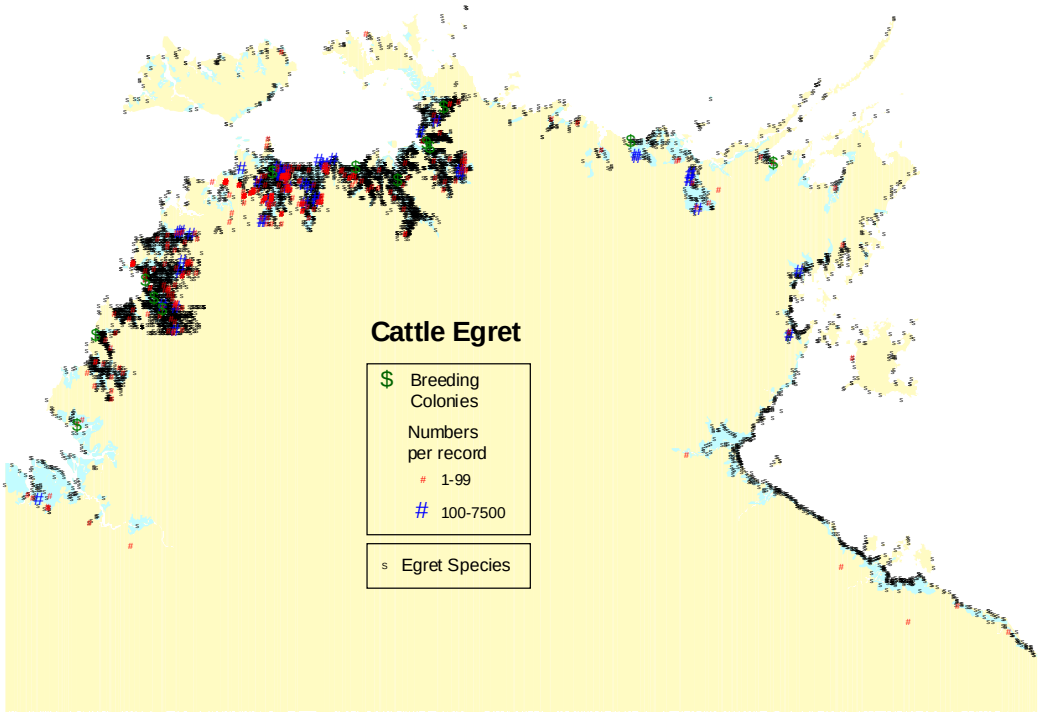

Figure 64. Distribution of all Cattle Egret records.

counted during all ground surveys. There were also a further 293 records from aerial surveys. There were also 8317 *egret spp.* records made during aerial surveys many of which could have included Cattle Egret. Away from breeding colonies, Cattle Egret were recorded in groups of all sizes from individual birds at the foot of a grazing animal through to large aggregations in their thousands. The two largest single records were of 7 500 in May 1995 and 3 500 in July 1998. Both were in the Arafura Swamps. Even though Cattle Egret were recorded in some quite large groups, the majority of the observations were of small groups. About 50% of Cattle Egret records were of fewer than 10 birds.

Seasonality

Cattle Egret, like the other three egret species, were recorded in all months of the year. The monthly records and total numbers counted suggested no obvious large departures from (or influxes into) the survey area at any time of the year. Because Cattle Egret start breeding a little earlier than the other species, there were slightly lower numbers recorded in the November to January period (rather than the December to February period as for other egrets) when many birds nesting in colonies were not counted.

Breeding

Cattle Egret breeding was a little different from other egret species. The majority of Cattle Egret, particularly the larger colonies, tended to start well before any other egrets, in fact before any of the other colonial breeding species. These Cattle Egret colonies began in November, with other species of colonial breeding waterbirds joining in from late December through to February, depending on the species. As such, Cattle Egret in these colonies usually had hatched young while most of the other species were sitting on eggs, and then most of the Cattle Egret had left the colonies when the other egrets were still feeding small young. In other colonies where Cattle Egret were in small numbers compared to the other species, they nested in greater synchrony with the other species. This situation was more obvious in the smaller Cattle Egret breeding sites outside of the north west area.

Cattle Egret were confirmed breeding in 13 colonies (Figure 64), but may have been involved in smaller numbers in other egret breeding colonies. The majority of these colonies are used every year and involve many thousands of Cattle Egret. Whether these breeding aggregations account for most of the Cattle Egret using the survey area cannot be said for certain at this stage. Nothing in these surveys suggested many, if any, Cattle Egret left most of the survey area to breed but this cannot be confirmed until planned future banding/tracking studies are done. It is possible, however, that not all Cattle Egret breed every year but still remain in the survey area during the breeding season.

The vast majority of Cattle Egret colonies were in mangroves along the coast or rivers. There was little breeding in paperbark trees on the freshwater floodplains where a number of other species of colonial nesting waterbird often nested. Colonies in which Cattle Egret nested were recorded throughout most of the main part of their range where the colony sites seemed to provide a good spread to cover the non-breeding records of Cattle Egret made during these surveys. Possible exceptions included the lack of a confirmed Cattle Egret breeding colony in the Arafura Swamp or the wetlands to the north of Blue Mud Bay. The colonies located in the general North East Arnhem Land area did not seem to have the number of birds in them to account for all the non-breeding records in this area. Therefore it seems that either some Cattle Egret breeding has been missed in the area, or they move further west to the large colonies of the north west to breed. Surveys of these areas without breeding colonies between November and February did not record large numbers of Cattle Egret, so perhaps they leave the area. Again, such interpretation cannot be confirmed until banding/tracking work is done. Cattle Egret in the far south east of the survey area were only ever recorded in very small numbers. Perhaps they use other egret colonies in the area or they move into Queensland to breed.

NANKEEN NIGHT HERON

Geographic Distribution

Given Nankeen Night Heron are primarily nocturnal and my surveys involved very little night surveying, they were a species that was difficult to survey. Further complicating this was the fact that birds roosting during the day, usually roosted during the day under the vegetation canopy and rarely moved or took flight with just a single pass during aerial surveys. Given this, Nankeen Night Heron are likely to be much more numerous and widely spread than recorded in these surveys. Nevertheless, they were still recorded throughout the survey area (Figure 65). Like Pied Heron, the top 10% of group counts were also fairly well spread, but the majority were in the northern half of the survey area.

Nankeen Night Heron were recorded throughout all habitats, from smaller inland wetlands, through the large freshwater floodplains to the saline coastal wetlands. These records obviously only refer to roosting birds as night feeding was not monitored. Although they were not actually seen on the coast, tracks and feathers found in marine turtle hatching areas suggested they probably fed on turtle hatchlings at night on sandy mainland beaches and islands.

Numbers

Throughout all surveys, and outside of their breeding colonies, there were only 53 ground records of Nankeen Night Heron totalling over 1 000 birds. The figures equate to around 0.9% of all waterbird records and around 0.2% of the total number of waterbirds counted during all ground surveys. The low number of ground records for this species is expected given their nocturnal habits. Nankeen Night Heron were recorded a further 112 times from aerial surveys, totalling nearly 7 000 birds.

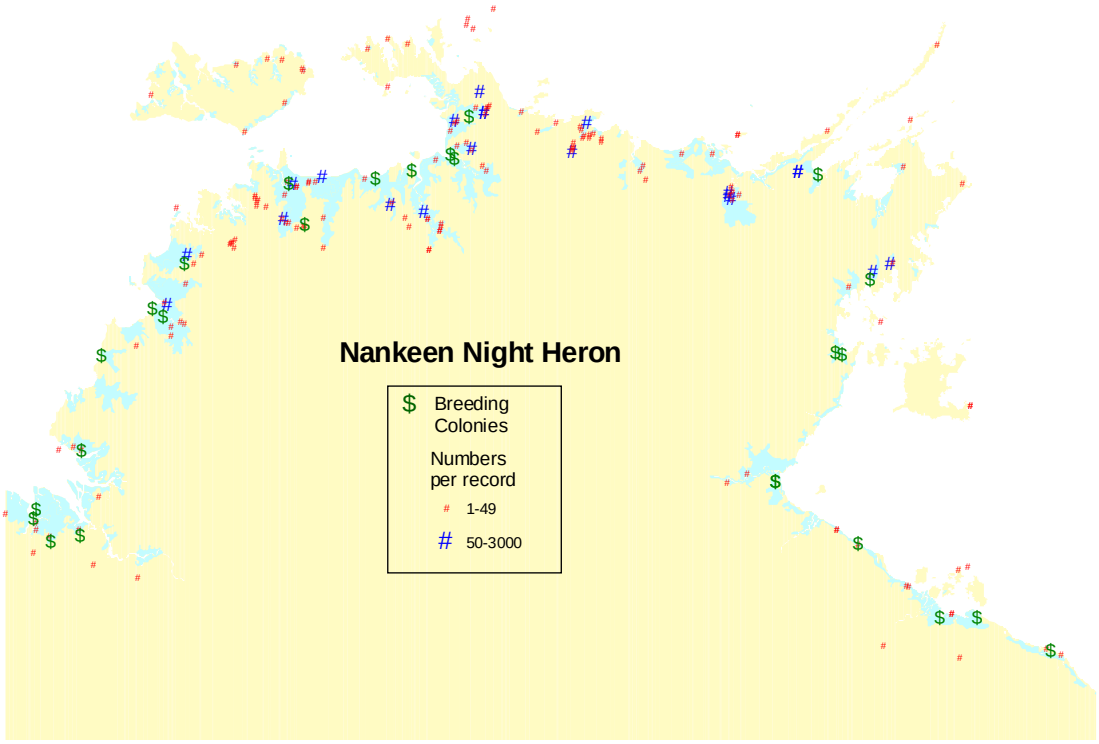

Figure 65. Distribution of all Nankeen Night Heron records.

This latter number was still in the top half of all waterbird species totals from aerial surveys. Given this species may have only had a small percentage of their numbers detected in these surveys, they could well be one of the more abundant of the resident waterbirds in the survey area.

Nankeen Night Heron were usually recorded in groups of varying sizes from single birds through to the largest record of 3 000. This was of a large roost in a swamp north of Blue Mud Bay in September 1996. There were no ground surveys done of this site but no nests could be seen from the air and it was outside the normal breeding season for Nankeen Night Heron. Other larger non-breeding roosts of 300 to 800 birds were recorded on wetlands associated with the Adelaide River, Coopers Creek (off the East Alligator River), Murgenella Creek and in several sites in the Arafura Swamp. All were dry season aerial counts which are likely to have detected only a small proportion of the birds present. This would be the case for many of the records of this species regardless of the size of the count.

Seasonality

The difficulty of surveying Nankeen Night Heron, and the resultant relatively low number of records, makes comment on seasonality difficult. Nankeen Night Heron were recorded in all months of the year, with most records and highest monthly totals being in the dry season. As with the other colonial breeding species, lower numbers from December to February can at least partly be attributed to birds being in breeding colonies and not counted in the survey data used for this report.

Breeding

Nankeen Night Heron nested in both mixed species waterbird colonies and on their own in colonies of various sizes. The numbers involved in breeding varied from many thousands to a few pairs. Nankeen Night Heron were confirmed breeding in 26 colonies (Figure 65). Because the other colonial breeding waterbird species were relatively easy to find, the breeding of Nankeen Night Heron in the larger mixed species colonies has probably been fairly comprehensively recorded in these surveys. The numbers recorded breeding in the colonies (see Chatto 2000b) are probably better representation of their numbers and distribution than non-breeding records of the species. Nankeen Night Heron colonies involving breeding in small isolated groups on their own, on the other hand, has probably been poorly represented in my records compared to the true number in the survey area. Nankeen Night Heron breeding was a little less regular than most of the other colonial nesting species.

The majority of Nankeen Night Heron colonies were located in mangroves along the coast or rivers. Except for the central northern part of the survey area, where I suspect there would be at least one unrecorded colony (probably in the Arafura Swamp), colonies in which Nankeen Night Heron nested were recorded throughout the survey area and seemed to provide a good spread to cover the non-breeding records of this species made during these surveys. Although not as well recorded as the other species of colonial breeding waterbirds, the breeding season for Nankeen Night was mainly between March and June.

GLOSSY IBIS

Geographic Distribution

Glossy Ibis were recorded throughout the survey area, although they were not as widespread in the south east (Figure 66). Apart from a single bird on a small wetland on an island off north east Arnhem Land, there were no birds recorded on islands during the surveys. However, it is likely that surveys done of the wetlands on the Tiwi Islands at the right time of the year would record them, and Noske and Brennan (2002) reported them as rare vagrant to Groote Eylandt. Birds were recorded from the upstream freshwater wetlands though to the more saline coastal wetlands, but not along the coast as is frequently the case with the Australian White Ibis.

The distribution of the top 10% of single counts was fairly evenly spread throughout their recorded range, suggesting that at most places where they were recorded they were present in good numbers.

Numbers

Although Glossy Ibis were not in the top 10 species in terms of the number of times they were recorded from ground surveys they were the fifth highest in terms of total numbers recorded. This is even though nearly all Glossy Ibis appear to leave the survey area during the months (January to March) that the mixed species waterbird breeding colonies are active. Throughout all surveys there were 152 ground records of Glossy Ibis totalling over 35 500 birds. These equate to around 2.5% of all waterbird records and around 5.4% of the total number of waterbirds counted during all ground surveys. There were also a further 422 records from aerial surveys.

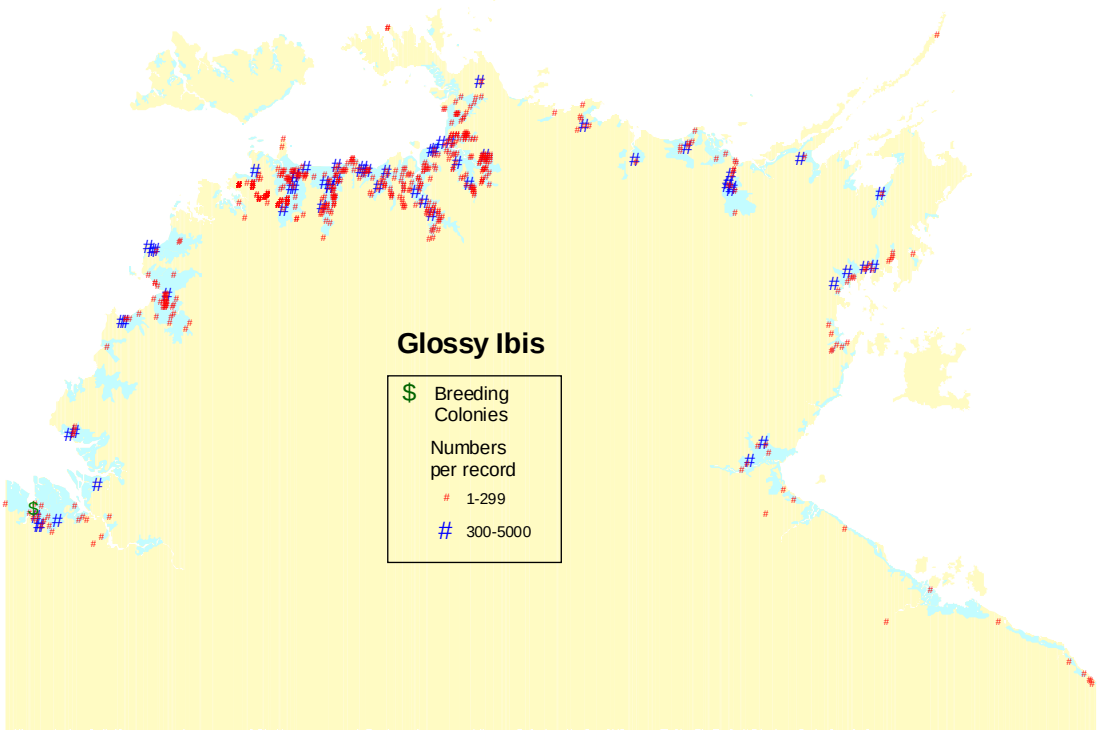

Figure 66. Distribution of all Glossy Ibis records.

Away from breeding colonies, Glossy Ibis were recorded in medium sized through to large groups, but not often in singles or small groups. There were 14 single flock counts of in excess of 1 000 birds, the largest being 5 000, and the top 10% of records in terms of the largest group counts were all in excess of 200 birds. Counts of 2 000 or more birds were recorded adjacent the northern part of Blue Mud Bay and at a number of well spread locations between Murgenella and the far south west of the survey area. The average number of birds per record throughout the surveys was around 125.

Seasonality

Glossy Ibis were recorded in all months of the year but there was a dramatic drop in numbers throughout most of the survey area during the wet season. Apart from the far south west of the survey area, where there is a single breeding colony, Glossy Ibis depart the survey area to breed elsewhere at this time. During this period only very occasional birds are seen in the survey area. Numbers of Glossy Ibis start to drop off in November, and the first of the birds start returning again in late February, but not in larger numbers to late March. On one occasion (early April 1993) a large group of Glossy Ibis (500+) was recorded flying into coastal wetlands to the east of Darwin from the sea to the north. They came down from a great height, and it is possible that this may have been birds coming into the Top End from locations to the north of Australia. This may suggest that not all Glossy Ibis using the Top End breed in Australia.

Breeding

Glossy Ibis were confirmed breeding at only one location during my surveys. Around 5 000 Glossy Ibis were recorded breeding in a very large mixed species colony on the Keep River Estuary in the far south west (Chatto, 2000b). It is unlikely that my surveys would have missed breeding colonies of this species so it is clear that all birds not involved in this colony and residing in the survey area during their non-breeding season must move out of the area to breed elsewhere. Whether they move north to breed, as suggested above, and/or south (where the major know breeding colonies are e.g. the Lake Eyre Basin and the Murray Darling Basin, R. Jaensch *pers. comm.*) is not known and needs to be further investigated by banding or satellite tracking. The very small numbers of Glossy Ibis that remain in the survey area during the wet season are almost certainly non-breeding birds.

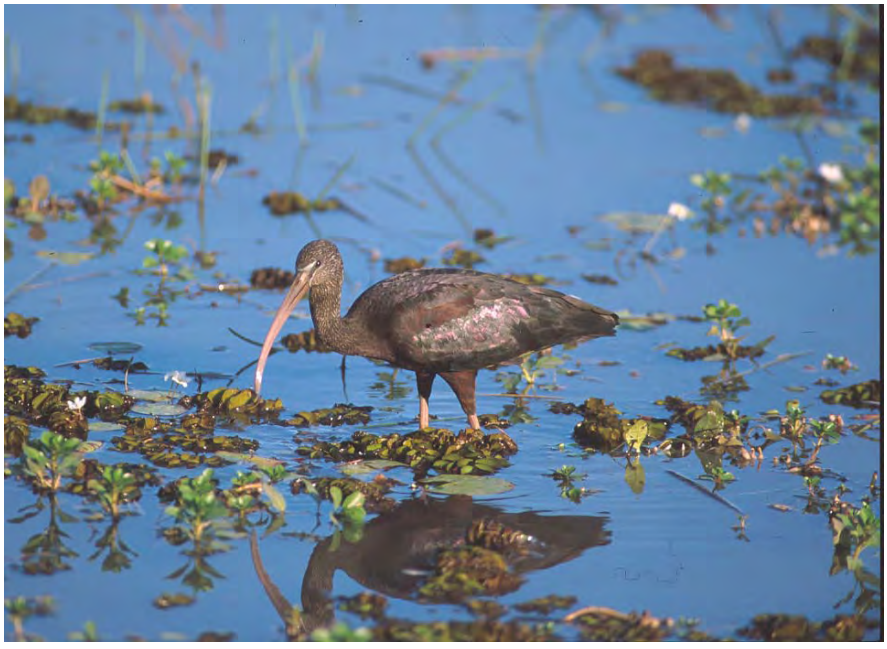

Plate 19. Glossy Ibis. Photo G. Miles.

AUSTRALIAN WHITE IBIS

Geographic Distribution

Australian White Ibis were one of the most widely distributed waterbirds in these surveys, being recorded throughout the survey area (Figure 67). The distribution of the top 10% of single counts was spread fairly evenly throughout the mainland part of their distribution. Australian White Ibis were recorded everywhere from the more saline wetlands near the coast through to the freshwater wetlands of the upstream areas. They were frequently recorded along mud and mangrove coasts and river/creek banks, and also islands where these habitats were present. They were often associated with Straw-necked Ibis on freshwater wetlands and in areas such as grazed, slashed or burnt grasslands, and paperbark forests. Both of these ibis species also frequented urban parks and ovals. The only places where Australian White Ibis were not regularly recorded were along the sandy, oceanic beaches that did not have wetlands associated with them, such as parts of North East Arnhem Land and some of the islands.

Australian White Ibis were regularly recorded on Melville Island during my surveys, yet two or three birds only were seen by Mathews (1914) in three months on Melville Island in the early 1900s. Perhaps this is a species that has also increased in numbers in the north of Australia as it has in southern Australia.

Numbers

Away from breeding colonies, Australian White Ibis are another of the more frequently recorded waterbirds. In ground surveys they were the most frequently recorded of the ibis and 7th of all waterbirds. Because Australian White Ibis did not consistently form the large flocks that Glossy Ibis did, they were recorded in lower total numbers.

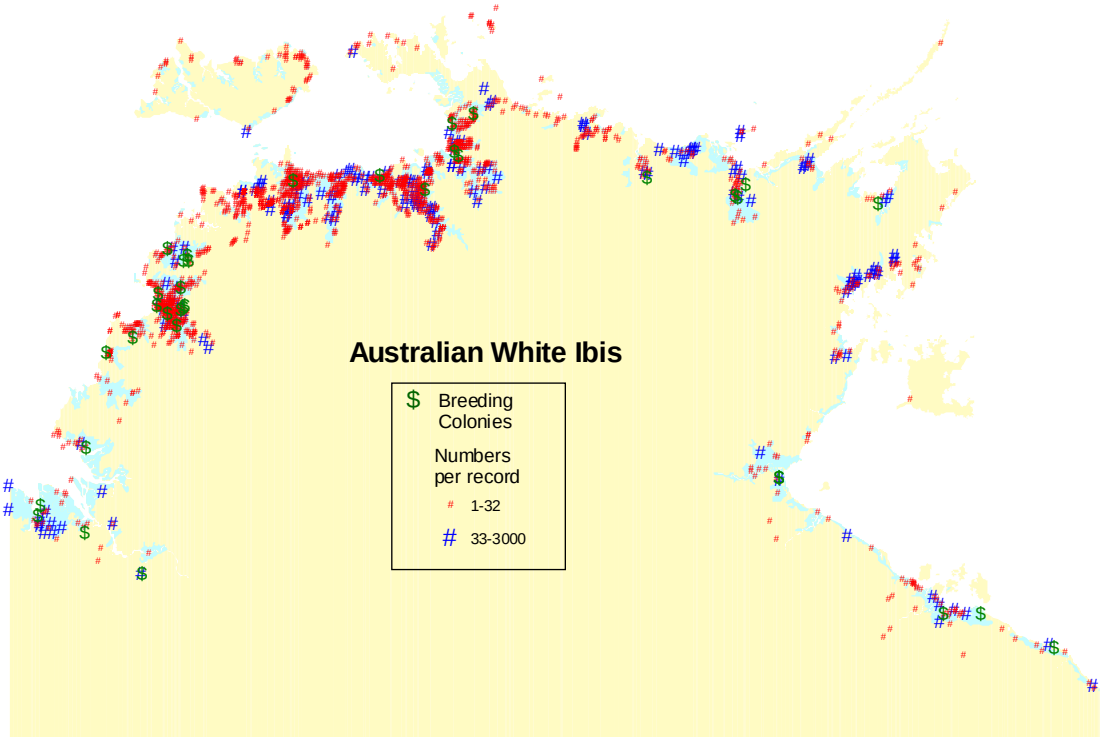

Figure 67. Distribution of all Australian White Ibis records.

Throughout all ground surveys there were 224 records of Australian White Ibis totalling around 7 400 birds. The figures equate to around 3.7% of all waterbird records and around 1.2% of the total number of waterbirds counted during ground surveys. Being found throughout the survey area and easily seen and identified, there was also a large number of aerial records. These numbered 1 548 and places them as the third most frequently recorded waterbird behind *egret spp.* and Magpie Goose.

Away from breeding colonies, Australian White Ibis were recorded in flocks of all sizes varying from single birds through to low thousands. There were six individual records of in excess of 1 000 Australian White Ibis, the largest being 3 000. This record, in May 1995, was on the Thomson River wetlands near Maningrida. The next two highest single records, both of 2 000 birds, were in late June 1995 on the Finniss River wetlands and in late July 1998 in the Arafura Swamp. Even though Australian White Ibis were recorded in some quite large groups, the majority of the observations were of small groups. Around 90% of records were of 20 birds or less.

Seasonality

Australian White Ibis were recorded in all months of the year, though their numbers and the number of times they were recorded was a little lower between December and February. Most of this time is prior to their local breeding season so cannot be explained, like the other colonial species, by numbers present in breeding colonies not being counted. The lower numbers at this time may be due to a combination of fewer surveys done in January compared to the other months, and/or some dispersal of birds throughout the wet season-flooded areas further inland in the survey area that were not well covered. It may also be that a small percentage of Australian White Ibis leave the survey area to breed elsewhere, as this corresponds with the departure time of the Straw-necked Ibis, which all leave the survey area to breed elsewhere.

Breeding

Australian White Ibis were recorded nesting in 39 colonies (Figure 67). The majority of these colonies are used every year. Even though most of these colonies were mixed species colonies, there are still many, many thousands of Australian White Ibis breeding in them. Whether these breeding aggregations account for most of the Australian White Ibis using the survey area needs to be investigated by future banding studies.

Australian White Ibis colonies were located in mangroves along the coast or rivers, and in paperbarks in freshwater swamps. This species would also occasionally breed by themselves in floodplain reeds. They were the only (tree-nesting) colonial nesting waterbird to also nest in this habitat. Colonies in which Australian White Ibis nested were spread throughout the survey area, and matching the distribution of their non-breeding records, they were more frequent along the north and west parts of the survey area. Like most colonial breeding species, the floodplains between the Daly and Finniss Rivers and between the Adelaide River and Murgenella Creek had large numbers of colonies. The breeding season for Australian White Ibis was mainly between the beginning of March and the end of July though there was a little variation either side of these dates.

Although comparing the distribution of non-breeding records of Australian White Ibis with regularly used colonies shows most of the areas with large number of birds recorded also had a colony in the vicinity, there were a couple of exceptions. The area around the northern part of Blue Mud Bay and some of the upstream areas of the floodplains to the east of Darwin had many Australian White Ibis recorded but no colonies in the areas. A mixed waterbird colony was searched for in the fairly large, often densely waterbird populated wetlands of the area to the north of Blue Mud Bay, but one was never found. Perhaps one was missed here, as in the upstream area to the east of Darwin where one or two smaller, perhaps irregular, colonies may have existed and not been detected.

STRAW-NECKED IBIS

Geographic Distribution

Straw-necked Ibis were recorded from throughout the survey area, though more frequently in the northern and western sections (Figure 68). Most of the top 10% of individual counts were also mostly within this northern area. Straw-necked Ibis were recorded from the upstream freshwater wetlands but not often in the more saline coastal wetlands, and never along the coast as was the case with the Australian White Ibis. Straw-necked Ibis were also more commonly seen than the other two species of ibis in wetland areas that had mostly dried since the previous wet season. As such, they are commonly seen in areas such as grazed or burnt, dry floodplains and among drying wetlands under paperbark forests. They are also frequently seen on urban parks and ovals. Apart from the Tiwi Islands and a single bird on a small wetland on an island off north east Arnhem Land, there were no birds recorded on islands during the surveys. Noske and Brennan (2002) report them as rare vagrants on Groote Eylandt.

Numbers

When present in the survey area, Straw-necked Ibis are a fairly frequently recorded and abundant species. There were 162 ground records of Straw-necked Ibis totalling just over 5 300 birds. These equate to around 2.6% of all waterbird records and around 0.9% of the total number of waterbirds counted during all ground surveys. There were much larger counts made from the air, with the largest being 5 000 birds. Most Straw-necked Ibis left the survey area to breed, but when here they often inhabited drier areas not well represented by ground counts, so reporting rates and cumulative counts are likely to be under-represented compared to most other resident species. Because they are easily detected and identified from the air there were a further 493 records (totalling over 31 000 birds) from aerial surveys.

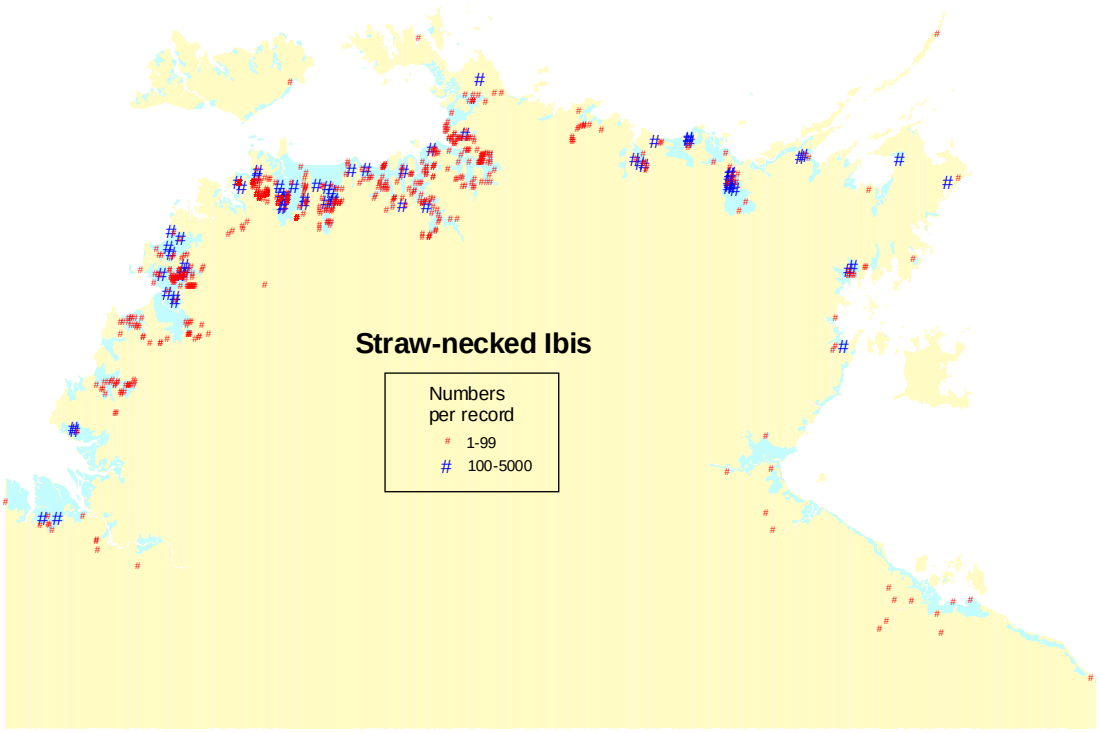

Figure 68. Distribution of all Straw-necked Ibis records.

Straw-necked Ibis were seen in groups of all sizes but very large groups (i.e. 1 000 plus) were not often recorded because they tended to be fairly well spread throughout the landscape, and hence were recorded as a number of separate smaller counts. The average number of birds per record for this species throughout the surveys was around 40.

Seasonality

Straw-necked Ibis were recorded in all months of the year except January, but there was a dramatic drop in numbers throughout the survey area during the wet season. Very few Straw-necked Ibis remain over most wet seasons. Numbers start to drop off in November, and the first of the birds start returning again in March and April, presumably after breeding elsewhere.

Breeding

Straw-necked Ibis were not confirmed breeding in the survey area during my surveys, but juvenile plumaged birds were frequently seen in the survey area after the wet season. It is unlikely that my surveys would have missed breeding colonies of this species so it is clear that all birds leave the survey area to breed, except perhaps in very rare circumstances (eg Frith and Davies, 1961). As with Glossy Ibis, the largest known breeding colonies for Straw-necked Ibis are in the Lake Eyre and Murray Darling Basins. The small numbers of Straw-necked Ibis remaining in the survey area during the wet season are almost certainly non-breeding birds. Occasionally larger numbers remain, for example in the 1990 wet season, which was one of the driest wet seasons on record for the Top End. Whether the local dryness triggered them to stay or whether it was also dry in the area(s) they normally go to breed is unknown. While remaining in the Top End for that season they did not breed even though the Australian White Ibis were breeding in large numbers at the time.

Plate 20. Straw-necked Ibis. Photo. F. Woerle.

ROYAL SPOONBILL

Geographic Distribution

Royal Spoonbill were recorded throughout the survey area (Figure 69). They were more frequently recorded in the north west and less frequently recorded along the eastern part of the survey area. The top 10% of records, by count, were spread throughout the survey area, but the majority were on the wetlands in the north west. Royal Spoonbill were more frequently recorded on freshwater wetlands, but they were also regularly seen in the saline wetland areas abutting the coast. However, they rarely moved onto the coast like some other species. Most records were also from the mainland, with the species not often seen on islands.

Numbers

Royal Spoonbill were a reasonably frequently recorded waterbird, but not highly abundant. They were far more commonly seen in the survey area than Yellow-billed Spoonbill. Away from breeding colonies Royal Spoonbill were recorded in ground counts 117 times totalling around 2 200 birds. The figures equate to around 1.9% of all waterbird records but less than 0.4% of the total number of waterbirds counted during all ground surveys. There were also a further 93 records from aerial surveys. Royal Spoonbill would associate with other frequently recorded white birds such as egrets and Australian White Ibis and it is likely that some Royal Spoonbill would have been present in records of flocks of such species taken during aerial surveys.

Away from breeding colonies, Royal Spoonbill were recorded in a wide range of flock sizes of up to 400 birds, but most groups were less than 20.

Seasonality

Royal Spoonbill were recorded in all months of the year, though their numbers and the number of times they were recorded was a little lower between December and February. This may be due to a combination of fewer surveys done in January compared to the other months and some dispersal throughout the wet

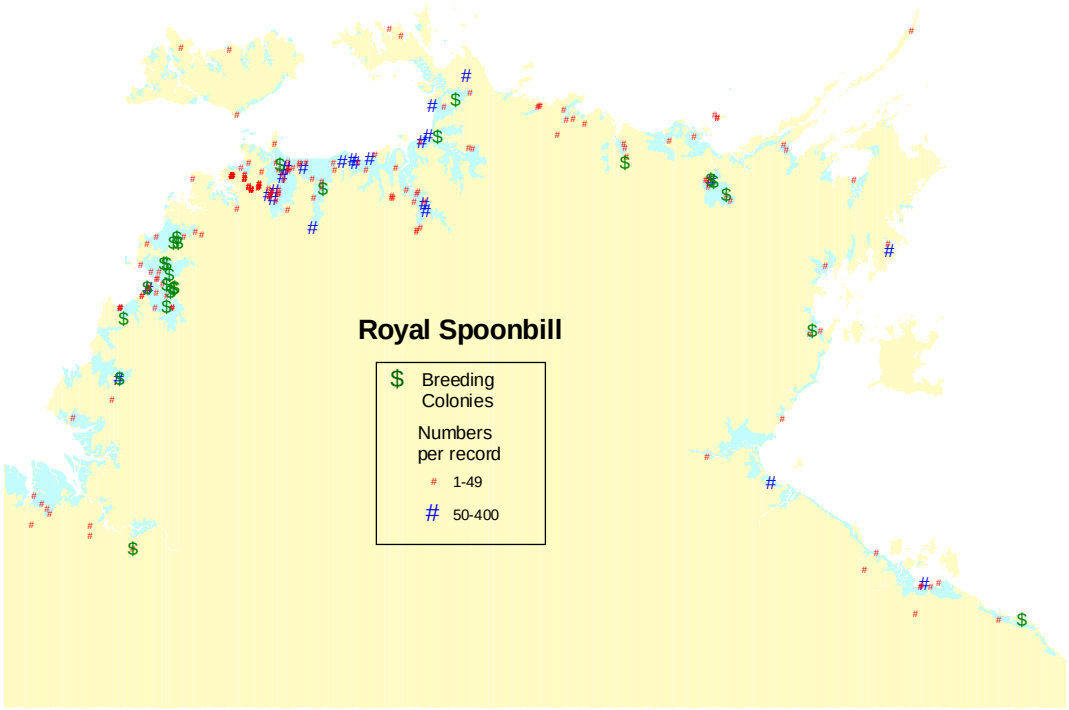

Figure 69. Distribution of all Royal Spoonbill records.

season-flooded areas in the survey area that were not well covered. It may also be that a small percentage of Royal Spoonbill leave the area totally to breed elsewhere.

Recorded numbers were also a little lower in the period May and July which is likely to be due to birds in breeding colonies not being counted.

Breeding

Royal Spoonbill were recorded nesting in 25 colonies (Figure 69). The majority of these colonies are used every year. Even though most of these colonies were mixed species colonies, there are still thousands of Royal Spoonbill in total breeding in them. Whether these breeding aggregations account for most of the Royal Spoonbill using the survey area cannot be said for certain at this stage. It is possible that, even though the colonies are used every season, some birds may not breed every year. It is also possible that some birds may move out of the survey area to breed. Only future banding studies will confirm these things, but it appears that most Royal Spoonbill are resident breeding waterbirds in the survey area.

Royal Spoonbill colonies were recorded in mangroves along the coast or rivers, and in paperbarks on freshwater wetlands. Colonies were spread throughout the survey area. Like the distribution of non-breeding records, most colonies were also in the north west. The floodplains between the Daly and Finniss Rivers had quite a high density of colonies. The breeding season for Royal Spoonbill was mainly between April and July though there was a little variation either side of these dates.

The distribution of breeding colonies compared to the distribution non-breeding records of Royal Spoonbill suggests some birds may move further to breeding colonies in the far south west and along the east side of the Top End. The frequency of non-breeding records combined with the lack of colonies found in the upstream areas of a number of the floodplains to the east of Darwin suggests that there may be some smaller, perhaps irregular, colonies that were not located during the surveys. Further information on the breeding of this species, including details of other reported Northern Territory breeding (south of the Top End) is available in the first report in this series (Chatto, 2000b).

Plate 21. Royal Spoonbill and Little Egret, both in breeding plumage. Photo. F. Woerle.

YELLOW-BILLED SPOONBILL

Geographic Distribution

Yellow-billed Spoonbill were recorded from a small number of scattered locations around the survey area (Figure 70). These records were all in the south west, north west or the south east of the survey area. Even though this species is clearly not highly abundant in the survey area, it is likely to be more numerous and more widely spread than my surveys show. Small numbers of Yellow-billed Spoonbill could have easily been un-intentionally recorded among aerial records of *egret spp.* or Royal Spoonbill. A & E Withers (*pers. comm.*) reports Yellow-billed Spoonbill to be occasionally present on Cobourg Peninsula, J. Woinarski (*pers. comm.*) has a record from Melville Island and Tindale (1922) mentions a flock on Groote Eylandt. This latter author also states that they were plentiful on the adjacent mainland, which was not found to be so in my surveys. McKean (1985) also records them as occasional visiting small groups during the dry season in Keep River National Park which is just south of my survey area near the NT/WA border.

Numbers

Yellow-billed Spoonbill were one of the less abundant waterbirds recorded during my surveys. There were only 11 ground records of this species totalling 26 birds. There were also three further records of individual birds made from the air. The largest record was of 10 birds but most records were of single birds.

Figure 70. Distribution of all Yellow-billed Spoonbill records.

Seasonality

The small number of records for Yellow-billed Spoonbill in my surveys makes it hard to comment on seasonality in detail. All records were between March and October which suggests dry season use of the survey area. Other authors (eg McCrie and Watson, 2003; Shurcliff and McKean, 1990 and Crawford, 1972) also suggest these birds are dry season visitors.

Breeding

Yellow-billed Spoonbill were not confirmed breeding during my surveys, and are not likely to be an abundant breeding waterbird in the survey area. Only two references to breeding in the survey area were found in the literature. Frith and Davies (1961) report breeding in the wetlands east of Darwin in May, and Goodfellow and Scott (2001) report breeding in the south west of the Top End, but neither give any further details.

R. Jaensch (*pers. comm.*) has observed this species breeding in substantial numbers in the Barkly wetlands south of the Top End.

Plate 22. Black-necked Stork (see over) near Darwin, June 1990. Photo R. Chatto.

BLACK-NECKED STORK

Geographic Distribution

Black-necked Stork were recorded throughout the survey area in a wide variety of habitats (Figure 71). They were mostly observed in freshwater wetland areas, on both large flooded areas and small drying wetlands. They were also frequently seen on saline coastal wetlands, coastal beaches, including in the shallows well out to sea from the shoreline. They were recorded on most of the islands. The many records on Melville Island in my surveys are contrary to Mathews (1914) who records them as rare in his surveys of the early 1900s. Perhaps this is species has increased in numbers in this area. Black-necked Stork are also occasionally seen in urban areas such as along drains or small artificial lakes around Darwin. The recorded distribution of this species in my surveys was greater than the other species, although this is undoubtedly influenced by the fact that Black-necked Stork are extremely easy to see and identify from the air, whether alone or when mixed with other waterbirds.

Numbers

Black-necked Stork were recorded on 1086 occasions from all methods of survey combined. This is second only to Magpie Goose and Australian White Ibis in terms of the number of separate records. Black-necked Stork were very easily seen and identified from the air and hence the vast majority of records are from aerial surveys. Throughout all ground surveys there were 163 records (as opposed to 923 aerial records) of Black-necked Stork totalling 351 birds. (The aerial count total was just over 1 800 birds). In ground counts the Black-necked Stork figures equate to around 2.7% of all waterbird records and around 0.6% of the total number of waterbirds counted during all ground surveys.

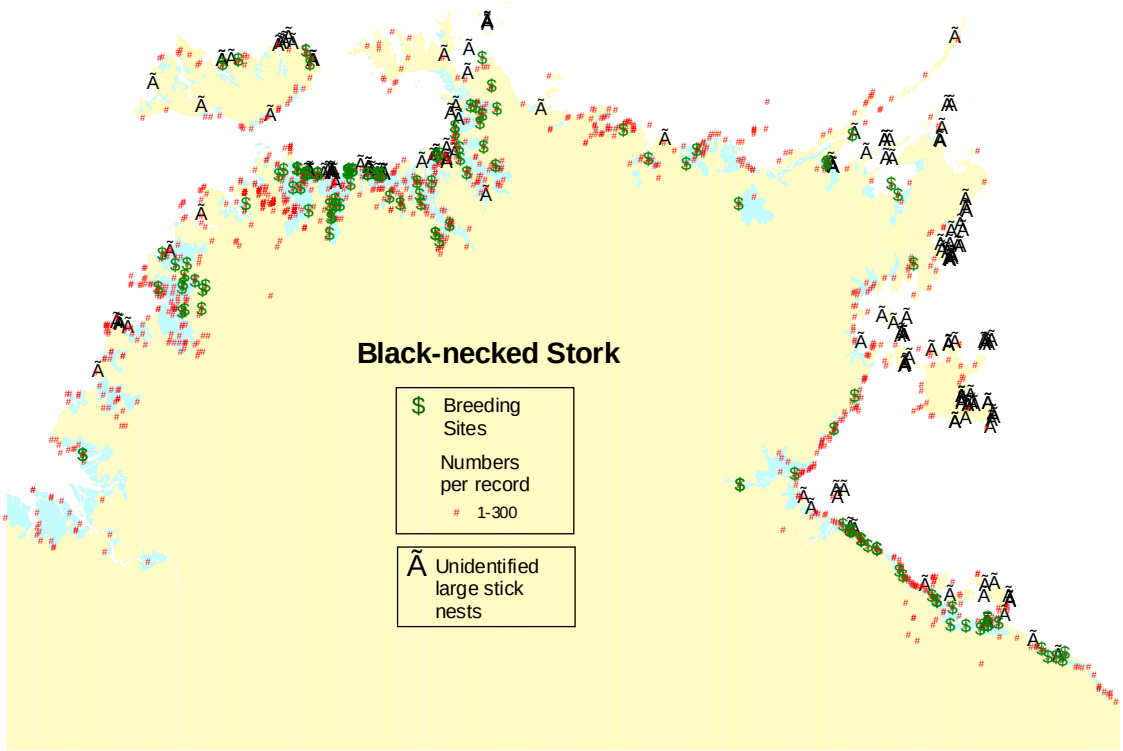

Figure 71. Distribution of all Black-necked Stork records.

Around 90% of Black-necked Stork records were of a single bird or a pair of birds. The majority of other records were of 3-5 birds, which quite often represented a pair of adults and their flying offspring. Large groups were not commonly recorded, with only 20 records of ten or more in a group. The largest record was of 300. This count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. Even though this count was over quite a large area, it is still a large and high density count for this species. This site, near Murgenella, was previously discussed in more detail under survey block 7.

Seasonality

Black-necked Stork were recorded in all months of the year with no large changes in monthly totals suggesting no significant movement in or out of the survey area. Most records and the highest numbers were recorded in March and April and October and November. The first two months would have been quite heavily influenced by the larger number of surveys (associated with the annual Magpie Goose aerial surveys, and previously mentioned in the methods section) rather than there being more birds, and the second peak is likely a reflection of the influx of new young into the population.

Breeding

Black-necked Stork nests were located through most of the survey area, although the main areas were the north west and the south east (Figure 71). Nests were found in mangroves along the coast or river shoreline, in paperbarks on floodplains and in tall monsoonal forest trees close to wetlands. One was also found on top of a pillar of rocks. Active nests were sometimes found less than a kilometre apart, both in mangroves along the coast and in paperbarks on the floodplains. In one case at least three active nests were found within about a kilometre of coast just south east of the Limmen Bight River. No nests were found on any of the smaller islands, even though the birds visit these sites to feed (including nocturnal feeding on marine turtle hatchlings).

It is also possible that some of the unidentified large stick nests (Figure 71) recorded in mangroves or forested areas near wetlands may have been of Black-necked Stork nests.

In my surveys most nests were observed to have eggs or small young from March to May, with most nesting being finished by July/August. However, a few which had either started later or were perhaps re-nesting, were seen with eggs or tightly sitting adults in July. Individual nests that had begun in March had fledged their young by July.

Frith and Davies (1961) recorded Black-necked Stork nests beginning in May and June in wetlands to the east of Darwin.

Latitudes and longitudes taken while flying over nests were not always precise enough to permit confirmation that observations in other years were for the same nest. Nevertheless, a number of very close location readings in different years suggested individual nests can be re-used, or that new nests were constructed nearby. When time permits, a more detailed examination of these data may permit more confident inferences about re-use of the same sites and structures.

OSPREY

Geographic Distribution

Osprey were recorded from nearly all of the Northern Territory coast and most of the offshore islands (Figure 72). They were never seen far from the coast. They were generally less common in the western half of the Top End and the greatest number of records was in north east Arnhem Land and the Gulf of Carpentaria. They were not recorded at all from the Joseph Bonaparte Gulf and only occasionally along other parts of the coast such as the northern and eastern coasts of Van Diemen Gulf, Castlereagh and Arnhem Bays and in the vicinity of the mouth of the Roper River. These are all areas dominated by mangroves and mudflats, and with few islands in the vicinity. Such areas would presumably have a number of problems to hinder successful hunting by Osprey. The shallow, sediment-filled waters of these areas would make observing fish and avoiding obstacles hidden under the water more difficult. Lurking predators such as crocodiles would also be harder to see in terms of the Osprey becoming the hunted, while in the water.

Numbers

Osprey were second behind White-bellied Sea Eagle in terms of the number of times raptors considered in this project were recorded from ground surveys. Throughout all surveys there were 117 ground records of Osprey totalling 173 birds. These equate to just over 1.9% of all waterbird records but, as would be expected, well under 0.1% of the total number of waterbirds counted during all ground surveys. Osprey are another of the species which are spread around the coast in low densities. Hence, they were more likely to be represented in higher numbers in aerial surveys. Osprey were recorded a further 666 times from aerial surveys. This puts Osprey as the fifth most frequently recorded waterbird from aerial surveys.

Being a more solitary bird Osprey were nearly always recorded in ones and two, but records of up to six birds were made on occasions.

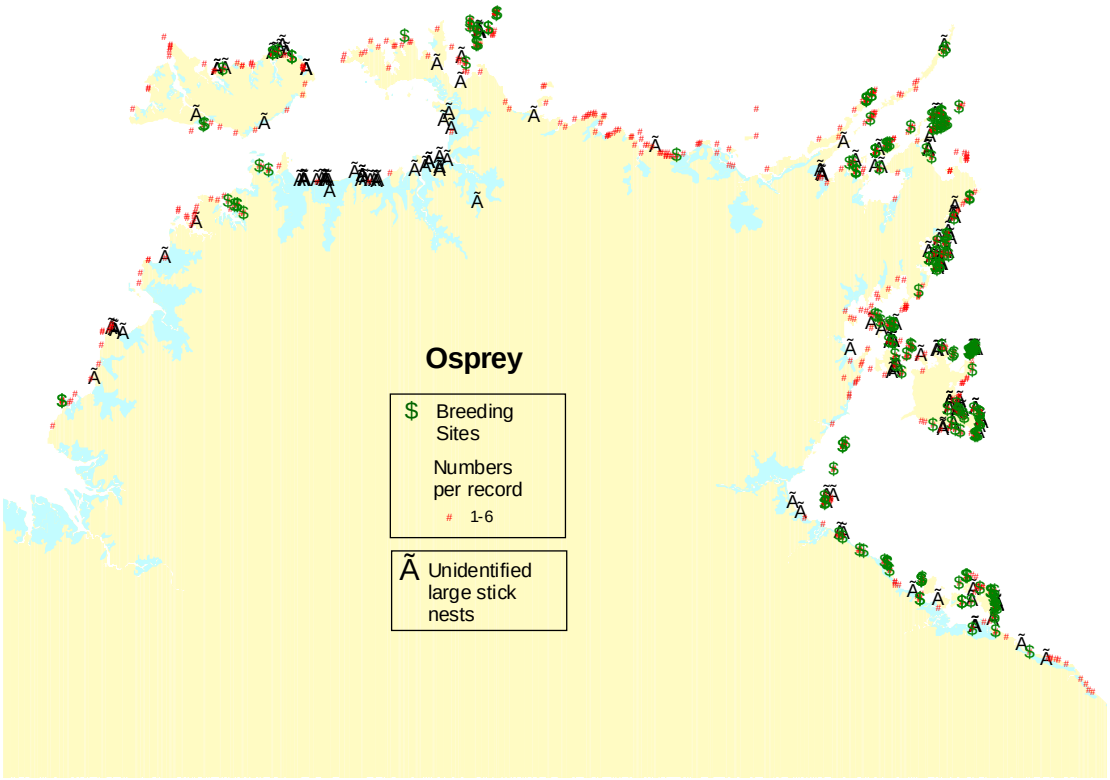

Figure 72. Distribution of all Osprey records.

Seasonality

Osprey were recorded in all months with nothing to suggest any significant seasonal changes in numbers. There was a slightly higher number of records in the month of May but this could be due to a combination of more intensive surveying of the Gulf of Carpentaria in this month and birds beginning to breed and becoming more conspicuous. Generally higher numbers were recorded from September through to November, which could be due to the influx of young into the population.

Breeding

Confirmed or probable Osprey nests were recorded on 201 occasions (Figure 72). These are all the records of nest sites, whether active at the time of recording or not. Also shown in Figure 72 are unidentified large stick nests. These are all larger nests that are likely to belong to Osprey, Brahminy Kite or White-bellied Sea Eagle (or occasionally Black-necked Stork). Some of these will likely be Osprey nest sites. As previously discussed with respect to Black-necked Stork, latitudes and longitudes for the same nest may have been recorded as slightly different on different surveys. Hence, multiple symbols in very close proximity on Figure 72 may represent one nest, but they may also represent more than one nest. Also a nest may have been assigned to a specific raptor (because of that bird being in attendance at the time) on one survey, and then recorded as an unidentified raptor nest on another survey, and these will also appear as two separate symbols on the map. Further surveys and analysis of data and notes will undoubtedly confirm the identity of most of these so far unconfirmed nests, not able to be done for this report.

The number of Osprey nests located during my surveys is certainly a considerable under-estimate of nests and even nesting territories, around the Northern Territory coast. This is also the case for the other two nesting coastal raptors covered in this report. The surveys were designed to cover many things and not specifically to locate raptor nests. Although nests located on rocks around the coast or on islands are easy to detect, those in trees behind the dunes are not – given they are less obvious and most of the coastal survey observations were made flying along the coast and looking seaward. A good example of this was shown when comparing notes with Parks and Wildlife Ranger Alan Withers who spent 10 years based on Cobourg Peninsula (north east of Darwin) in the 1980s and 1990s. He clearly had more records of Osprey (as well as White-bellied Sea Eagle and Brahminy Kite) nests than I had found in my surveys. It is also interesting to note that when his nest sites are compared to my actual Osprey records for the same area over the period of the surveys, nearly every nest site of his is close to an Osprey record of mine, while very few of my Osprey records are not near his nest sites. In other words the birds were more readily detected in such surveys than the nests. The locations of all coastal raptors reported in these surveys should be kept in mind when/if further surveying of nesting is done.

Confirmed Osprey nests from my surveys were recorded in two main sections of the survey area. There was substantial Osprey nesting in the north west of the survey area, but the majority was on the many large and small islands from north east Arnhem Land southward down the western side of the Gulf of Carpentaria to the Sir Edward Pellew Islands. Osprey nesting on some of the island chains off north east Arnhem Land, south of Cape Arnhem, the islands to the north and south east of Groote Eylandt and to the east of Vanderlin Island in the Pellews Group is quite dense. Active nests around a kilometre or less apart are found in most of these areas, and off the north east of Groote Eylandt there were four active nests on two adjacent islands in May 1994. There were two nests about one kilometre apart on Hawk Island and another two of similar distance apart on North East Isle. These two islands are about two kilometres apart. There were also another two active nests on nearby smaller islands at this same time. C. Limpus (1992) reports one nest with three eggs and one nest with two fledged young on Hawk Island in July 1992. I am not able to say whether they are the same nests but it is likely they are from the two territories on this island, suggesting use of these nearby nests in two out of two years for which observations are available.

The addition of the unconfirmed large stick nest sites to the map (Figure 72) does not change the overall distribution of possible Osprey nesting sites within these two main nesting areas. The areas where these unconfirmed nests could increase the Osprey nesting distribution are along the mid west coast of the Top End and around the southern and eastern coasts of Van Diemen Gulf, but most of these are most likely to be Brahminy Kite or White-bellied Sea Eagle nests.

There was a small number of locations where I recorded Osprey breeding in one season and White-bellied Sea Eagle in another season, sometimes on the same small island. At this stage I cannot say for certain that they were in exactly the same nest but have been told by a senior Traditional Owner (D. Yunupingu, *pers. comm.*) that this does happen.

Osprey nest sites were mostly on rocks on islands, but they were also found on the ground or beach on the islands. They were also located in trees along the coast and in man made objects such as electricity line towers, old boat masts and even on man-made platforms constructed specifically for Osprey to nest. Nests were found on the ground in among seabird breeding colonies, with the seabirds even commencing breeding around the base of the Osprey nest well after the Osprey had hatched young on their nest. As I have never observed Osprey feeding on terns this suggests added protection for the colony. This does not work so well for the terns when White-bellied Sea Eagle nest on the ground among their breeding colonies, which I have also observed. Large piles of tern carcasses also accompany these sites.

Osprey eggs were recorded in May, June, July and August, but most of the records were in May. Eggs in the latter part of this period were uncommon and may represent a second or restart nesting of that pair. Small young were recorded in April and old young in May so some pairs are obviously starting in late February and March. The latest month young were seen still on the nest was September.

Plate 23. Near-fledged Osprey young on a ground nest, Truant Island, July 1996. Photo R. Chatto.

BRAHMINY KITE

Geographic Distribution

Brahminy Kite were recorded throughout the survey area, but rarely very far from the coast, rivers or wetlands (Figure 73). They were not as frequently recorded on smaller offshore islands as either Osprey or White-bellied Sea Eagle. Brahminy Kite are easy to identify and fairly easy to see from the air so this map would represent a fairly good coverage of their overall distribution within the survey area.

Numbers

Brahminy Kite were one of the less frequently recorded and less abundant of waterbirds seen in ground surveys. Throughout all surveys there were 42 ground records of Brahminy Kite totalling 85 birds. The figures equate to less than 0.7% of all waterbird records and around 0.1% of the total number of waterbirds counted during all ground surveys. There were also a further 250 records from aerial surveys. This is higher than for ground surveys but they are still outside the top 20 most frequently recorded waterbirds from the air.

Being normally a more solitary bird Brahminy Kite were nearly always recorded in ones or two, but occasional records of up to five were made. However, others, such as N. McCrie (*pers. comm.*) have recorded up to 20 (mostly immature birds) in close proximity at the Darwin sewage ponds in the wet season of 1997.

Seasonality

Brahminy Kite were recorded in all months with nothing to suggest any seasonal changes in numbers over the survey area as a whole.

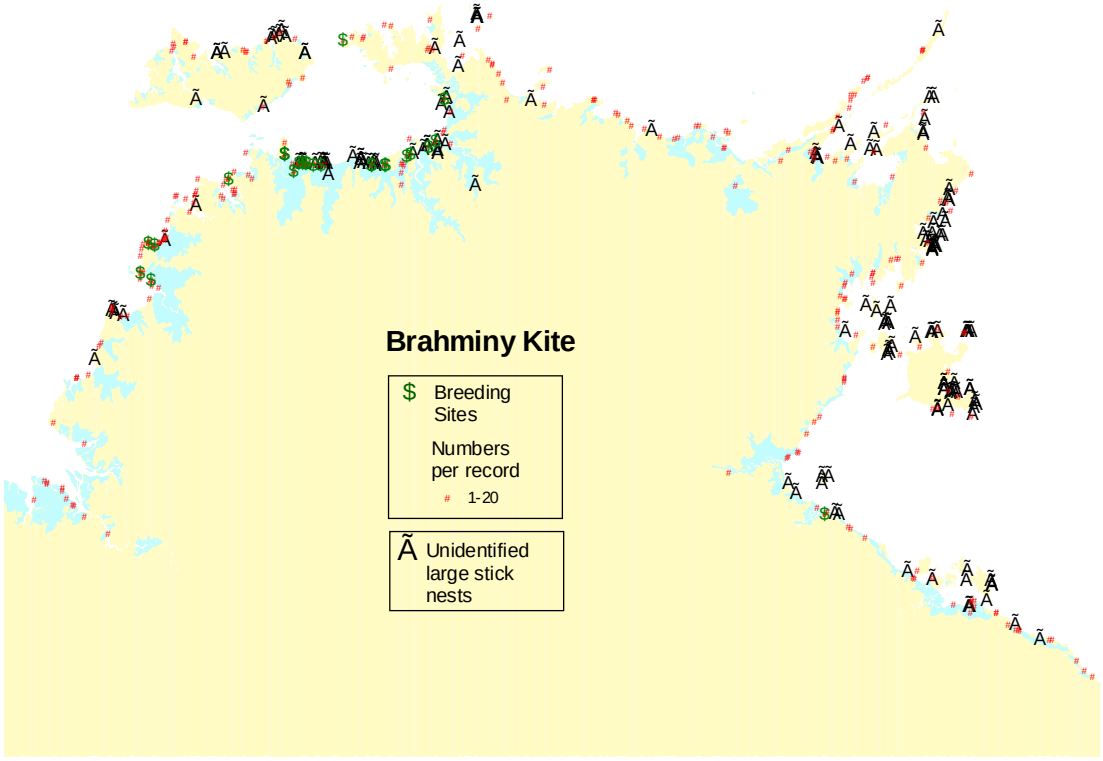

Figure 73. Distribution of all Brahminy Kite records.

Breeding

Confirmed or probable Brahminy Kite nests were recorded on 45 occasions (Figure 73). These are all the records of nest sites, whether active at the time of recording or not. Also shown in Figure 73 are unidentified large stick nest sites. Some of these will likely be Brahminy Kite nest sites. As discussed in the Osprey section, when referring to nests on Cobourg Peninsula, the number of Brahminy Kite nests detected in my surveys was well under the number recorded by A. Withers in the years he was stationed in this area. This is also likely to apply to other parts of the survey area.

The discussion in the Black-necked Stork section referring to multiple symbols in the one area on the distribution map possibly representing the same nest recorded on different surveys also applies to Brahminy Kite nests.

Except for one nest in the south east of the survey area, all Brahminy Kite nests were recorded from the north west. Why this is so, given they were widely distributed around the coast of the entire survey area is unknown. Brahminy Kite nests were always located in trees, not on rocks or the ground as Osprey and White-bellied Sea Eagle. They were usually close to the sea or a water body. They were also recorded nesting in suburban Palmerston and Darwin. The highest density of confirmed Brahminy Kite nests was along the south coast of the Van Diemen Gulf to the east of Darwin. In an aerial survey in early September 1993 that concentrated on nests in the coastline vegetation only, at least ten pairs of Brahminy Kite were recorded nesting in a 125km section of coastline. Along one part of this coast there were four nests within 6km of the coast and six within 18km.

Brahminy Kite were recorded sitting in mid July to early September and there was at least one record of a fully feathered young standing on a nest in late November. This seems to be the reverse to the nesting season quoted for this species by others who suggest breeding from the late wet season until mid dry (eg Storr, 1977 and Goodfellow and Stott, 2001).

Plate 24. White-bellied Sea Eagle (see over) taking a fish. Photo. R. Medling.

WHITE-BELLIED SEA EAGLE

Geographic Distribution

White-bellied Sea Eagle were regularly recorded throughout the survey area (Figure 74). They were recorded on small and large wetlands from the upper reaches of rivers through to, and all around the coast and on most of the offshore islands. The only part of the survey area where they were not recorded throughout was the Joseph Bonaparte Gulf in the south west. The situation on Melville Island is interesting when compared with a survey in the early 1900s. Mathews (1914) reported that Sea Eagle were rare on Melville Island but that Brahminy Kite were numerous. In my surveys I recorded both species on numerous occasions. Perhaps the numbers of White-bellied Sea Eagle has increased over the years, although Mathews would not have had the benefits of aerial survey.

White-bellied Sea Eagle are easy to identify and fairly easy to see from the air so this map would represent a fairly good coverage of their overall distribution within the survey area.

Numbers

White-bellied Sea Eagle were the most frequently recorded raptor in ground surveys. They were of course well down the list in terms of the most abundant species compared to all other waterbird species. Throughout all surveys there were 139 ground records of White-bellied Sea Eagle totalling 202 birds. The figures equate to just under 2.3% of all waterbird records but less than 0.1% of the total number of waterbirds counted during all ground surveys. There were also a further 480 records from aerial surveys, making them the 9th most frequently recorded waterbird from the air.

Being a solitary bird White-bellied Sea Eagle were nearly always recorded in ones or twos, but occasional records of five plus birds, and up to ten were made at times.

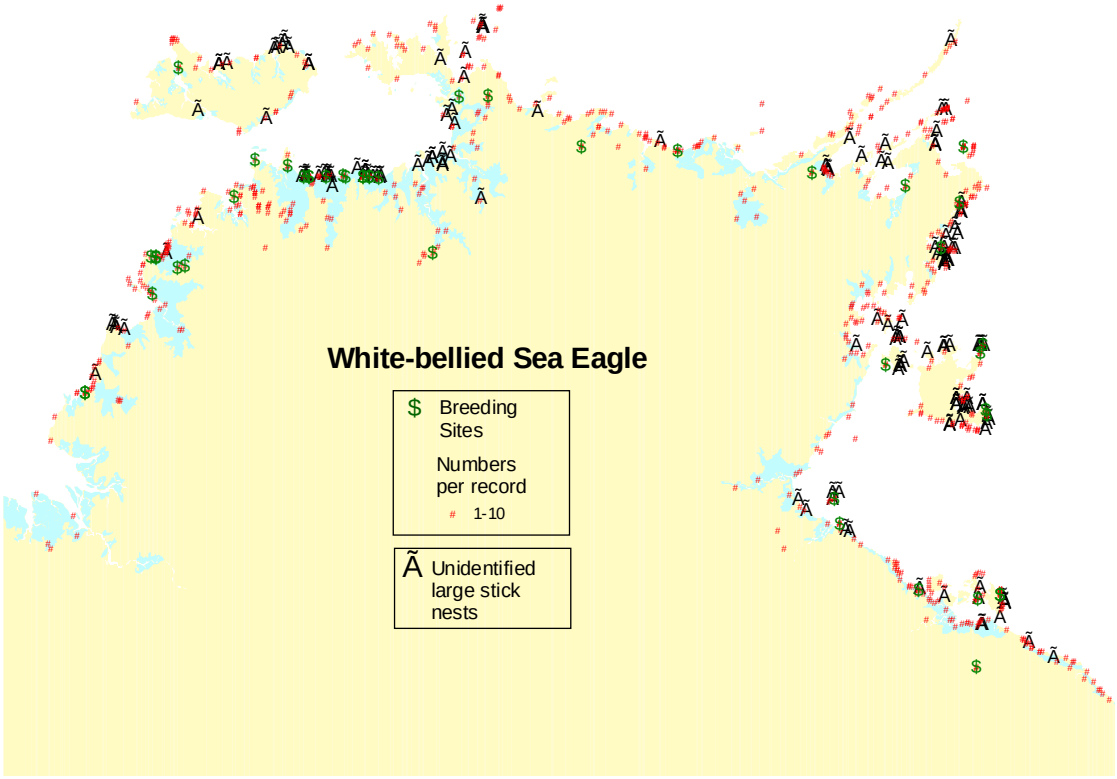

Figure 74 Distribution of all White-bellied Sea Eagle records.

Seasonality

White-bellied Sea Eagle were recorded in all months with nothing to suggest any seasonal changes in numbers.

Breeding

Confirmed or probable White-bellied Sea Eagle nests were recorded on 45 occasions (Figure 74). These are all the records of nest sites, whether active at the time of recording or not. Also shown in Figure 74 are unidentified large stick nest sites. These are all larger nests likely to belong to White-bellied Sea Eagle, Osprey or Brahminy Kite (or occasionally Black-necked Stork). Hence, some of these will likely be White-bellied Sea Eagle nest sites. Even considering records of unidentified large stick nest sites, the number of White-bellied Sea Eagle nests within the survey area is certainly going to be much greater than has been recorded in my surveys. This can be shown from more detailed work done by others in specific areas. A & E Withers *(pers. comm.)* reported 19 regularly used nest sites on Cobourg Peninsula, which is far more than I located in my surveys. Reasons for this have been previously discussed in the Osprey section. Another example is on the Magela Floodplain near the East Alligator River. Morton *et. al.* (1991) reported regular nesting in several places. None were confirmed in my surveys, although several large raptor nests were recorded when they were not active and not able to be confirmed to a species level during aerial surveys at the time. F. Woerle *(pers. comm.)* reports White-bellied Sea Eagle nesting on Copeland and Cowlard Island (off Croker Island) in July 1977. Both of these nests were located during my surveys but were not in use and therefore recorded as 'unidentified raptor' nests, even though thought to be White-bellied Sea Eagle nests. If the above three examples are reflective of other parts of the survey area then the number of White-bellied Sea Eagle nesting in this part of the Northern Territory is likely to be many more than I have recorded, thus making the survey area very significant for this species.

The discussion of very adjacent multiple symbols in the one area (see Black-necked Stork) on the distribution map is probably due to some nests being recorded at slightly different coordinates rather than necessarily being different nests.

Confirmed White-bellied Sea Eagle nests were recorded throughout the survey area. They were located in trees, on rocks and on the ground. The highest density of confirmed nests was along the coast of Chambers and Finke Bays in the Van Diemen Gulf area to the east of Darwin. A July 1993 aerial survey concentrating on nests in the coastline vegetation only, recorded at least six pairs of White-bellied Sea Eagle nesting in a 65km section of coastline. The nearest two nests were 5km apart and three of the nests were in a 15 km section of coast. This is not as high a density as some of the Osprey nesting detailed previously.

There were some locations when I recorded White-bellied Sea Eagle breeding in one season and Osprey in another season, sometimes on the same small island. At this stage I cannot say for certain that they were in exactly the same nest but have been told by a Traditional Owner (D. Yunupingu, *pers. comm.*) that this does happen.

White-bellied Sea Eagle eggs were recorded between early May and mid June, downy young in July, and well feathered young from mid July to mid September.

One of the highest densities of nesting White-bellied Sea Eagle (21 active nests) recorded in Australia is reported along the Mary River area (S.C.R.S.R.).

SWAMP HARRIER

Geographic Distribution

Swamp Harrier were recorded from scattered locations throughout the survey area (Figure 75). Most records were along the northern part of the survey area, particularly the wetlands to the east of Darwin. With the exception of one record on a small island off Croker Island, Swamp Harrier were not recorded on islands. However, it is likely they would occasionally visit at least the larger islands with wetlands. A & E Withers *(pers. comm.)* reports them at times on Cobourg Peninsula, J. Woinarski (*pers. comm.*) reports one on the Wessels Islands and they are reported from Groote Eylandt in Noske and Brennan (2002).

Numbers

Throughout all surveys there were 29 ground records of Swamp Harrier totalling 34 birds. The figures equate to around 0.5% of all waterbird records and well under 0.1% of the total number of waterbirds counted during all ground surveys. There were also a further 43 records from aerial surveys. Most of the records of Swamp Harrier were of single birds but records of up to four birds were made during the surveys.

Seasonality

Swamp Harrier were recorded as a dry season visitor, beginning to arrive in March and gone by October. They were recorded every month from March to September but not outside of this period. The greatest number of records was in July, followed by August. These two months were also the only two months in which observations of more than one bird per record were made.

Breeding

No records were made of breeding by Swamp Harrier during the surveys.

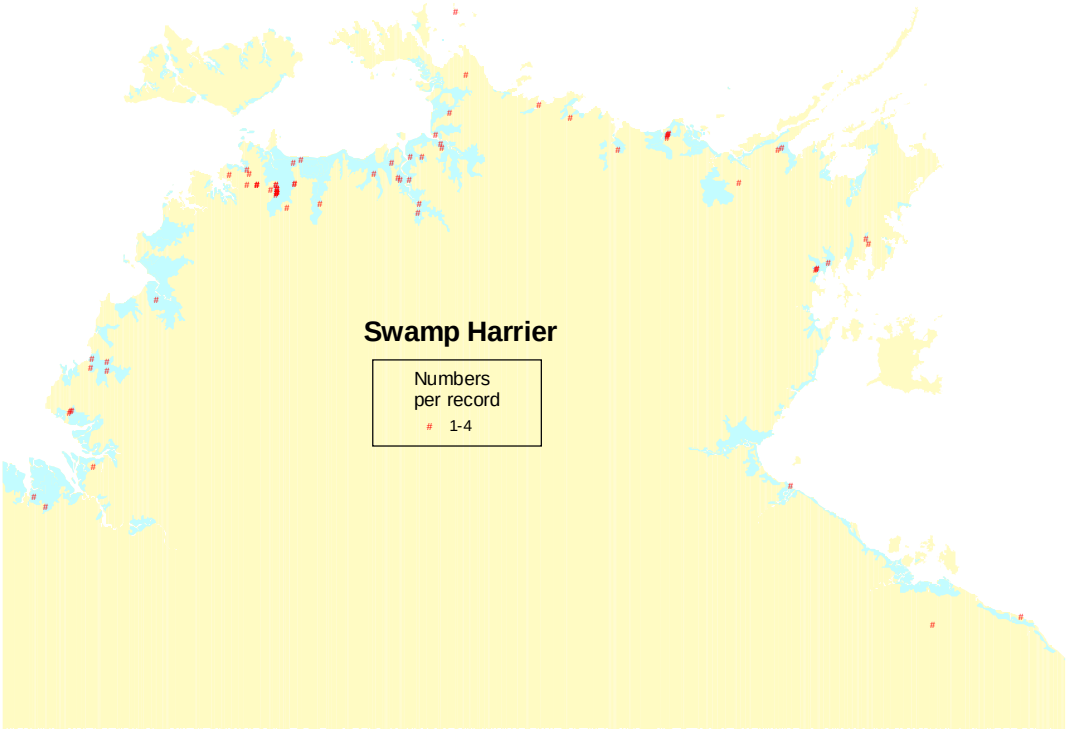

Figure 75. Distribution of all Swamp Harrier records.

BROLGA

Geographic Distribution

Brolga were recorded through the survey area (Figure 76). Most of the large counts were in the northern part of the survey area. Flocks on most of the eastern side of the Top End were generally smaller. Brolga were recorded on all wetlands from the smaller inland swamps through to the saline coastal wetlands, and were frequently observed out in the middle of hot, dry (often burnt) floodplains in the late dry season. This is a fairly extensive habitat type late in the dry season and not one that was very well surveyed. Brolga would leave these areas from time to time during the day to fly into wet areas to drink.

Numbers

Brolga were a reasonably frequently recorded and abundant species in ground surveys. Throughout all surveys there were 127 ground records of Brolga totalling just over 15 100 birds. The figures equate to around 2% of all waterbird records and around 2.5% of the total number of waterbirds counted during all ground surveys. In aerial surveys they were recorded on 403 occasions and the total numbers from these records made them the 10th most abundant waterbird counted in aerial surveys.

Around half the Brolga records were of two pairs or less, but flocks of up to 5 000 were also recorded. This latter count was a total for a stretch of flood plain about half a kilometre wide and running for several kilometres and it was at a time where seasonal conditions had drawn a huge number of waterbirds into the area. This site, near Murgenella, was further discussed under the survey block 7 section of this report. Other single records of 3 000 or more birds were also made on the Tomkinson River floodplain south of Maningrida and in the very important Brolga area to the north of Blue Mud Bay. All of these records were in the mid to late dry season.

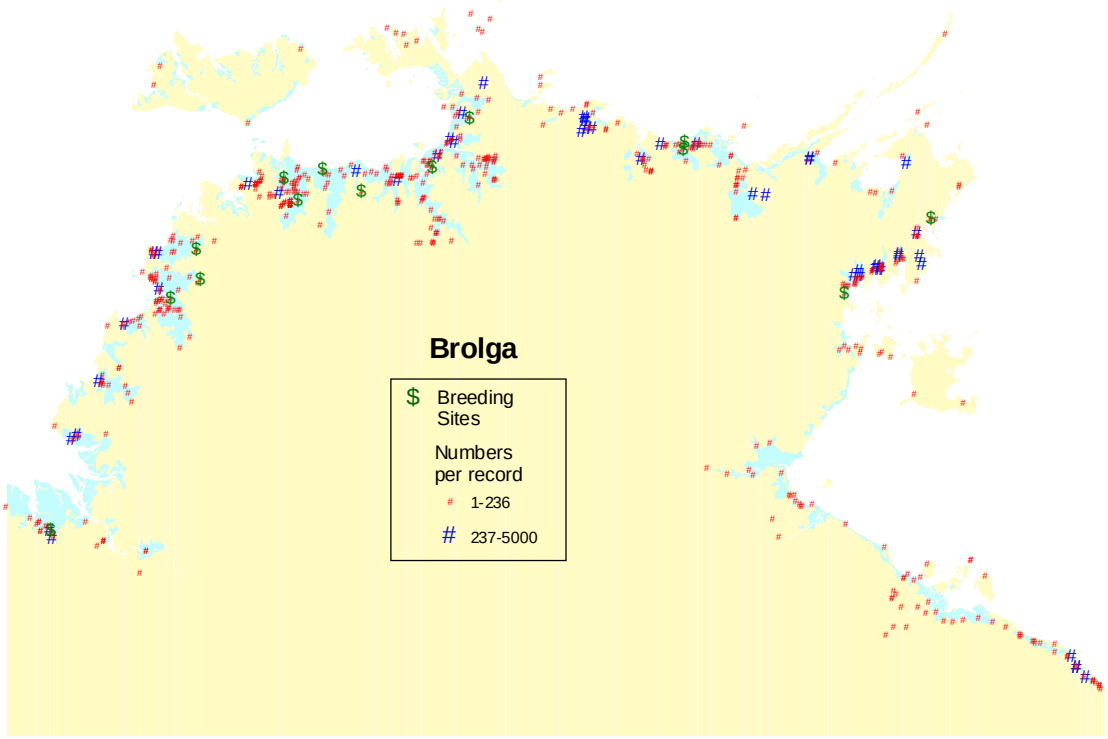

Figure 76. Distribution of all Brolga records.

Seasonality

Brolga were recorded in all months of the year. The number of records fluctuated a little but in general was highest between March and October, but the monthly count totals were clearly highest from July to September.

Breeding

There were only 14 breeding records of Brolga during my surveys (Figure 76). Except for one record in the far south west, these records were all in the northern part of the survey area and well spread. These breeding records suggested breeding between March and September. Most records were of eggs in March with young being seen into July. The single September record was in the far south west of the survey area which may see Brolga nesting a little different in timing in the north of the survey area, although A & S Keates *(pers. comm.)* reports breeding in the south west in April 2004 as well.

Others reporting breeding from areas where breeding was not recorded in my surveys include on Cobourg Peninsula (A & E Withers, *pers. comm.*) and the upper Adelaide River, the Liverpool floodplain, the Glyde River floodplain north of the Arafura Swamps, in behind Buckingham Bay, the wetlands associated with the Goromuru and Peter John Rivers around Melville Bay, the wetlands above Grindal and Jalma Bays, in from Bennet Bay in the southern part of Blue Mud Bay and the Rose River, north of the Roper River (C.R.A., S.C.R.S.R.).

The number of Brolga nests seen during my surveys pales into insignificance compared to the numbers of Brolga recorded. Even though the upstream wetland areas where Brolga also nest (Bayliss, 1985) were not well covered during these surveys, it is unlikely that a large number of Brolga nests would have been missed if all Brolga remained in the survey area to breed. Hence, most Brolga must move out of the survey area to breed. R. Jaensch (*pers. comm.*) has noted the lower Cape York area is an important nesting area for this species, and this may be one possible example of a breeding site for Brolga from my survey area.

Plate 25. Feeding Brolga, Kakadu. Photo F. Woerle.

CHESTNUT RAIL

Geographic Distribution

Chestnut Rail were recorded in scattered locations through the northern and eastern parts of the survey area (Figure 77). They were recorded from mangrove areas around the coast and along the downstream parts of rivers, and also on a number of islands. They were not recorded from anywhere along the west coast of the survey area to the south of Bynoe Harbour. They were most frequently recorded on the islands off North East Arnhem Land. Being normally secretive birds, they were not well covered in my surveys and their distribution is likely to be a lot more extensive around the Northern Territory coast than shown on the map. Chestnut Rail were more easily detected on islands because they utilized sandy and rocky areas rather than just thick mangroves, and could often be seen from the air as well as the ground. On these islands they could also be initially suspected and then detected by their habit of repeatedly using a particular small rock on a beach to break mollusc shells. This is further detailed in Woinarski *et. al*. (1998).

Numbers

Throughout all surveys there were 21 ground records of Chestnut Rail totalling 61 birds. The figures equate to around 0.3% of all waterbird records and less than 0.1% of the total number of waterbirds counted during all ground surveys. There were also a further 12 records from aerial surveys.

Most records were of single birds, but groups of several birds were seen at times on some of the smaller islands off North East Arnhem Land.

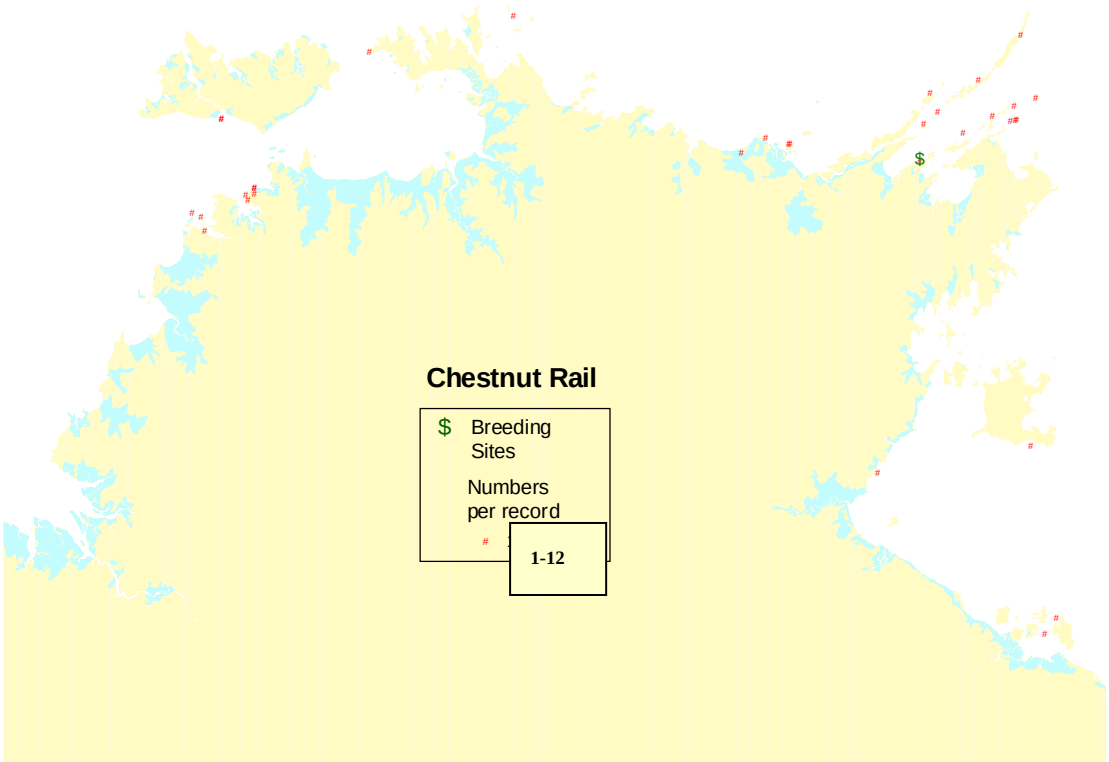

Figure 77. Distribution of all Chestnut Rail records.

Seasonality

Even though there were not a lot of records in total, Chestnut Rail were recorded fairly evenly throughout all months during the year, suggesting that this species is a resident of the survey area.

Breeding

Chestnut Rail are likely to be a resident breeding waterbird but nests are even more hidden than the birds themselves, and the nests were not searched for during these surveys. One possible record of breeding was made on one of the islands off North East Arnhem Land in September 1994, but this was based on behaviour of an adult rather than actually finding the nest (Figure 77).

There are a number of other breeding records for this species in the survey area. Nesting in the Darwin area has been documented from September to January (Raglass, 1977; Franklin and Barnes, 1997). Mathews, (1914) records eggs on Melville Island in early November and A & E Withers *(pers. comm.)* records them breeding on Cobourg Peninsula, but could not remember exactly when, other than probably in the wet season.

Plate 26. Example of a small rock used by Chestnut Rails for breaking shells. Photo R. Chatto

PURPLE SWAMPHEN

Geographic Distribution

Purple Swamphen were recorded from a number of sites in the north west part of the survey area but at few locations outside this area (Figure 78). This is one of the species of waterbird covered in this report that is likely to be an irregular and infrequent visitor to the survey area, being seen in reasonable numbers at certain sites in some years and not at all at the same sites in other years. The largest 10% of records, by count, were scattered throughout most of their recorded range in these surveys.

Purple Swamphen were most frequently recorded on larger freshwater wetlands but sometimes on smaller ones. They were mostly found on wetlands dominated with reeds or sedges. All but one of the records (on a fairly large swamp on an island of the mid north coast) were on the mainland.

Numbers

Throughout all surveys there were 17 ground records of Purple Swamphen totalling over 3 700 birds. The figures equate to around 0.3% of all waterbird records and around 0.6% of the total number of waterbirds counted during all ground surveys. There were also a further 17 records from aerial surveys.

Purple Swamphen were recorded in groups varying from one or two birds through to a large group of 2 000 birds on a single wetland in the far south west in June 1999. There were ten records of 100 or more birds.

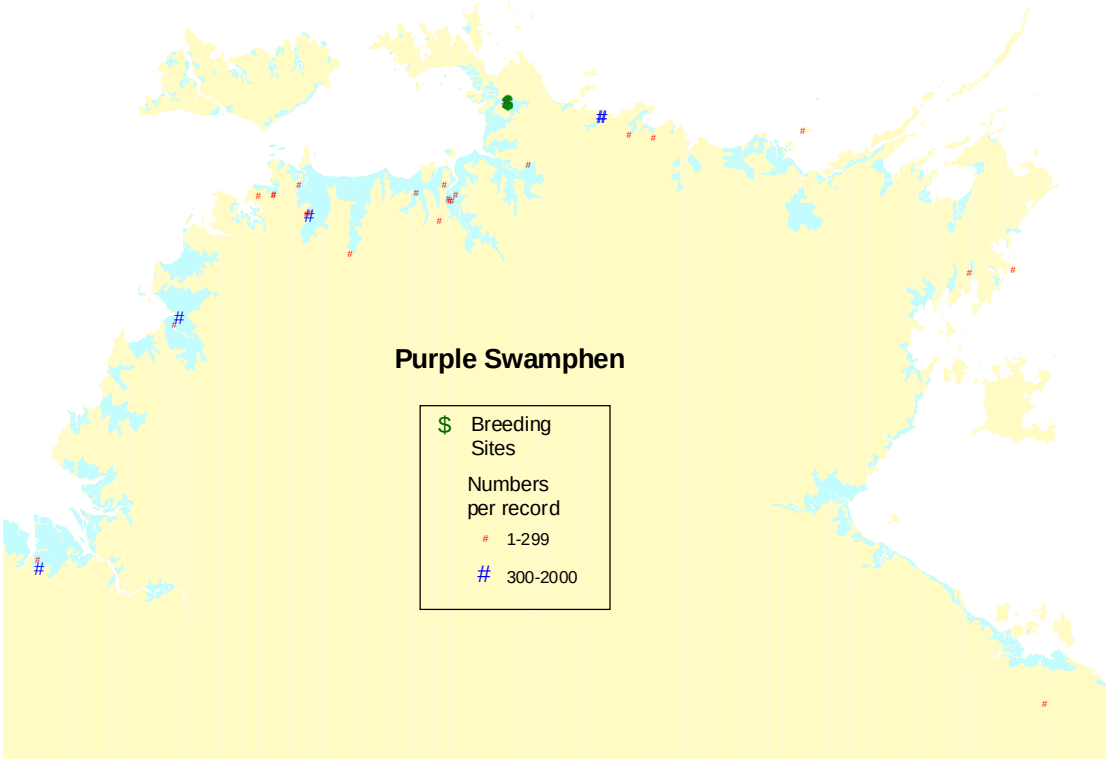

Figure 78. Distribution of all Purple Swamphen records.

Seasonality

Purple Swamphen were recorded in all months except January, March, May and September. They were recorded 13 times in the month of April but all other months had five or fewer records. There are insufficient records to comment confidently on any seasonal pattern, although they suggest Purple Swamphen are more likely to be present in the dry season. However, as indicated before, this species is likely to be irregular in its visitation to the survey area. Morton *et. al.* (1991) recorded Purple Swamphen on only a few occasions during many repeat surveys of sites in the Alligator Rivers area between 1981 and 1984. All records, except one in January, were made between June and September.

Breeding

Purple Swamphen were only recorded breeding on the one occasion during my surveys (Figure 78). This was at two nearby locations on the large wetlands associated with Murgenella Creek to the north of Kakadu National Park. No counts were made because it was difficult to see all the nests from the air but there would have been 'tens' of nests at least. There were at least 500 birds in these areas at the time. This area was flown on a number of other occasions during the full period of the project and Swamphen only recorded once, suggesting that as well as erratic visitation of Purple Swamphen to the survey area, breeding is also only occasional.

During the survey period, breeding was also recorded on the wetlands of Legune Station in the far south west of the survey area, with two pairs, each with two young, reported by A & S Keates *(pers. comm.)*. A & E Withers *(pers. comm.)* also reports this species to occasionally breed in the early wet on Cobourg Peninsula with 6-8 pairs seen breeding at three different sites during his time stationed in this area.

P. Whitehead *(pers. comm.)* reports seeing young Purple Swamphen on Opium Creek, east of Darwin, in March 1988, and Frith and Davies (1961) reported them to breed between February and July in the floodplains between Darwin and western Arnhem Land in 1957, but they do not comment on numbers. Jaensch (1994) recorded only 16 pairs breeding on four inland wetlands of the sub-humid tropics of the Northern Territory, but suggested there could be more breeding in the region.

Plate 27. Purple Swamphen. Photo M. Armstrong.

EURASIAN COOT

Geographic Distribution

The Eurasian Coot was recorded at a small number of scattered locations during these surveys (Figure 79). As they are probably an irregular and infrequent visitor to most of the freshwater wetlands in the survey area, except perhaps in the far south east and south west, distributional records are likely to be more widespread than were detected in these surveys. Morton *et. al.* (1991), for example, observed Eurasian Coot on three occasions (between 50 and 350 birds) in their surveys of the Alligator Rivers area between 1981 and 1984, but none were seen in extensive aerial surveys of the same area during my surveys.

Most of my records were in, or just to the east, of the Darwin area. The higher number of records on these wetlands may suggest more birds here than elsewhere in the survey area. However, it is probably more the case that the greater number of surveys in this area increases the chances of seeing species which are only occasional and erratic visitors.

Having said that, there is one site within this Darwin area where Eurasian Coot have become regular dry season inhabitants. These are a group of artificial wetlands created around a golf course in a housing estate in Palmerston (just out of Darwin) over recent years. One to two hundred birds have now come to be regular mid dry to early wet season visitors to these wetlands, along with other such new visitors as Hardheads.

Numbers

Throughout all surveys there were 13 ground records of Eurasian Coot totalling around 5 200 birds. The figures equate to around 0.2% of all waterbird records and around 0.9% of the total number of waterbirds counted during all ground surveys. There were also a further three records from aerial surveys.

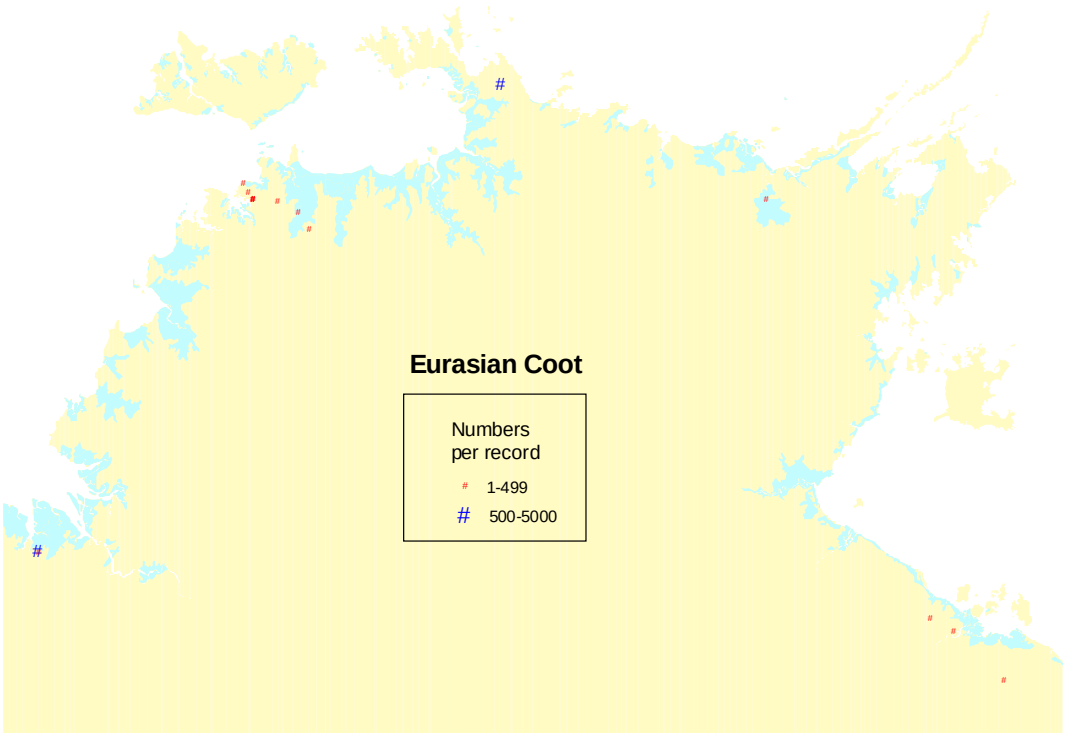

Figure 79. Distribution of all Eurasian Coot records.

Apart from a large flock of 5 000 recorded on a wetland in the south west of the survey area in June 1999 (and a smaller flock of 500 during exceptionally good conditions on a large wetland near Murgenella) all records of Eurasian Coot were of small groups.

Seasonality

Eurasian Coot were recorded in all months of the year except April, May and November. In all but two of the months where records were made there was only a single record each month. The only multiple record months were August (two records) and July (seven records). This does not include the regular presence of Eurasian Coot on the Palmerston wetlands, which have only been recorded once for the purpose of the distributional database. There are insufficient records from the surveys to confidently state a seasonal pattern to Eurasian Coot presence in the survey area, but they do suggest mostly dry season visitation and irregular presence over different years. Unrecorded observations over recent years on the Palmerston Golf Course artificial wetlands have shown Eurasian Coot to regularly turn up in the late dry season and remain until the first good rains. Both of these beginning and end dates can vary a little each year. In the 2004/2005 wet season it was noticed that a small number of birds did not leave. As Eurasian Coot are a species that have shown they can become a permanent resident on artificial urban wetlands in other parts of Australia, there may come a time when more of the birds remain permanently on these wetlands.

Breeding

Eurasian Coot were not recorded breeding within the survey area during these surveys, and no other documented records in the literature were found. However, A & E Withers *(pers. comm.)* reports seeing small numbers of Eurasian Coot breeding at two sites on Cobourg Peninsula in the early wet season.

To the south of my survey area Jaensch (1994) did record a small amount of Eurasian Coot breeding in the inland wetlands of the sub-humid tropics. Although he recorded breeding at eight sites, only 59 pairs were involved. This involved a relatively small survey effort, but in wetter years large numbers visit the Barkly wetlands, for example over 100 000 were estimated to be in the area in April 2002 (R. Jaeasch, *pers. comm.*).

Plate 28 Comb-crested Jacana (see over). Photo R. Chatto.

COMB-CRESTED JACANA

Geographic Distribution

Comb-crested Jacana were recorded throughout most of the survey area, but more frequently in the northern parts (Figure 80). There were few birds recorded on the northern part of the eastern side of the Top End and over most of the western side. The lack of records in the high waterbird density and diversity wetlands between the Finniss and the Moyle Rivers on this western side is surprising. This species is not always easy to detect from the air and most of the records are from ground surveys. Consequently, it is likely that the distribution map for this species shown in this report is under-representative and Comb-crested Jacana are probably found on many more wetlands than shown here.

Comb-crested Jacana were found primarily on wetlands with floating vegetation such as lilies or fallen reeds that allow walking over the water. Consequently, they were found mostly on persistent freshwater wetlands rather than saline coastal wetlands. They also frequented smaller isolated inland swamps. More detailed surveying of these habitats would likely further increase their recorded distribution within the survey area.

Numbers

Throughout all surveys there were 187 ground records of Comb-crested Jacana totalling just under 3 800 birds. The figures equate to just under 3.1% of all waterbird records and around 0.6% of the total number of waterbirds counted during all ground surveys. There were also a further 26 records from aerial surveys.

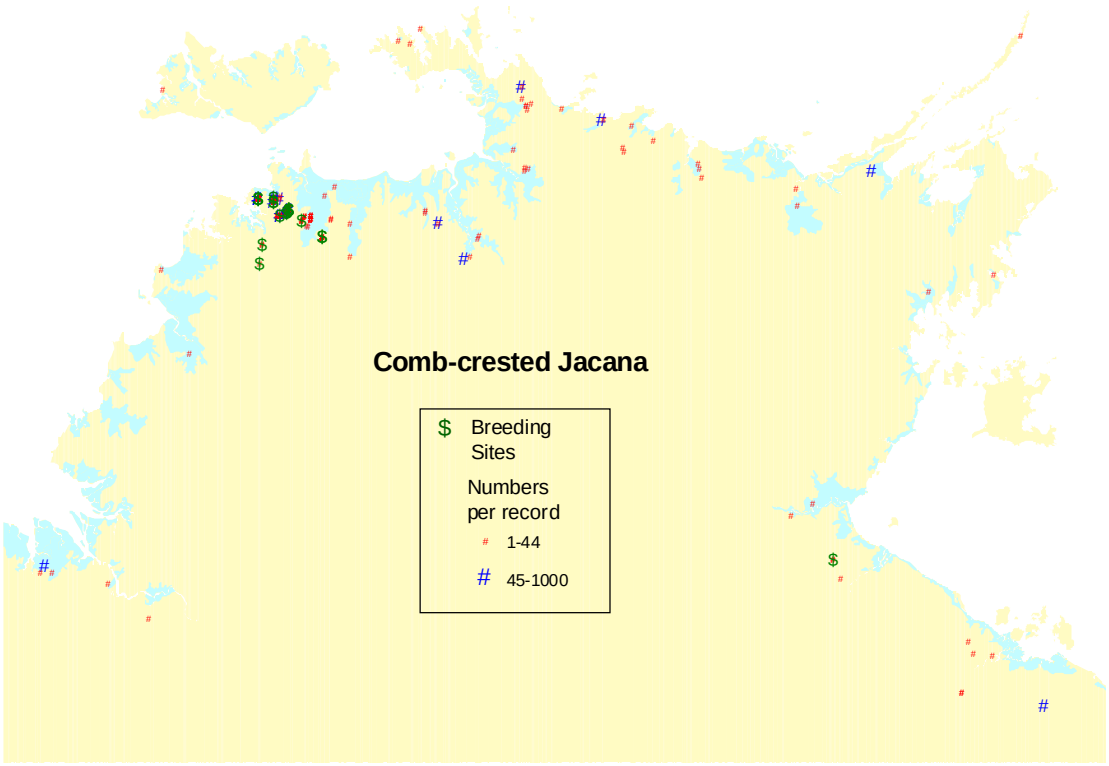

Figure 80. Distribution of all Comb-crested Jacana records.

Comb-crested Jacana were normally recorded in pairs or small groups. However, there were some quite large, high density groups at some sites. The largest record was of at least 1 000 birds, but this was a total count over quite a large wetland in exceptionally wet circumstances. This was south of Murgenella in August 1992 and has been previously mentioned in more detail (see survey block 7 summary). Other than this there were seven counts of 100 or more birds. These were all quite dense aggregations on relatively small wetlands (or remaining sections of water on larger floodplains) in the late dry season, and included fledged young from recent breeding. N. McCrie (*pers. comm.*) recorded 2 000+ on Fogg Dam to the east of Darwin in September 1983.

Seasonality

Most Comb-crested Jacana appear to be resident within the survey area. They were regularly recorded in all months of the year, although there was a definite increase in the number of records and the total counts of birds in the late dry season. This would likely be due to a combination of the concentrating of birds onto the drying back wetlands and the influx of fledged young into the population. The number of records and the total number of birds took a fairly sharp rise in August and then an equally quick drop off in December, probably due to local dispersal out onto the floodplains following the first of the wet season rains. This species is one of the few species (which include Magpie Goose, Whiskered Tern, White-winged Black Tern and the egrets, except Cattle Egret) to be present in good numbers out on the extensive areas of wet floodplain during the height of the wet season.

Breeding

Comb-crested Jacana were recorded breeding on 19 occasions (Figure 80). Breeding was observed on small swamps and large floodplains. Comb-crested Jacana were recorded breeding in each month between March and November, though mostly in the first half of this time period.

Apart from one record in the south east all breeding in my surveys was recorded around or near Darwin. This is certainly not their entire breeding range within the survey area as I have seen (but not recorded) nests when doing other air boat work on the floodplains to the east of Darwin. Other authors have also reported them breeding from other locations in the survey area. Why more breeding was not seen in my ground surveys in other areas is uncertain. However, if most breeding occurs out on the large floodplains then it would be difficult to detect in my surveys. Nests would not be able to be seen from the ground on the edges of these large floodplains, or from the air. (This situation may also apply to the lesser number of records of birds in the wet season). Airboat surveys of the floodplains would be one method to detect such nests but this was very infrequently done during my surveys. This method of surveying can also be very harmful to the nesting of such species.

Morton *et. al.* (1991) reports Comb-crested Jacana breeding in large numbers on the Magela Floodplain in Kakadu National Park. A number of other authors also document breeding, but all only refer to single or small numbers of nests, even though sometimes saying the birds are common in the area. Mathews (1914) for example, reported Comb-crested Jacana were common on the Jesse Creek wetlands on the north side of Melville Island but only reports one nest of four eggs. Hill (1913) also confirms Comb-crested Jacana breeding in the McArthur River area in the south east of the survey area but only refers to two clutches of eggs in mid January.

A & E Withers *(pers. comm.)* reports Comb-crested Jacana breed on Cobourg Peninsula. Frith and Davies (1961) reports Comb-crested Jacana nesting on the floodplains to the east of Darwin in January, April and May in their report table but makes no further reference to them in their text.

Jaensch (1994) reports finding small numbers breeding near the coast in his sub-humid tropics wetlands surveys, which include wetlands in the far south east and south west of my survey area.

BLACK-WINGED STILT

Geographic Distribution

Black-winged Stilt were recorded in most surveys and throughout the survey area (Figure 81). The distribution of the highest 10% of counts was also spread throughout the survey area, but most birds were recorded on the coastal wetlands to the east of Darwin and the area between the Roper River and Limmen Bight Rivers on the east coast. Other more important areas included around Blue Mud Bay and the coastal wetlands in the south west and south east of the survey area. Being easy to identify from the air, this distribution of this species within the survey area is likely to be fairly comprehensive.

Black-wing Stilt were not recorded on many islands but were recorded on the bigger ones such as the Tiwi Islands and Groote Eylandt. There was also a single bird seen a small swamp out on the end of the Wessel Islands chain.

Numbers

Black-winged Stilt were in the top 10 most frequently recorded and most abundant waterbirds in ground surveys. Being under-represented in this form of analysis because they leave the survey area to breed, they are likely to be among the most abundant waterbirds in the survey area when present. Throughout all surveys there were 194 ground records of Black-winged Stilt totalling over 27 600 birds. The figures equate to around 3.2% of all waterbird records and around 4.6% of the total number of waterbirds counted during all ground surveys. There were also a further 635 records from aerial surveys, which makes them the 4th most frequently recorded waterbird from the air. They were also number six on the list in terms of total numbers recorded from aerial surveys.

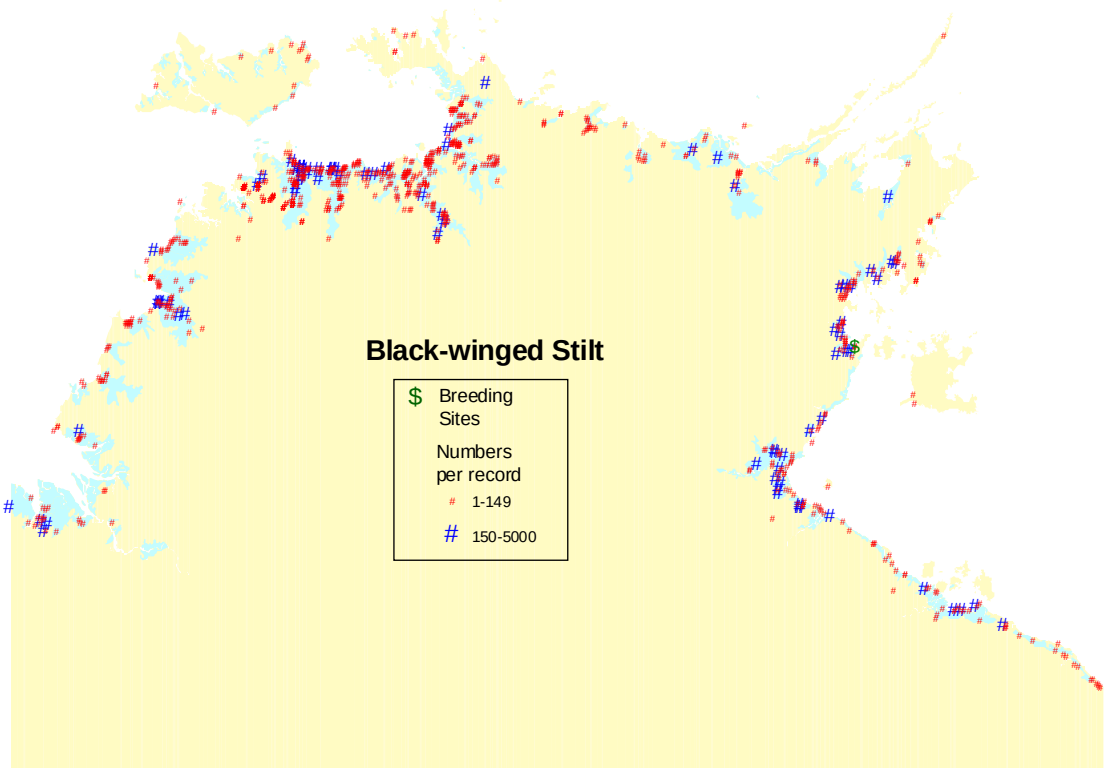

Figure 81. Distribution of all Black-winged Stilt records.

Black-winged Stilt were regularly recorded in groups of all sizes from single birds through to the largest single record of 5 000 birds, which was in the dry season on the coastal wetlands south of the Roper River. This count was actually only of a portion of the many thousands of birds in that area at the time, 14 000 of which were recorded in a single transect along the wetlands in the area parallel to the coast.

Seasonality

Black-winged Stilt were recorded in every month of the year, but least so in January and February. Although some Black-winged Stilt can be seen at any time of year, more birds appear to be present in the survey area in the dry season. Both the number of records and the total numbers counted, began to rise in March and there was clearly many more birds recorded from April to August compared to other months. Morton *et. al.* (1991) also reports that Black-winged Stilt were rarely abundant during the wet season but were common on most floodplains in the Alligator Rivers area in the dry season.

Breeding

Very few of the many thousands of Black-winged Stilt that visit the survey area remain to breed, and even then probably only very occasionally. There was only one small colony of five pairs found nesting at one site on one occasion during these surveys (Figure 81). This was on a small wetland near Blue Mud Bay and the birds were on eggs in mid May 1999. Outside of the survey period Crawford (1972) also reported a single nest with three eggs in March 1969 on a swamp near Darwin, and Goodfellow and Stott (2001) and N. McCrie (*pers. comm.*, via Hilary Thompson) report December to May breeding has occurred at Darwin and Palmerston sewage ponds, but all are very uncommon and single pair events. This breeding has included downy young in December and eggs and chicks in March.

Juvenile plumage birds were seen on a number of occasions during the surveys, suggesting birds are arriving here after breeding outside of the survey area. They were noted in all months between April and October, with most records in May. Although juvenile plumage birds were not always recorded, there were none noted outside of these months.

Garnett (1986) refers to 5 000+ Black-winged Stilt breeding on the ephemeral swamps inland from the Gulf of Carpentaria (Queensland) which is to the south east of my survey area. These colonies may not be regular, but if they were active during my survey period they may have attracted large number of Stilt from the south east of the survey area in years when the colonies were active. A similar situation may exist in the south west of the survey area, as R. Jaensch (*pers. comm.*), has recorded Black-winged breeding on the coastal plains of the north west coast of Western Australia following cyclonic rains. Further evidence to suggest such colonies are not regular can be seen by large numbers of Black-winged Stilt being recorded in all the dry season months over different years during my surveys. More detailed, future analysis of the Black-winged Stilt records collected during surveys of this area may provide better knowledge of such movements.

Jaensch (1994) found Black-winged Stilt to be among the top 10 birds by number in his survey area of the Barkly Tableland wetlands, but only found one colony of about 40 pairs breeding, although his surveys were not done during the wet season. R. Scoccimarro *(pers. comm.)* reports around 10 pairs breed each dry season on the Katherine Sewage Ponds, although this is around 300 km south of my survey area.

Marchant and Higgins (1990) documented only two breeding records in the Northern Territory for this species.

RED-NECKED AVOCET

Geographic Distribution

Red-necked Avocet were recorded from scattered locations throughout the mainland survey area (Figure 82). Most birds were recorded on the bare saline wetlands just in behind the coast in an area just to the east of Darwin, around Blue Mud Bay and between the Roper and Limen Bight Rivers on the east coast. Being easy to identify from the air, this distribution of this species within the survey area is likely to be fairly comprehensive.

Red-necked Avocet were not recorded on any of the islands, nor Cobourg Peninsula, though A & E Withers *(pers. comm.)* reported them as an occasional visitor to the latter site.

Numbers

Throughout all surveys there were 25 ground records of Red-necked Avocet totalling around 6 500 birds. The figures equate to around 0.4% of all waterbird records and around 1.1% of the total number of waterbirds counted during all ground surveys. There were also a further 40 records from aerial surveys.

Most records were of medium to larger groups with two thirds of the records being of 50 or more birds in a flock. The largest single flock was of at least 3 000 birds on a wetland just to the east of Darwin.

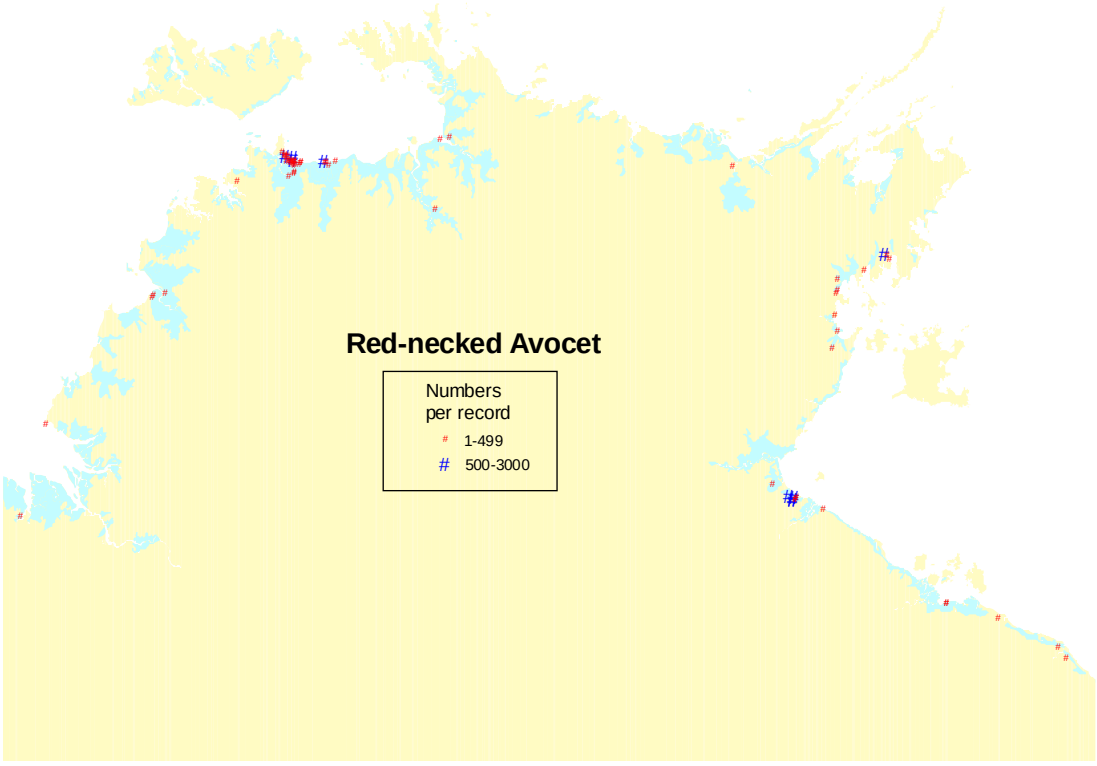

Figure 82. Distribution of all Red-necked Avocet records.

Seasonality

Red-necked Avocet were recorded in all months except January, February and June. The number of records for the months that this species was recorded, are relatively even except for highs in July and December and a low in October. The lack of an obvious seasonal pattern from these records could be a reflection on the low number of records in conjunction with survey biases. Total numbers of birds counted in these months, however, seemed to suggest higher numbers in the early to mid dry season, but a high number in December may also suggest some irregularity to their seasonal use of wetlands in the survey area.

Breeding

Red-necked Avocet have never been documented as breeding in the survey area and were not recorded breeding during the surveys. Jaensch (1994) found Red-necked Avocet breeding at only one site (involving only three pairs) during his surveys in the Barkly Tableland sub-humid tropics wetlands between March and September 1993.

Plate 29. Red-necked Avocet. Photo C. Minton.

MASKED LAPWING

Geographic Distribution

Masked Lapwing were recorded in most surveys and from throughout the survey area (Figure 83). They were most frequently recorded in the north west. The highest 10% of counts were also spread throughout the survey area, indicating that in most places they occurred they were present in good numbers. Being easy to identify from the air, this distribution of this species within the survey area is likely to be fairly comprehensive.

Masked Lapwing were recorded in all habitats from urban and rural, watered short grasslands, through all types of large and small fresh and saline wetlands to coastal beaches. They were also regularly recorded on larger islands.

Numbers

Masked Lapwing were the most frequently recorded waterbird in ground surveys, and 11th on the list for aerial surveys. Throughout all surveys there were 318 ground records of Masked Lapwing totalling around 10 300 birds. The figures equate to around 5.2% of all waterbird records and around 1.7% of the total number of waterbirds counted during all ground surveys. There were also a further 441 records from aerial surveys.

Although there were some very large dry season concentrations recorded during the surveys, most records were of pairs or small groups scattered throughout the area. The largest single record was of 800 birds. This was in late July 1998 in the Arafura Swamps but several records of groups of 300 or more were recorded on wetlands at a number of locations between there and the Daly River.

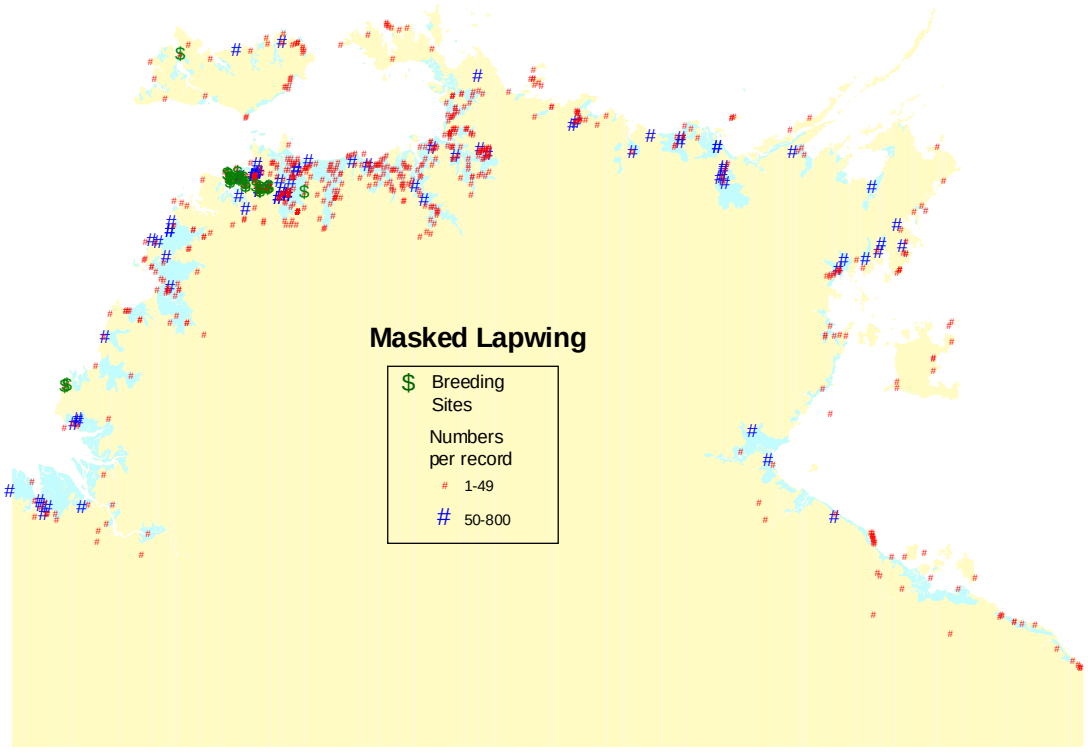

Figure 83. Distribution of all Masked Lapwing records.

Seasonality

Masked Lapwing were recorded in all months of the year. Over the survey area as a whole the number of records and the total number of birds was lowest from December to February and highest in April and then from July to October. An aerial survey done over the wetlands on the Mary River floodplain in May 1991 made note of the large increase in numbers of Masked Lapwing (along with other birds such as Straw-necked Ibis and Australian Pratincole) from the March surveys of the same area. This suggests birds may disperse or move inland out of the survey area during the wet season. Morton *et. al.*, (1991) also found numbers of Masked Lapwing fluctuated from low numbers in the wet season to a peak in October on the Alligator Rivers system east of Darwin. With the wet season flooding causing water to be too deep for them over their normal grassland feeding areas, some of the birds may also move into areas like Darwin where such habitats (eg ovals, golf courses etc.) are not flooded. It is also possible that movements of Masked Lapwing may vary from year to year depending on how much of their habitat goes under water.

Breeding

Masked Lapwing were recorded breeding on 23 occasions during the survey period (Figure 83). Apart from one record in the south west and one on Melville Island, all were in the vicinity of Darwin. Breeding was recorded in all months except June suggesting breeding can occur at any time throughout the year, but was less likely to commence during the later part of the dry season.

The number of breeding records in the Darwin area, compared to the rest of the survey area is a little surprising but this may be influenced by additional Darwin records coming from complaints from residents about swooping birds. It may also be that Masked Lapwing are more likely to breed on short grassed high ground areas away from the actual surveyed wetlands, and perhaps they do not advertise their nesting as readily by being defensive in areas away from frequent human presence. These points, in combination with the quick nature of most site visits during these surveys, could be reasons why few were recorded breeding away from the Darwin area. Even so, if a reasonable percentage at least of the Masked Lapwing recorded in the survey area bred there, then it would be expected that more breeding instances would have been recorded. Perhaps many birds depart the survey area to breed but because their breeding season can be quite extended there are always some non breeding birds present, particularly when discussion is based on looking at the cumulative monthly totals over all years.

Other authors have confirmed breeding in other areas within the survey area, but none refer to numbers that are close to the number of non-breeding birds present in their respective areas. A & S Keates *(pers. comm.)* for example reported several chicks among the hundreds of Masked Lapwing on the wetlands around Legune Station in the far south west of the survey area in late April 2004. To the east of Darwin, Frith and Davies (1961) reported some Masked Lapwing eggs on the rice-field levee-banks between January and May, while further east around the East Alligator River F. Woerle *(pers. comm.)* reports chicks (in mid January) on only a small number of occasions compared to references to other breeding water birds. Morton *et. al*. (1991) also reports breeding on dry banks near water in the early dry season in the Alligator Rivers Region. Further to the east, Thompson (1983) reports being informed of two young on the South Goulburn Island airstrip in late January. Along the east coast of the survey area, Noske and Brennan (2002) report chicks present on Alyangula Golf Course on Groote Eylandt although they do not say when, however, I observed a pair on eggs in February 2006 – after doing the analysis of data for this report. White (1917) reported one nest of eggs on a salt pan adjacent the Roper River in February 1916. In the Borroloola area Hill (1913) reported small flocks of Masked Lapwing to be present in the open country from October to December, but only thought that breeding commenced in January.

Jaensch (1994) found Masked Lapwing to be among the top 10 birds by number in his survey area but only found three instances of breeding, although his surveys were not done during the wet season.

AUSTRALIAN PRATINCOLE

Geographic Distribution

Australian Pratincole were recorded throughout the survey area, though observations were fewer and scattered in the south east (Figure 84). This species would not have been well covered in my surveys because it frequented dry (often burnt) floodplains and grasslands away from wet areas at the time. As scattered individuals roosting or hunting over these types of habitats were more difficult to see, particularly during aerial surveys, many birds would have been missed. As such it is a species likely to be found in more locations within the survey area than shown here.

Apart from two records on the Tiwi Islands, Australian Pratincole were not recorded on any islands or Cobourg Peninsula during my surveys. However, others have reported them on some of these areas. A & E Withers *(pers. comm.)* reports they can be reasonably numerous on Cobourg Peninsula (i.e. 100's) at times, Noske and Brennan (2002) details reports of occasional occurrences of this species on Groote Eylandt and Woinarski (*pers. comm.*) has observed them on the Wessel Islands in the north east.

Numbers

Throughout all surveys there were 110 ground records of Australian Pratincole totalling around 4 000 birds. The figures equate to around 1.8% of all waterbird records and around 0.7% of the total number of waterbirds counted during all ground surveys. There were also a further 19 records from aerial surveys.

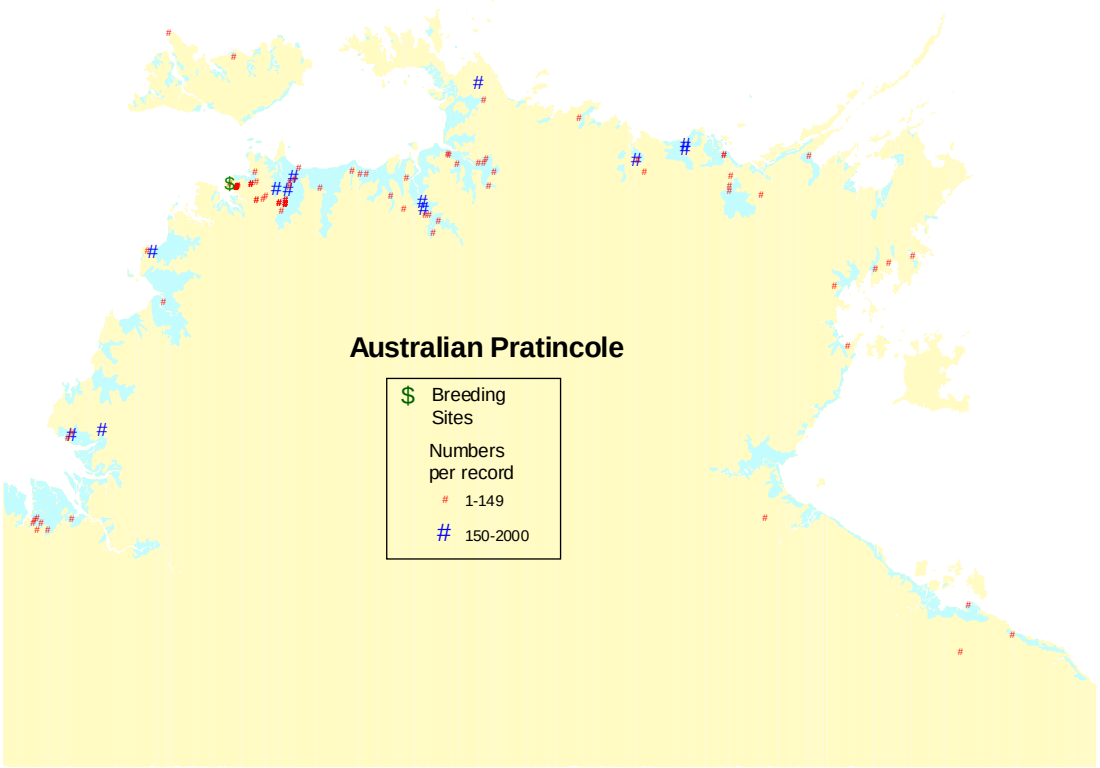

Figure 84. Distribution of all Australian Pratincole records.

As well as being under represented in terms of overall distribution within the survey area, numbers counted are also likely to be well under. This occurs because many areas with birds present would not have been surveyed and those that were would likely to have given underestimates because of the difficulty in the aerial observing of a bird that is dispersed in low densities and is difficult to see against dry bare floodplain or burnt grassland. This difficulty was also pointed out by Morton *et. al.* (1991), but they were able to improve their estimate of numbers in the Alligator River wetlands with extensive ground surveys. As an indication of how my counts of this species could be well under throughout the survey area, Morton *et. al.* estimated around 30 000 birds present in their survey area during the dry season, while my limited surveys of this area revealed nowhere near this number.

Most observations of this species during my surveys involved birds hunting in low densities over large areas. As such most of the records were of 50 birds or less. However, there were still some reasonable aggregations (involving up to 2 000 birds) recorded. All of the birds involved in the highest 10% of flock counts were recorded along the northern and western coast of the mainland. This is where there was extensive areas of dry and/or burnt floodplain in the vicinity during the dry season.

Seasonality

Australian Pratincole were recorded only between April and December, although there were only six records in November and one in December. The highest monthly count was in July but the greatest number of individual records was in October. This species is mostly a dry season visitor to the survey area. Morton *et. al*. (1991) reported this species to reach a peak in November on the Alligator River wetlands, and then disappear the following month. As my surveys showed numbers dropping over the full survey area in October, some birds may move into the Alligator Rivers system prior to migrating. Substantial numbers migrate to Indonesia (Higgins and Davies, 1996).

Breeding

This species was not recorded breeding by me during these surveys but there were at least two records made during the survey period by other observers. Consequently, it appears most birds leave the survey area to breed. Although recorded on 23 wetlands in the sub humid tropics just south of my survey area Jaensch (1994) did not record this species breeding, although this may reflect survey timing and location of nests away from wetlands.

Reports of breeding in the survey area are restricted to three examples in Darwin. N. McCrie (*pers. comm.*) reports a pair nesting in Darwin in November 1991 and L. Eclipse (*pers. comm.*) reported a pair successfully hatching young at Darwin Airport in October/November 2003. J. Estebergs (*pers. comm.*) has known this species to breed in paddocks near Lee Point, Darwin.

Frith and Davies (1961) reported that although nests of Australian Pratincole were not actually located on the floodplains to the east of Darwin in 1957, March/April behaviour clearly suggested breeding.

A & S Keates *(pers. comm.)* reported 59 birds on 25 April 2004 on Legune Station in the far south east of the survey area to all be in breeding plumage but were probably arrivals from southern breeding grounds.

GULL-BILLED TERN

Geographic Distribution

Gull-billed Tern were recorded throughout the survey area (Figure 85). They were primarily recorded from along the coast and the more saline open wetlands in behind the coast. Their presence on large dry saline flats, such as in from the Port McArthur area, meant they may have been missed because these areas were not often fully surveyed. They were also regularly recorded on small and large islands in the survey area. On the coast, Gull-billed Tern were often found in mangrove areas with associated mud or mud/sand intertidal zones. In some of these mangrove and mud bays they were often seen in good numbers associated with many Little Tern, a species more often associated with more sandy beaches around other parts of the Australian coast. (Gull-billed Tern were also seen harassing Little Terns in these areas).

Sometimes difficult to distinguish from Caspian Terns in aerial surveys, there was also a combined Gull-billed and/or Caspian category recorded during these surveys. There were 111 records of this combined group, but the addition of these records to the map of Gull-billed Tern would not extend their overall distribution within the survey area (Figure 85).

The two sub-species of Gull-billed Tern (the larger Australian sub-species *macrotarsa*, and the smaller Asian sub species *affinis*) were both regularly observed throughout the survey, sometimes together. Most records were made without separating the two sub-species and so discussion here mostly relates to the two sub-species combined.

Numbers

Throughout all surveys there were 191 ground records of Gull-billed Tern totalling just over 11 200 birds. The figures equate to 3.1% of all waterbird records (10th) and around 1.8% of the total number of waterbirds counted during all ground surveys. As Gull-billed Tern leave the survey area to breed, these percentages could be higher for parts of the year. However, this would be further complicated by the different movement patterns of the two sub-species.

There were also a further 251 Gull-billed Tern records from aerial surveys. As well as the 111 *gull-billed/caspian tern spp.* records, there were also 3077 *tern spp.* records, involving 339 000 birds (Figure 86) made during aerial surveys. There are many other species (including Gull-billed Tern) that could have been involved with the *tern spp.* records along the coast, but most of the inland records would have involved this species, Caspian Tern, Whiskered Tern or White-winged Black Tern. The addition of this *spp.* records would undoubtedly increase the number of records and total counts for Gull-billed Tern.

Gull-billed Tern were recorded in flocks of all sizes from single birds to the largest single record of 750 birds. There were nine separate records of 350 Gull-billed Tern or more, and all except two (one near Murgenella and one in Buckingham Bay in the north east) were in Chambers Bay to the east of Darwin. All of these records were in the dry season, between late April and early September.

Seasonality

As little effort was made to count the two sub-species separately, and each has a different seasonal movement pattern, it is hard to make informative comment on seasonality. Over such a large survey area, this is further complicated by the probable irregular breeding movements out of the survey area by the Australian sub-species, and the failure of some individuals of the Asian sub-species to migrate in a given year.

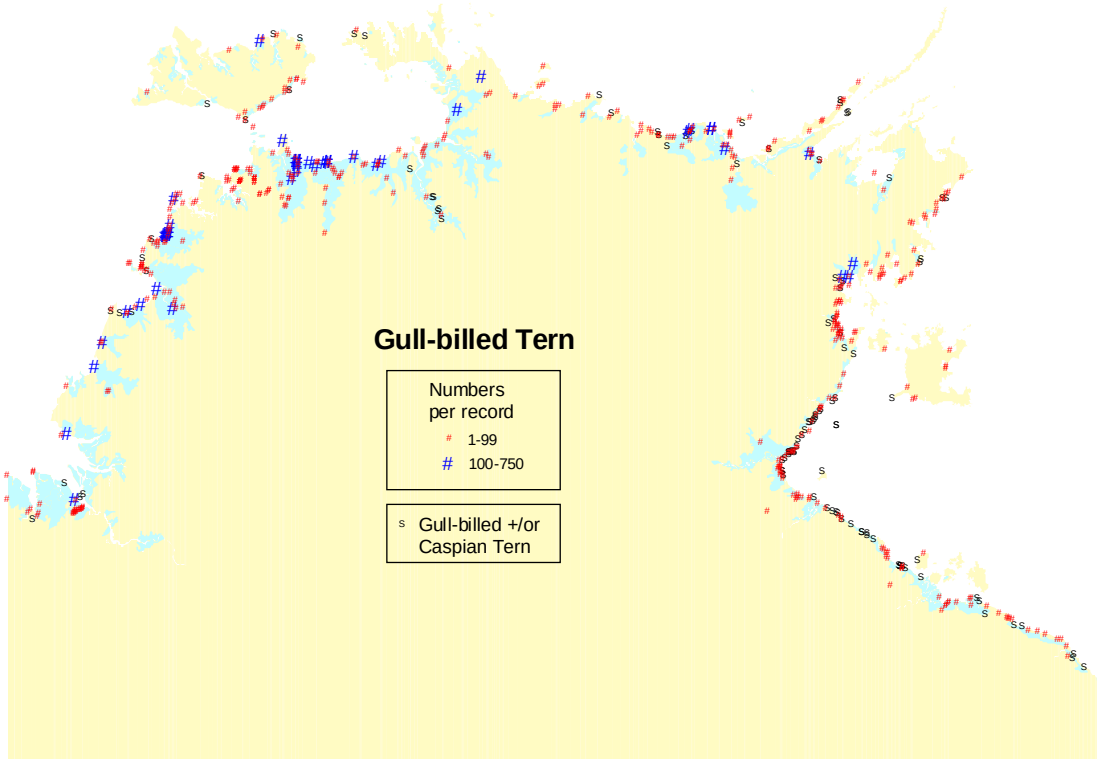

Figure 85. Distribution of all Gull-billed Tern records.

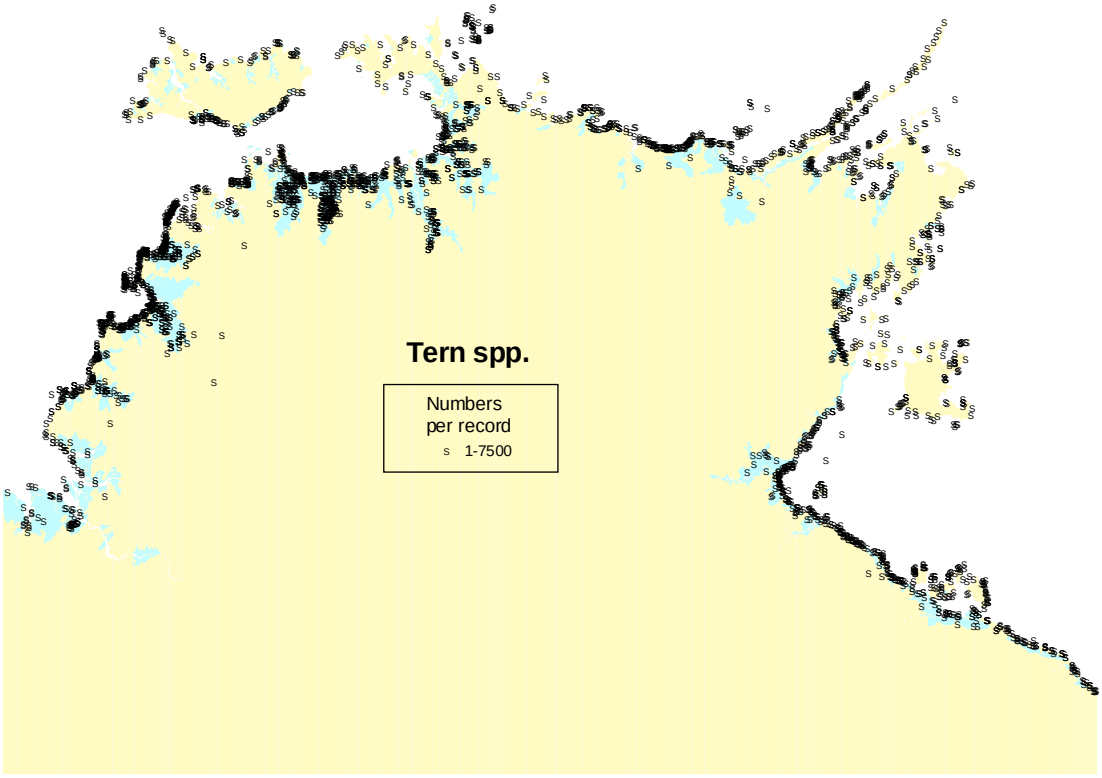

Figure 86. Distribution of all *Tern spp.* records.

Recognising these constraints, surveys showed Gull-billed Tern, as a combined group, were recorded in all months of the year. There were a lower number of records in January and February. This may have represented movement out of the area by the Australian sub-species for breeding. The months with the greatest number of records were July through to November, but the largest numbers of birds recorded were July to September. As an indication of flock size the average number of birds per record, was highest from April to September. Given the migratory patterns of the Asian sub-species (ie dry season departure) these results suggest that there are more of the Australian sub-species in the survey area.

Bamford (1990) found Gull-billed Tern to be most common in August in Kakadu National Park between 1987 and 1990, while McKean (1980) reported the Australian race *macrotarsa* to winter in Darwin between May and November and the Asian race *affinis* was only recorded in small numbers between September and April.

Breeding

Gull-billed Tern were not recorded breeding in the survey area during these surveys and have not been reported to do so in the past. Gull-billed Tern flocks with some, or all, in breeding plumage were noted in all months from April to November, though the only record in November was of partial breeding plumage. Extensive notes were not made to definitively separate the two sub-species but both were seen in breeding plumage. The Asian sub-species was specifically noted as being in good breeding plumage in mid October in the south east while the Australian sub-species in the same area were not in breeding plumage. Breeding plumage reported in the month of April, but not referenced to a particular sub-species, may have also involved Asian birds prior to migration north. Outside the months of April and October most of the breeding plumage probably relates to the Australian sub-species. For example, flocks of both sub-species were seen to have only the Australian sub-species in breeding plumage in all months between May and September. Nevertheless, it is possible that over-wintering Asian sub-species may go into breeding plumage in Australia, as was observed during these surveys for some over-wintering migratory shorebirds.

Most Gull-billed Tern flocks that had birds in breeding plumage, also had birds in non-breeding plumage. This applied to both sub-species. One or two birds were recorded in partially moulted out juvenile plumage on two occasions, once in August and once in October, but the sub-species was not recorded. No full juvenile plumage birds were ever recorded, of either sub-species.

Jaensch (1994) did not find breeding Gull-billed Tern in the Barkly Tableland wetlands south of my survey area in surveys between March and September 1993, but K Bellchambers *(pers. comm.)* subsequently found 800 nests at three sites in this area in 1994/5.

COMMON TERN

Geographic Distribution

Common Tern were recorded along the coast and out to sea in a number of locations around the survey area (Figure 87). Observations on this species were limited compared to most other species detailed in this report because of the small amount of time spent doing surveys at sea, and this species is probably much more widely distributed than shown. Observations that were made during surveys at sea, and on offshore islands, suggested that they spent most of their time at sea hunting among pelagic fish feeding aggregations when conditions were suitable. Depending on the sea conditions and the distance off shore (which was usually further than the range of inshore tern species such as Crested Terns), Common Tern would either roost at sea in large flocks or, if close to land (usually islands), make trips back and forth to hunt. Large land roosting flocks were seen during the day on a number of islands around the coast, while at other locations those resting at sea during the day could be seen coming into roost on islands just before dark.

The series of records running in a NW/SE line off the mid north coast were made on a boat trip from Millingimbi to Darwin. Here many thousands of Common Tern were observed feeding over the tuna feeding aggregations, and then resting in large rafts of birds on the water between feeds. Common Tern were by far the dominant species present in this area at this time. The boat was in motion continually through day and night, but records were collected only during daylight hours. Common Tern would probably have been present during daylight hours to the east and west of the 'line of dots' on the map but this area was travelled at night. Once around Cobourg Peninsula and into Van Diemen Gulf there was more daylight steaming but few Common Tern present.

Common Tern were occasionally seen hunting in the downstream section of larger rivers, but only recorded on inland wetlands on two occasions. On one occasion a single bird was seen over a freshwater wetland near Darwin in late November 1991. The other record is actually a little out of the survey area but is included here as it is of interest. The record was of a small number of cyclone-blown sick and dead birds found on a tailing dam of the Merlin Diamond Mine to the south east of the survey area in March 2001. Common Tern also frequent the Darwin Sewage Ponds, but this is very close to the coast.

Consideration should also be given to coastal records of the many *tern spp.* records shown in Figure 86 and discussed previously under the Gull-billed Tern section.

Numbers

Throughout all surveys there were 108 ground records of Common Tern totalling over 20 700 birds. (Boat records are counted as ground records for the purposes of this section. Boat records relate to a number of species but mainly to this species). The figures equate to around 1.8% of all waterbird records and around 3.4% of the total number of waterbirds counted during all ground surveys. There were also a further 13 records from aerial surveys. It is also likely that some of the more than 1 200 *tern spp.* records between the months of September and February (corresponding to the main period of time that Common Tern are in the survey area) could include Common Tern.

It is difficult to say much about the overall abundance of this species, because the majority of their feeding habitat was out to sea and hence outside of the main survey area and/or out of normal survey hours. As such, only a tiny proportion of the population was ever surveyed; either at sea when feeding or on land after dusk when they came in to roost. They are also one of the species that leave the area to breed. Nevertheless, it is likely that Common Tern may well be the most abundant of the birds considered in this report if all Northern Territory territorial waters were regularly included in the survey area.

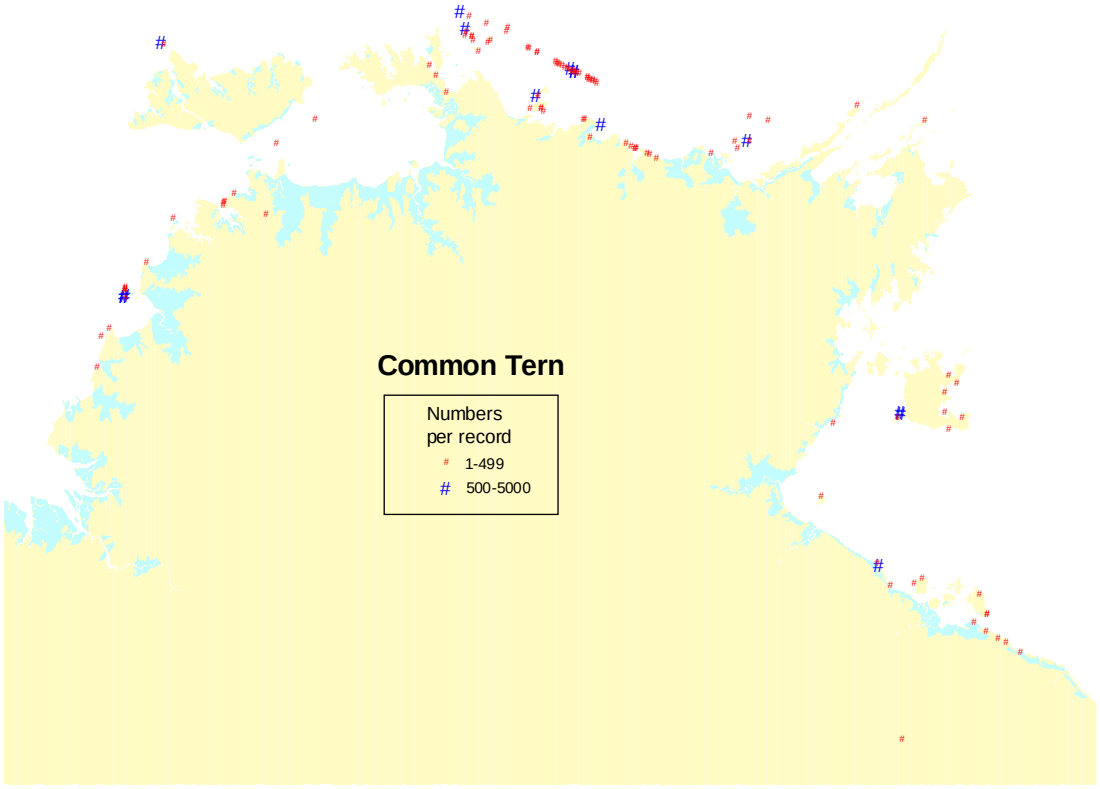

Figure 87. Distribution of all Common Tern records.

Seasonality

Common Tern were recorded in all months of the year except January, but this is probably more reflective of a lack of suitable surveys during this month rather than the birds not being here. A large increase in the number of records and/or the number of birds became obvious from September and continued to February, after which there was an equally sudden drop in March. These results show that not all Common Tern migrate each year, but that most are late dry to early wet season visitors to the survey area.

Breeding

Common Tern are a migratory species that breeds in the northern hemisphere (Higgins and Davies, 1996) and they were not recorded breeding in the survey area during the project. A small number of notes were made in reference to breeding plumage for this species, but most birds in the survey area were seen in non-breeding plumage. Breeding plumage, in terms of full black caps and long tail streamers was noted in the months of October/November and in May. These sightings probably picked up birds returning to the survey area after breeding and then late departing birds respectively.

WHISKERED TERN

Geographic Distribution

Whiskered Tern were recorded throughout the survey area, though a little less frequently in the north east and far south east (Figure 88). This is another of the species that was more frequently recorded in the extensive floodplains to the east of Darwin. Except for North Perron Island, Whiskered Tern were infrequently recorded on the islands, and then, only on larger islands with more extensive wetlands.

Whiskered Tern often associate with White-winged Black Tern, particularly hunting over the floodplains. Both are hard to separate during aerial surveys, except when in breeding plumage. Consequently, many records involve a combination call (recorded as *Marsh Tern spp.*) of what could have been either or both of these species. The addition of the 315 *Marsh Tern spp.* records to the map (Figure 88) does not extend the confirmed distribution of Whiskered Tern greatly within the survey area, except possibly for a few places along the south east coast. However, these additional records could increase the density of records within the confirmed Whiskered Tern range.

Whiskered Tern were predominantly recorded on small and large wetlands, but were also recorded along rivers (where they roosted on mud or sandbanks exposed at lower tides), on the coast and in the intertidal zone. They were also occasionally seen hunting out to sea.

Numbers

Whiskered Tern were among the more frequently recorded (4^{th}), and more numerous (10^{th}), of the species of waterbirds in these surveys – even without the additional *Marsh Tern spp.* records, and despite the fact that they leave the area to breed. Throughout all surveys there were 274 ground records of Whiskered Tern totalling over 17 400 birds. The figures equate to around 4.5% of all waterbird records and around 2.9% of the total number of waterbirds counted during all ground surveys. There were also a further 117 records from aerial surveys. There were also 3077 *tern spp.* records (involving nearly 339 000 birds) made during aerial surveys which are likely to have included Whiskered Tern, particularly the many inland *tern spp.* records.

Whiskered Tern were not often recorded as individual birds and were usually recorded in groups. Group sizes varied from the low tens to the high hundreds. The largest single record was of 1 300 birds, but there were often much larger numbers spread over large floodplains which were recorded by a number of separate calls while flying around. Larger groups (>100birds) were also spread over much of their recorded range, though more so in the northern parts. Most of the larger groups were predominantly recorded in the wetlands to the east of Darwin.

Larger groups of *Marsh Tern spp*. were recorded throughout the survey area rather than more so in the northern half. The larger groups in the south east at least, were probably White-winged Black Tern. The three largest of the combined species records were all between 2 500 and 5 000 birds, and were also likely to be White-winged Black Tern which generally occur in much larger flocks than Whiskered Tern. These sites, which were all on the west coast, are further discussed in the White-winged Black Tern section.

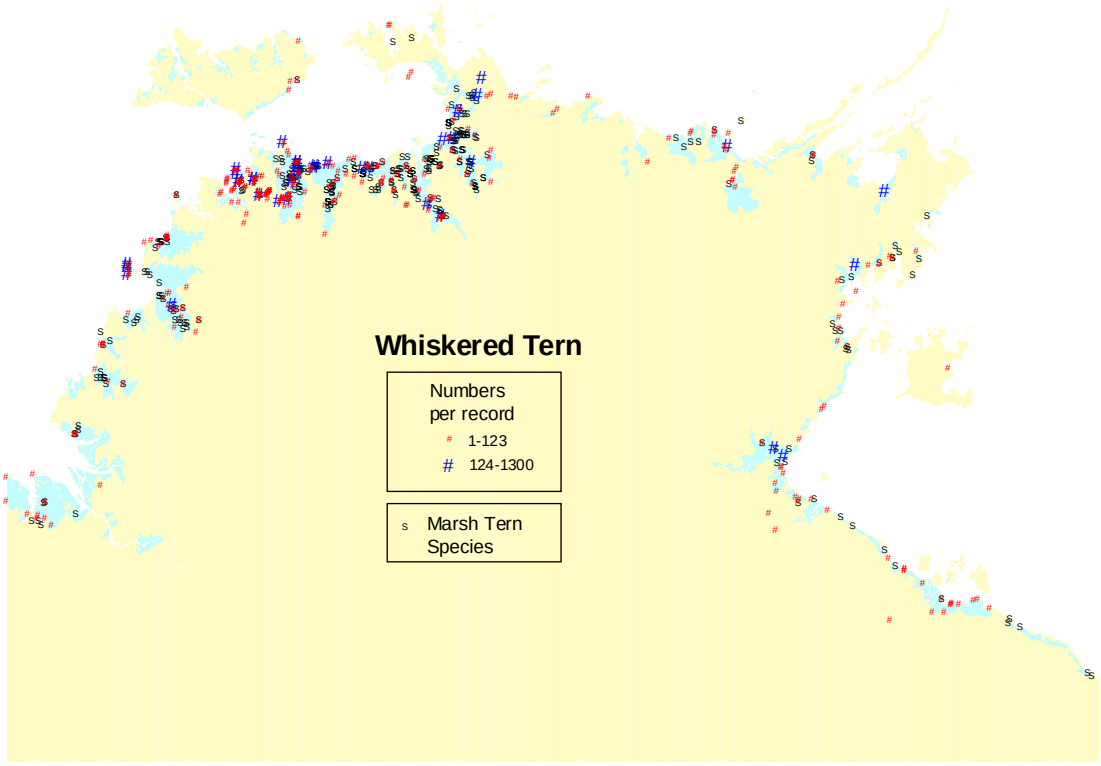

Figure 88. Distribution of all Whiskered Tern records.

Seasonality

Whiskered Tern were recorded in all months of the year, with the highest number of records and birds generally being recorded between April and October. This suggests that Whiskered Tern are here all year but in higher numbers in the dry season. Inconsistency between months in different years also suggested irregularity of movement in and out of the survey area. Morton *et. al.* (1991) also found Whiskered Tern to be present all year round but more abundant in the dry season in the Alligator Rivers area.

Breeding

Whiskered Tern were not confirmed breeding in the survey area, although they were frequently seen in varying extents of breeding plumage. Partial to full breeding plumage was recorded in all months except February and April, but mostly between October and January. Birds were also recorded as not being in breeding plumage in all months of the year. In most groups there was only a part of the group that showed breeding plumage. Given these observations, it appears that only some of the birds in an area move out to breed at any one time, and any breeding departures are somewhat erratic and not highly seasonal.

A & S Keates *(pers. comm.)* recorded many of the hundreds of Whiskered Tern present to be in breeding plumage on the wetlands in the far south west of the survey area in late April 2004. This does not necessarily mean they are breeding there as substantial numbers breed in the coastal plains of north west Western Australia (R. Jaensch, *pers. comm.*).

Jaensch (1994) reported only seven pairs of Whiskered Tern breeding in the Barkly Tableland wetlands to the south of my survey area between March and September 1993.

WHITE-WINGED BLACK TERN

Geographic Distribution

White-winged Black Tern were recorded throughout the survey area (Figure 89). They are another of the species to be more frequently recorded in the extensive floodplains to the east of Darwin.

White-winged Black Tern often associate with Whiskered Tern, particularly hunting over the floodplains. Both are hard to separate during aerial surveys, except when in breeding plumage. Consequently, there were a lot of records made of a combination call (recorded as *Marsh Tern spp.*) of what could have been either or both of these species. The addition of the 315 *Marsh Tern spp.* records to the map (Figure 89) does not extend the overall distribution of White-winged Black Tern greatly within the survey area, except possibly for a few places along the coast in the south east. However, these additional records could increase the density of records within the confirmed White-winged Black Tern range.

White-winged Black Tern were often recorded on the wetlands of a mixture of sizes and along rivers, but, unlike the Whiskered Tern, they were also commonly recorded on the coast, out on the islands and hunting out to sea.

Numbers

White-winged Black Tern were not among the more frequently recorded species in ground surveys, but they were still the 6th most abundant. Given they leave the survey area to breed, and much of the time they are here they are out hunting over the floodplains (an area not easily accessed for ground surveying), White-winged Black Tern are likely to be even more abundant than these result suggest.

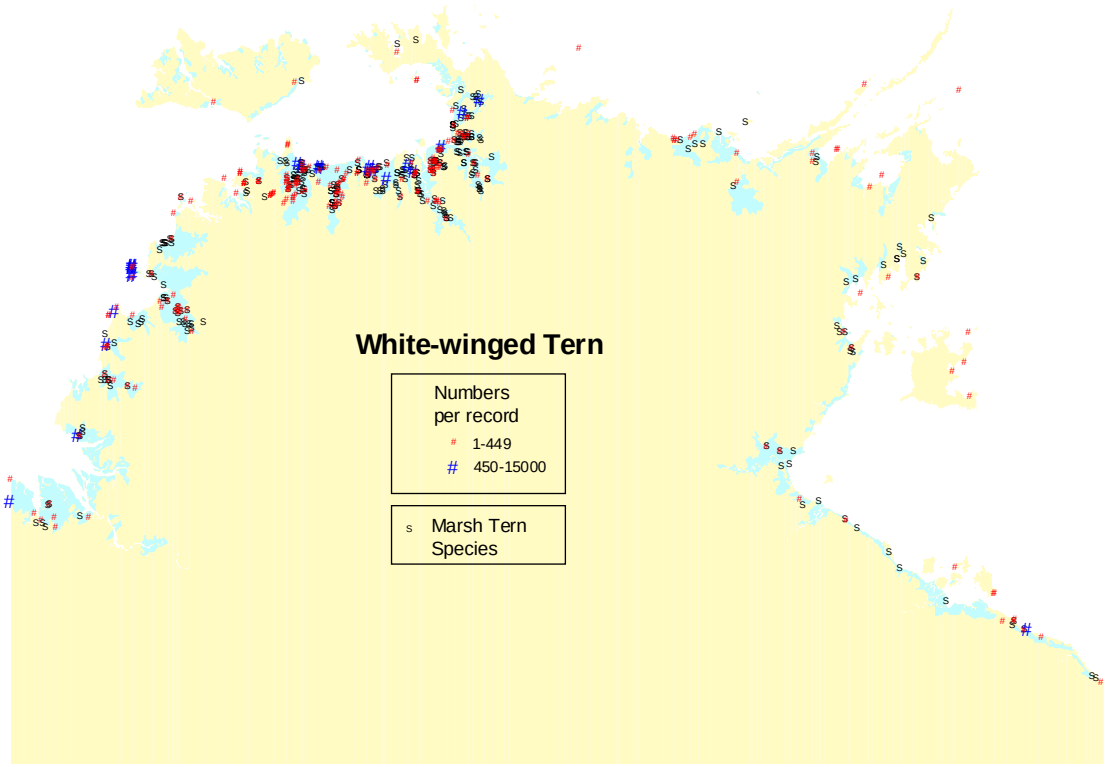

Figure 89. Distribution of all White-winged Black Tern records.

Throughout all surveys there were 76 ground records of White-winged Black Tern totalling around 29 200 birds. The figures equate to around 1.2% of all waterbird records and around 4.8% of the total number of waterbirds counted during all ground surveys. There were also a further 166 records of White-winged Black Tern from aerial surveys. There were also nearly 2 200 *tern spp.* records (involving over 222 000 birds) in the November to May period which corresponds the main period of time that White-winged Black Tern are in the survey area. Some of these records would include White-winged Black Tern.

White-winged Black Tern were recorded in many different sized groups ranging up to many thousands. The largest single record was of at least 15 000 birds on North Perron Island in mid March 1992. This was likely to be an aggregation of birds for migration and most were going into breeding plumage. All had departed the island not long after the March survey. Larger groups (>400birds) were mostly seen along the coast of the north west part of the survey area. These large groups were also mostly in March/April, which also suggests pre-departure flocks. One reasonably large group of 800 was also seen in September. This may have represented newly arrived birds.

Seasonality

Most White-winged Black Tern migrate out of the survey area to breed during the dry season (with at least some known to go to Asia, R. Jaensch *pers. comm.*) but a small percentage remain. White-winged Black Tern were recorded in all months of the year except June, with the highest number of records generally being recorded between November and May and very few records between July and October. The highest numbers counted were clearly in February, March and April. In the first of these three mentioned months they could be seen in huge numbers on the large flooded floodplains, while in the latter part of these three months they were seen in large groups (often on beaches) flocking up prior to migration. Even though the number of records increased from October to November, the numbers of birds counted didn't show a sharp increase until the December counts, suggesting a few may start arriving from September but most not until early December.

Breeding

White-winged Black Tern are non-breeding migrants to Australia. Varying extents of breeding plumage was recorded in March, April, May, September, November and December. Records of birds without any signs of breeding plumage were also made in February, October, November and December. This suggests that at least some birds go into breeding plumage before they depart and are still in breeding plumage when they return. None of the birds remaining here during the breeding season were recorded in breeding plumage, which may indicate, like other migrating shorebirds, they are first-year birds.

WATERBIRDS – BY SPECIES
LESS COMMON SPECIES

Northern Pintail

A very rare vagrant. Not recorded in my surveys and only one record located for the survey area. A single bird located by M. Belio at Knuckey Lagoons in October 2003.

Blue-billed Duck

A very rare vagrant. Not recorded in my surveys and only one record located for the survey area. A single eclipse male reported from Darwin Sewage Ponds in March 1985 (Noske and van Gessel, 1987).

Freckled Duck

A very rare vagrant. Not recorded in my surveys, but could have been missed among aerial *duck spp.* records. Two records located for survey area - a single bird seen Darwin Sewage Ponds 31 January 2003 and several in 2002 (N. McCrie, *pers. comm.*).

During 1993-2002, Freckled Duck were recorded throughout the Barkly wetlands, to the south of the Top End. Recorded most often in the wet season in groups of up to 80 birds. Breeding confirmed on two occasions (Jaensch, 2003).

Australian Wood Duck

An occasional, non-breeding, nomadic visitor to the survey area. Recorded on two occasions during these surveys (Figure 90). Four birds recorded near Darwin in September 1994 and 10 birds near the South Alligator River in October 2001.

McCrie and Watson (2003) report occasional May to October records in other areas to those recorded in my surveys, including Fogg Dam, Darwin Sewage Ponds and the south west regions.

Recorded at 10 sites (breeding at one) in surveys of wetlands of the sub-humid tropics between March and September 1993 (Jaensch, 1994).

Chestnut Teal

A very rare vagrant. Not recorded in my surveys, but possible that non-breeding specimens could be over-looked among Grey Teal in aerial surveys. McCrie and Watson (2003) report this bird to be only recorded in the Darwin region with the most recent record on Darwin Sewage Ponds in June 1990. Storr (1977) notes two specimens collected near Darwin in 1958 as reported by H. J. Frith

Hoary-headed Grebe

Probably a vagrant. Not recorded in my surveys, but possible that birds could be over-looked among Australian Grebe in aerial surveys.

Crawford (1972) records a single male on Fogg Dam to the east of Darwin on 3 July 1967. Goodfellow and Stott (2001) reports it as a scarce dry season visitor to Darwin Sewage Ponds and to Kapalga (near the South Alligator River), but it was not recorded at this latter site by Morton *et. al.* (1991) in 3 years of surveys in early 1980s and McCrie (*pers. comm.*) suggests it is very rare.

Six birds recorded three sites (breeding at one) in surveys of wetlands of the sub-humid tropics between March and September 1993 (Jaensch, 1994).

Great Crested Grebe

Generally an occasional, non-breeding, nomadic visitor to the survey area, but occasional influxes. Recorded on three occasions during these surveys (Figure 90). All records on or near Darwin River

Dam, a large water storage dam just south of Darwin. Single birds recorded in February and October 2003 and 25 birds recorded in September 1995.

McCrie and Watson (2003) record birds also at Darwin Sewage Ponds and Cooinda on the upstream South Alligator River.

Little Grebe

A very rare vagrant. Not recorded in my surveys and only one record located for the survey area. A single bird at Darwin Sewage Ponds in Sept/Oct 1999 (McCrie, *pers. comm.*).

Great Cormorant

Probably an occasional visitor to the survey area, although possibly more common at Darwin River Dam (McCrie, 2003) which was included in the survey area but only visited a small number of times. Not confirmed in my surveys for remainder of survey area, but possible that specimens could be over-looked among Little Black Cormorant in aerial surveys.

Other records for survey area include five records of one to five birds between 1972 and 1977 from locations near Darwin and the wetlands to the east (Thompson, 1977) and a few birds along the McArthur River in the south east of the survey area (Barnard, 1914).

There are no records of breeding in the survey area and the only record of Great Cormorant (40 birds) breeding in the Northern Territory was at Lake Woods in May 1993 (Jaensch, 1994).

Little Bittern

A very rare vagrant, not recorded in my surveys.

Storr (1977) documents two records, one from near Darwin and the other from the McArthur River. N. McCrie (*pers. comm.*) records a pair in Darwin in 2001 and reports birds seen at Fogg Dam east of Darwin.

Black Bittern

Fairly secretive bird not well covered in these surveys. Undoubtedly more abundant and widespread than recorded in these surveys, for example Don Franklin (*pers. comm.*) saw 30 or more in a few hours along the treed banks of the lower Finniss River.

Thirteen records during surveys, all near Darwin or far south east, except one record on Melville Island (Figure 90). All records between February and October. One record of breeding, three non-feathered young handed in from near Darwin in October 2001.

Numerous other records from other parts of survey area including: Keep River in the far south west (McKean, 1985), Litchfield National Park to the south west of Darwin (Griffiths *et. al.*,1997), Cobourg Peninsula (A & E Withers, *pers. comm.)*, the Alligator Rivers area (Morton *et. al.* 1991), Melville Island (Mathews, 1914) and near Gove in the north east (Boekel, 1976).

Sarus Crane

Probably an occasional visitor or present in small numbers, at least in the south east and south west of the survey area. Single record of two birds during survey period near Northern Territory/Western Australian border in April 1993 (Jaensch, 1994), but possible that specimens could be over-looked among Brolga.

Goodfellow and Stott (2001) report occasional records from near Darwin, the floodplains from the Adelaide River to the South Alligator River and the floodplains from the Roper River to the McArthur River.

Buff-banded Rail

Fairly secretive bird not well covered in these surveys. Twelve records during surveys, between March and December and all in Darwin area and to the east (Figure 90). Undoubtedly more abundant and widespread than recorded in these surveys.

Records from other parts of survey area include: Litchfield National Park to the south west of Darwin (Griffiths *et. al.*,1977), Cobourg Peninsula (A & E Withers, *pers. comm.*), the Alligator Rivers area (Morton *et. al.*, 1991) and Borroloola area, where reported breeding in January (Barnard, 1914). Some quite large groups recorded, for example 30-40 Holmes Jungle near Darwin around October 2002 (N. McCrie, *pers. comm.*) and 20 individuals near dam wall of Fogg Dam in October 2004 (C. McFadden, *pers. comm.*).

Recorded on three wetlands in the Barkly Tablelands wetlands south of survey area (Jaensch, 1994).

Lewin's Rail

A rare vagrant and a secretive bird not located in these surveys. Recorded as an addition to the avifauna of the Northern Territory by a specimen caught in Darwin (McKean, 1983).

Bush-hen

Secretive bird not located in these surveys.

Recorded as wet season visitor (and possible dry season) in several places around Darwin (McCrie and Watson, 2003), Litchfield National Park to the south west of Darwin (Griffiths *et. al.*,1977) and near Borroloola in June 1986 (Holmes and Noske, 1990).

Recorded breeding in February in wetlands to east of Darwin in late 1950's (Frith and Davies, 1961).

Ballion's (Marsh) Crake

An uncommon vagrant and a secretive bird not well covered in these surveys. Two records during surveys, one in September 2002 near Darwin and one in far south west in June 1999 (Figure 91). Undoubtedly more abundant and widespread than recorded in these surveys.

Records from other parts of survey area include: Fogg Dam (McCrie and Watson, 2003), Cobourg Peninsula (A & E Withers, *pers. comm.*), Groote Eylandt in January 1990 (Noske and Brennan, 2002), the Alligator Rivers area (Morton *et. al.*, 1991) and near Borroloola (Robinson *et. al.*, 1992).

Recorded on three wetlands in the Barkly Tablelands wetlands south of survey area (Jaensch, 1994).

Spotless Crake

A rare vagrant and a secretive bird recorded only once in these surveys (Figure 91).

Records by others from survey area include: Litchfield National Park to the south west of Darwin (Griffiths *et. al.*,1997), Darwin and Fogg Dam (McCrie and Watson, 2003), Melville Island (J. Woinarski, *pers. comm.*.), South Alligator River floodplains (Goodfellow and Stott, 2001) and the Arafura Swamp (Brennan *et. al.*, 2003).

White-browed Crake

Fairly secretive bird not well covered in these surveys. Undoubtedly more abundant and widespread than recorded in these surveys. Eleven records during surveys, most near Darwin or in wetlands to the east, but also in south east of the survey area (Figure 91). Records spread throughout year. Recorded breeding on two occasions, three young on lake of golf course near Darwin in February 2004 and two half grown young at Fogg Dam in August 1991.

Numerous other records from other parts of survey area including: Keep River in the far south west (McCrie and Watson, 2003), Litchfield National Park to the south west of Darwin (Griffiths *et. al.*,1977), South Alligator Rivers area (Morton *et. al.*, 1991), (McCrie and Watson, 2003), Cobourg Peninsula (A & E Withers, *pers. comm.*), Melville Island, including breeding in January (Mathews, 1914) and Groote Eylandt (Noske and Brennan, 2002).

Dusky Moorhen

A very rare vagrant, not recorded in my surveys. Two records in far south east of survey area by others. Two birds seen on Little River, a tributary running into the McArthur River in August 1976 (Thompson, 1976) and single bird September 1986 near Calvert River (Robinson *et. al.*, 1992).

Black-tailed Native-hen

A rare vagrant, not recorded in my surveys. Thompson (1977) reports single bird in April 1975 along Stuart Highway about 120 km south of Darwin, Barnard (1914) records a few birds were seen at small waterholes filled by storms in December 1913 in the far south east of the survey area and McCrie and Watson (2003) report several birds recorded in the far south west of the survey area.

Banded Stilt

A very rare vagrant, only confirmed once in my surveys. Single bird among Black-winged Stilt near Darwin in July 1990. No other records found for survey area.

Oriental Pratincole

A migratory species not well covered in these surveys because its preferred habitat is grasslands. Only four records in these surveys (August to November), and all Darwin area or Fogg Dam (Figure 91). Undoubtedly more abundant and widespread than recorded in these surveys.

Numerous other records from other parts of survey area including: Tipperary, south west of Darwin (Crawford,1972), Cobourg Peninsula (A & E Withers, *pers. comm.*), the Alligator Rivers area (Morton *et. al.*, 1991), Murgenella area (F. Woerle, *pers. comm.*), Groote Eylandt (Noske and Brennan, 2002) and the far south west of the survey area (Garnett, 1986).

Flocks of hundreds flying over Fogg Dam, 15 November 2004 (C. McFadden, *pers. comm.*). Birds seen in breeding plumage on 22 November 2003 and 21 March 2004 in Darwin (N. McCrie, *pers. comm.*).

Many thousands recorded in Barkly wetlands south of survey area in December 1993 (Jaensch, *pers. comm.*) and also recorded in the central Victoria River District (A. Fisher, *pers. comm.*).

Plate 30. Buff-banded Rail. Photo. F. Woerle.

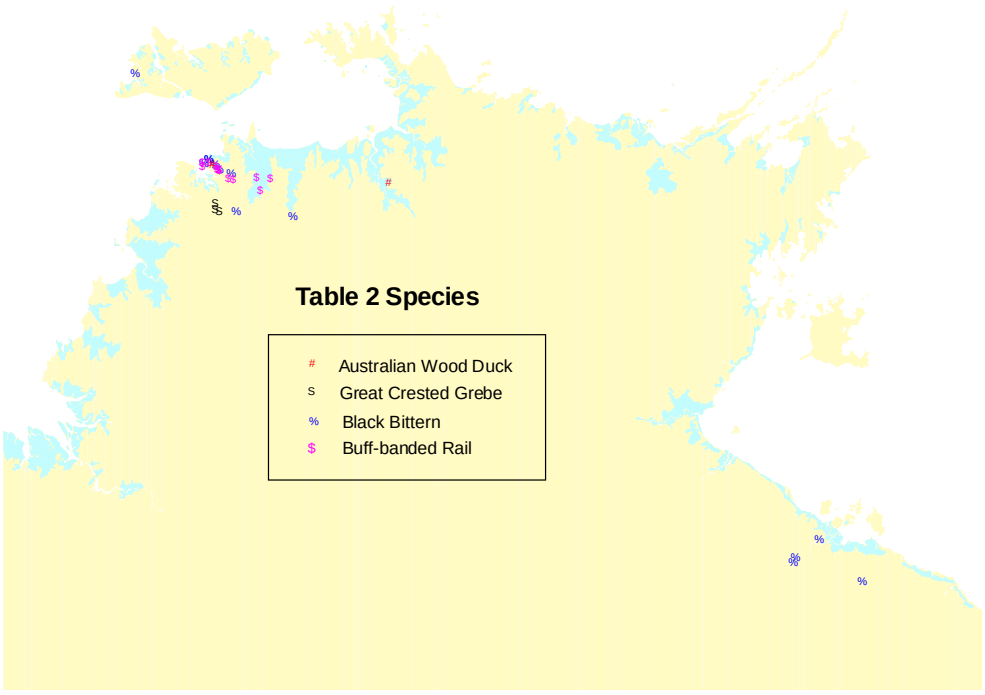

Figure 90. Distribution of Australian Wood Duck, Great Crested Grebe, Black Bittern and Buff-banded Rail records.

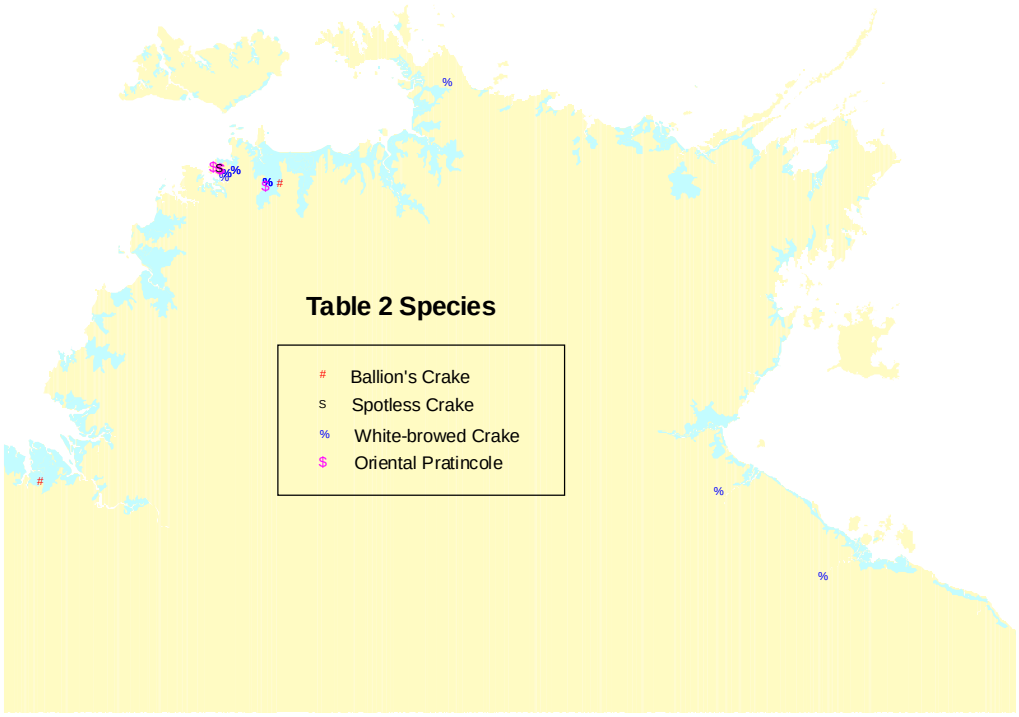

Figure 91. Distribution of Baillon, Spotless and White-browed Crakes and Oriental Pratincole records.

FUTURE RESEARCH

This project has concentrated on locating and documenting the broad distribution and status of coastal and wetland fauna, with particular emphasis on important sites, in the remote and little studied Top End of the Northern Territory. This report has detailed the waterbird group of species. The many surveys done during this project have clearly shown that there are numerous national and internationally important sites for waterbirds in this area. Further, many of these sites are still relatively undisturbed. Now that the sites have been located and documented it is critical to establish and maintain monitoring programs to ensure the security (managed if necessary) of these sites. The surveys have also shown that there is still much important research that needs to be done to better understand the ecology of waterbirds within the Top End, particularly with regard to their movements within and out of this part of Australia. To this end, one of the priorities for aquatic bird research in the Northern Territory should include banding and tracking studies. This should perhaps include the expansion of the cannon netting programs that have been run for many years in the north west of Western Australia and more recently on the Queensland side of the Gulf of Carpentaria.

The project to date has concentrated on the wetlands and the coastlines of the mainland and the islands around the Northern Territory. For far too long these highly significant areas were left largely unstudied. Now that the first step has been taken with regard to these areas and future monitoring and management recommended, the surveys should not stop at the coastline. It is important that we also extend surveys into marine waters to locate and document the important areas off our coastline. The so far largely unsurveyed inshore and offshore seas off the Northern Territory coast may also reveal nationally and/or internationally important numbers of wildlife that we know too little about. The distribution and status of wildlife species for which the Northern Territory is responsible for, such as cetaceans, dugongs, marine turtles, sea snakes, pelagic seabirds etc. in our offshore waters is virtually unknown.

The future monitoring of our known wetland and coastal sites that are significant for fauna, and the future survey work extending out into our coastal seas, should be done while the Top End of the Northern Territory is in the unique position of still having such large areas of undisturbed and unmodified habitat. It should precede the pressures associated with increasing human populations and new or more intensive development begins to cause detrimental changes.

The large quantities of data collected on waterbirds (and the other fauna species groups) during this project were only given restricted analysis in order to produce this mostly descriptive report. Future research should also include more detailed analysis to optimise use of these data to improve our understanding of the distribution and status of waterbirds (and the other wildlife) in the Top End.

Plate 31. Waterbirds in a Kakadu Sunset Photo F. Woerle.

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Plate 32. Mixed waterbirds, Magela Floodplain, Kakadu. Photo. M. Armstrong.

APPENDICES

APPENDIX A
SUMMARY OF SPECIES DATA FOR INDIVIDUAL SURVEY BLOCKS

SURVEY BLOCK 1 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	12379	23
Wandering Whistling-Duck	2322	6
Australian Pratincole	2101	3
White-Winged Black Tern	1855	9
Glossy Ibis	1830	19
Egret Species	1765	101
Black-Winged Stilt	980	24
Australian White Ibis	841	30
Brolga	586	15
Duck Species	557	7
Cattle Egret	489	10
Marsh Tern Species	373	8
Masked Lapwing	282	14
Grey Teal	266	3
Pacific Black Duck	192	6
Straw-Necked Ibis	185	7
Pied Heron	180	13
Gull-Billed Tern	169	22
Australian Pelican	164	16
Plumed Whistling-Duck	154	4
Little Egret	121	13
Whiskered Tern	106	7
White-Faced Heron	66	26
Rajah Shelduck	40	4
Black-Necked Stork	40	24
Red-Necked Avocet	21	2
Nankeen Night Heron	18	4
Pink-Eared Duck	16	1
Brahminy Kite	15	12
Whistling-Duck Species	15	3
Great Egret	14	12
Gull-Billed Or Caspian Tern	13	4
Green Pygmy-Goose	13	3
Eurasian Coot	10	1
Pied Cormorant	10	1
Intermediate Egret	9	5
White-Bellied Sea Eagle	6	3
Little Pied Cormorant	4	3
Swamp Harrier	4	3
Australian Darter	2	2
Hardhead	2	1
Great-Billed Heron	1	1
Yellow-Billed Spoonbill	1	1
Little Black Cormorant	1	1
TOTAL	**28218**	**477**

SURVEY BLOCK 1 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Grey Teal	11204	10
Wandering Whistling-Duck	9166	9
Glossy Ibis	7865	12
Plumed Whistling-Duck	5802	6
Eurasian Coot	5000	1
Pacific Black Duck	3093	15
Black-Winged Stilt	3016	8
Marsh Tern Species	2550	2
Hardhead	2083	8
Purple Swamphen	2050	2
Whistling-Duck Species	2000	1
Brolga	1456	11
Australian White Ibis	1198	15
Duck Species	1000	2
Magpie Goose	803	10
Australian Pratincole	766	8
Masked Lapwing	698	15
Straw-Necked Ibis	621	8
Pink-Eared Duck	500	1
White-Winged Black Tern	450	1
Egret Species	426	12
Pied Heron	396	5
Gull-Billed Tern	336	7
Rajah Shelduck	179	8
Comb-Crested Jacana	147	4
Little Egret	136	12
Whiskered Tern	118	5
White-Necked Heron	110	12
White-Faced Heron	100	13
Royal Spoonbill	95	8
Australian Pelican	77	4
Intermediate Egret	74	7
Nankeen Night Heron	50	7
Black-Necked Stork	35	12
Australian Darter	24	4
Great Egret	22	11
Green Pygmy-Goose	16	2
Australian Grebe	12	2
Little Pied Cormorant	11	3
Black Swan	6	2
Swamp Harrier	4	3
White-Bellied Sea Eagle	4	3
Little Black Cormorant	2	2
Ballion's Crake	1	1
Pied Cormorant	1	1
TOTAL	**63703**	**295**

SURVEY BLOCK 2 – AERIEL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	8060	8
Egret Species	5770	497
Rajah Shelduck	2816	22
Grey Teal	645	6
Pacific Black Duck	644	7
Duck Species	522	8
White-Winged Black Tern	507	7
Brolga	342	15
Straw-Necked Ibis	221	31
Cattle Egret	141	16
Pied Heron	135	15
Glossy Ibis	100	1
Black-Winged Stilt	77	14
Australian White Ibis	77	25
Royal Spoonbill	56	2
Australian Pelican	48	10
Cormorant Species	46	12
Little Pied Cormorant	33	14
White-Faced Heron	32	16
Black-Necked Stork	31	30
Little Egret	27	6
Intermediate Egret	26	6
Great Egret	25	16
White-Bellied Sea Eagle	21	18
Pied Cormorant	19	6
White-Necked Heron	19	10
Marsh Tern Species	16	9
Ibis Species	10	1
Hardhead	10	1
Osprey	10	10
Wandering Whistling-Duck	9	4
Brahminy Kite	7	6
Gull-Billed Tern	7	3
Masked Lapwing	7	2
Little Black Cormorant	6	5
Australian Darter	6	6
Green Pygmy-Goose	6	3
Swamp Harrier	4	4
Whistling-Duck Species	3	2
Whiskered Tern	3	3
Great-Billed Heron	2	2
Large Raptor or Stork Nest	1	1
Cormorant Spp And/Or Darter	1	1
Plumed Whistling-Duck	1	1
TOTAL	**20549**	**882**

SURVEY BLOCK 2 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Gull-Billed Tern	541	4
Rajah Shelduck	450	3
Marsh Tern Species	300	1
Grey Teal	150	2
Whiskered Tern	120	4
White-Winged Black Tern	91	2
Masked Lapwing	80	4
Black-Winged Stilt	75	1
Little Egret	25	2
Common Tern	10	1
Pacific Black Duck	2	1
Brahminy Kite	1	1
TOTAL	**1845**	**26**

SURVEY BLOCK 3– AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Egret Species	42166	2076
White-Winged Black Tern	25416	13
Magpie Goose	23192	47
Whistling-Duck Species	13486	33
Australian Pelican	9247	147
Plumed Whistling-Duck	9021	5
Wandering Whistling-Duck	6667	18
Cattle Egret	6491	74
Straw-Necked Ibis	6142	110
Marsh Tern Species	5624	31
Australian White Ibis	5129	375
Duck Species	3927	41
Glossy Ibis	3392	41
Pied Heron	3229	71
Grey Teal	3066	18
Brolga	3000	64
Black-Winged Stilt	2345	65
Cormorant Spp And/Or Darter	2170	4
Pacific Black Duck	1590	11
Rajah Shelduck	877	59
Cormorant Species	874	32
Gull-Billed Tern	739	20
Pied Cormorant	261	38
Ibis Species	258	13
White-Faced Heron	214	53
Little Pied Cormorant	191	47
Black-Necked Stork	174	112
Whiskered Tern	169	10
Masked Lapwing	154	40
Royal Spoonbill	147	26
Australian Darter	120	46
Nankeen Night Heron	118	10
Little Black Cormorant	99	33
Gull-Billed Or Caspian Tern	97	7
Green Pygmy-Goose	63	4
White-Necked Heron	61	22
White-Bellied Sea Eagle	52	40
Great Egret	52	35
Brahminy Kite	41	32
Intermediate Egret	27	15
Little Egret	27	13
Pied Cormorant Species	20	1
Osprey	14	11
Great-Billed Heron	8	8
Red-Necked Avocet	5	1
Large Raptor Or Stork Nest	5	5
Comb-Crested Jacana	5	2
Australian Grebe	5	1
Common Tern	1	1
Swamp Harrier	1	1
Yellow-Billed Spoonbill	1	1
TOTAL	**180180**	**3983**

SURVEY BLOCK 3 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
White-Winged Black Tern	17860	11
Magpie Goose	6404	7
Common Tern	5341	11
Glossy Ibis	3650	4
Grey Teal	3554	6
Gull-Billed Tern	2487	26
Whiskered Tern	1694	16
Whistling-Duck Species	1000	1
Masked Lapwing	987	7
Black-Winged Stilt	870	7
Straw-Necked Ibis	840	3
Pacific Black Duck	816	5
Pied Heron	600	2
Egret Species	558	4
Australian White Ibis	540	3
Purple Swamphen	500	1
Australian Pratincole	360	3
Rajah Shelduck	320	7
Australian Pelican	315	8
Hardhead	250	2
Nankeen Night Heron	200	1
Brolga	142	5
Wandering Whistling-Duck	126	3
Ibis Species	100	1
Red-Necked Avocet	100	2
Duck Species	100	1
Little Egret	87	8
Royal Spoonbill	60	2
Intermediate Egret	50	1
Great Egret	42	7
White-Faced Heron	36	5
Australian Grebe	35	2
White-Necked Heron	30	2
Brahminy Kite	25	5
White-Bellied Sea Eagle	22	6
Garganey	20	1
Black-Necked Stork	20	1
Cormorant Species	13	2
Little Pied Cormorant	13	2
Little Black Cormorant	10	1
Australian Darter	6	2
Osprey	4	1
Great-Billed Heron	3	3
Plumed Whistling-Duck	1	1
TOTAL	**50191**	**199**

SURVEY BLOCK 4 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Rajah Shelduck	3016	24
Magpie Goose	2806	14
Waterbird Species	1561	16
Whistling-Duck Species	1002	3
White Waterbird Species	935	9
Egret Species	867	93
Black-Winged Stilt	540	3
Australian White Ibis	529	64
Duck Species	510	2
Straw-Necked Ibis	459	16
Green Pygmy-Goose	436	10
Brolga	400	3
Masked Lapwing	367	18
Pied Cormorant	264	23
Australian Pelican	217	31
Pied Heron	200	2
Pacific Black Duck	163	4
Glossy Ibis	160	3
Whiskered Tern	116	8
White-Winged Black Tern	115	2
Ibis Species	105	6
Intermediate Egret	100	1
Cormorant Species	91	8
Marsh Tern Species	80	2
Great Egret	64	14
Little Black Cormorant	60	3
Little Egret	60	2
Wandering Whistling-Duck	60	2
Gull-Billed Tern	57	7
White-Faced Heron	56	13
Black-Necked Stork	51	29
Little Pied Cormorant	50	5
Australian Darter	29	21
Cormorant Spp And/Or Darter	23	7
White-Necked Heron	21	2
Grey Teal	20	1
Great-Billed Heron	18	18
Brahminy Kite	14	10
White-Bellied Sea Eagle	12	11
Cattle Egret	11	2
Plumed Whistling-Duck	10	1
Pink-Eared Duck	10	1
Osprey	9	9
Nankeen Night Heron	6	4
Gull-Billed Or Caspian Tern	3	1
Swamp Harrier	2	1
Large Raptor Or Stork Nest	1	1
Royal Spoonbill	1	1
TOTAL	**15687**	**531**

SURVEY BLOCK 4 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	50069	108
Green Pygmy-Goose	4604	125
Wandering Whistling-Duck	4182	60
Marsh Tern Species	3232	4
Pacific Black Duck	3142	64
Whiskered Tern	3065	98
Masked Lapwing	2901	157
Pied Heron	2749	67
Grey Teal	2567	37
Comb-Crested Jacana	2125	115
Rajah Shelduck	1653	91
Black-Winged Stilt	1464	62
Intermediate Egret	1450	142
Australian Pelican	1375	20
Glossy Ibis	1359	58
Egret Species	1359	21
Straw-Necked Ibis	1092	79
Brolga	988	19
Australian White Ibis	877	87
Plumed Whistling-Duck	821	5
Cattle Egret	787	71
Waterbird Species	750	1
Gull-Billed Tern	563	37
Australian Grebe	561	71
Little Pied Cormorant	491	96
Little Black Cormorant	477	61
Australian Pratincole	446	44
Pink-Eared Duck	415	3
Great Egret	391	84
Common Tern	369	6
Hardhead	338	18
Royal Spoonbill	321	50
White-Winged Black Tern	314	19
Duck Species	300	3
Little Egret	186	57
Eurasian Coot	124	7
Australian Darter	113	42
White-Necked Heron	91	37
Black-Necked Stork	84	49
Oriental Pratincole	80	3
White-Faced Heron	44	30
White-Bellied Sea Eagle	40	27
Chestnut Rail	32	8
Brahminy Kite	23	14
Cormorant Species	21	2
Osprey	17	12
Great-Billed Heron	14	7
Garganey	13	5
White-Browed Crake	12	5
Yellow-Billed Spoonbill	11	5
Pied Cormorant	10	7
Ibis Species	10	1
Buff-Banded Rail	9	9
Purple Swamphen	8	3
Black Bittern	8	6
Swamp Harrier	6	6
Maned (Wood) Duck	4	1
Nankeen Night Heron	3	3
White-Winged Black Tern	2	1
Red-Necked Avocet	2	1
Banded Stilt	1	1
Spotted Crake	1	1
Pratincole Species	1	1
Great Crested Grebe	1	1
TOTAL	**98568**	**2335**

SURVEY BLOCK 5 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	206863	1597
Egret Species	88828	3841
Duck Species	78789	190
Whistling-Duck Species	64865	114
Wandering Whistling-Duck	31553	51
Plumed Whistling-Duck	20751	47
Glossy Ibis	18772	275
White Waterbird Species	13171	76
Pied Heron	10949	278
Australian White Ibis	10016	705
Black-Winged Stilt	9115	292
Straw-Necked Ibis	7589	241
Cattle Egret	7396	154
Marsh Tern Species	7014	202
White-Winged Black Tern	5898	99
Rajah Shelduck	5406	228
Australian Pelican	4721	93
Pacific Black Duck	4694	57
Waterbird Species	4608	49
Grey Teal	3976	30
Whiskered Tern	3335	50
Brolga	3280	118
Red-Necked Avocet	3229	20
Masked Lapwing	2200	207
Ibis Species	1974	30
Green Pygmy-Goose	1712	52
Australian Pratincole	1197	13
Gull-Billed Tern	1048	36
Intermediate Egret	968	40
Little Egret	900	30
Cormorant Species	880	69
Nankeen Night Heron	729	19
Royal Spoonbill	521	32
Little Black Cormorant	468	50
Purple Swamphen	460	7
Black-Necked Stork	456	242
Great Egret	419	69
Cormorant Spp And/Or Darter	401	10
Little Pied Cormorant	355	94
Australian Darter	353	81
Gull-Billed Or Caspian Tern	261	6
White-Necked Heron	178	77
Pied Cormorant	176	21
Pink-Eared Duck	132	3
White-Faced Heron	123	28
Brahminy Kite	54	41
Pied Cormorant Species	53	22
White-Bellied Sea Eagle	44	36
Comb-Crested Jacana	34	8
Swamp Harrier	23	20
Large Raptor Or Stork Nest	21	19
Maned (Wood) Duck	10	1
Black And/Or Whistling-Duck	10	1
Osprey	5	4
Hardhead	2	2
Great-Billed Heron	2	2
Yellow-Billed Spoonbill	1	1
Black Swan	1	1
Australian Grebe	1	1
TOTAL	**630990**	**10182**

SURVEY BLOCK 5 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	73336	95
Grey Teal	29279	22
Plumed Whistling-Duck	22090	13
Wandering Whistling-Duck	21080	30
Egret Species	18095	64
Black-Winged Stilt	13703	58
Glossy Ibis	12408	52
Whistling-Duck Species	9500	6
Pied Heron	8614	61
Whiskered Tern	7981	79
Pacific Black Duck	5143	36
Red-Necked Avocet	5123	14
Gull-Billed Tern	4760	34
White-Winged Black Tern	4692	20
Intermediate Egret	3873	78
Green Pygmy-Goose	3005	42
Masked Lapwing	2513	71
Rajah Shelduck	2458	44
Pink-Eared Duck	2302	10
Little Egret	2265	42
Little Black Cormorant	2232	27
White Waterbird Species	2000	1
Australian Pelican	1986	26
Australian White Ibis	1960	61
Australian Pratincole	1498	32
Royal Spoonbill	1459	33
Brolga	1409	36
Great Egret	1396	55
Waterbird Species	1000	1
Straw-Necked Ibis	911	45
Cattle Egret	872	37
Australian Grebe	830	29
Comb-Crested Jacana	806	43
Little Pied Cormorant	685	42
Purple Swamphen	534	6
Australian Darter	503	21
Marsh Tern Species	500	1
Nankeen Night Heron	468	19
Duck Species	340	6
Hardhead	223	5
Black-Necked Stork	134	51
White-Necked Heron	94	26
Oriental Pratincole	54	1
White-Faced Heron	51	9
Garganey	32	3
White-Bellied Sea Eagle	29	23
Yellow-Billed Spoonbill	13	4
Swamp Harrier	12	11
Ibis Species	12	3
Cormorant Species	10	2
Large Raptor Or Stork Nest	10	10
Brahminy Kite	7	3
Eurasian Coot	7	2
White-Browed Crake	4	3
Buff-Banded Rail	3	3
Osprey	2	2
Pratincole Species	2	1
Ballion's Crake	1	1
Pied Cormorant	1	1
Black Bittern	1	1
TOTAL	**274311**	**1557**

SURVEY BLOCK 6 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Egret Species	702	75
Wandering Whistling-Duck	328	23
Australian White Ibis	262	46
Masked Lapwing	246	24
Waterbird Species	201	29
Black-Winged Stilt	156	10
Gull-Billed Tern	150	17
Whistling-Duck Species	145	3
Australian Pelican	106	8
Rajah Shelduck	98	11
Green Pygmy-Goose	64	5
Black-Necked Stork	57	45
Australian Darter	54	35
Little Egret	53	35
Cattle Egret	50	1
White Waterbird Species	50	1
Common Tern	40	1
Osprey	39	37
Great Egret	38	32
Marsh Tern Species	30	1
Pied Heron	27	3
White-Bellied Sea Eagle	22	21
Brahminy Kite	16	16
Plumed Whistling-Duck	15	3
Pied Cormorant	14	4
Large Raptor Or Stork Nest	12	12
Little Pied Cormorant	11	8
Nankeen Night Heron	10	7
Little Black Cormorant	10	4
Magpie Goose	10	1
White-Faced Heron	8	7
Great-Billed Heron	8	8
Pacific Black Duck	7	2
Brolga	5	3
Comb-Crested Jacana	5	1
Intermediate Egret	5	3
Gull-Billed Or Caspian Tern	4	4
Australian Grebe	3	1
Royal Spoonbill	2	1
Whiskered Tern	2	2
White-Winged Black Tern	1	2
Straw-Necked Ibis	1	1
Cormorant Species	1	1
TOTAL	**3068**	**554**

SURVEY BLOCK 6 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Common Tern	506	3
Pied Heron	400	1
White-Winged Black Tern	200	1
Masked Lapwing	194	8
Egret Species	101	2
Waterbird Species	100	1
Little Egret	96	3
Gull-Billed Or Caspian Tern	50	1
Black-Winged Stilt	46	3
Australian White Ibis	41	3
Australian Pratincole	21	2
Great Egret	20	2
Intermediate Egret	15	2
White-Bellied Sea Eagle	12	6
Gull-Billed Tern	11	4
Osprey	10	8
Australian Pelican	10	1
Royal Spoonbill	7	2
Brahminy Kite	5	1
Wandering Whistling-Duck	5	2
Black-Necked Stork	4	4
Rajah Shelduck	4	1
Little Black Cormorant	3	1
Australian Darter	3	2
Nankeen Night Heron	3	2
Little Pied Cormorant	2	1
Brolga	2	1
Whiskered Tern	2	2
Chestnut Rail	2	2
Large Raptor Or Stork Nest	1	1
Plumed Whistling-Duck	1	1
Black Bittern	1	1
TOTAL	**1878**	**75**

SURVEY BLOCK 7 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	73110	200
Egret Species	61198	507
Grey Teal	10103	4
Brolga	9933	38
Whistling-Duck Species	9805	27
Wandering Whistling-Duck	8731	26
Pacific Black Duck	7213	18
Glossy Ibis	6095	27
Pied Heron	6079	38
Australian Pelican	5447	37
Straw-Necked Ibis	5354	29
Green Pygmy-Goose	4612	15
White-Winged Black Tern	3566	8
Duck Species	2892	16
Australian White Ibis	2459	119
Rajah Shelduck	1900	29
Plumed Whistling-Duck	1723	9
Nankeen Night Heron	1439	33
Black-Winged Stilt	1333	55
Masked Lapwing	1081	51
Little Black Cormorant	1053	26
Comb-Crested Jacana	1011	9
Australian Pratincole	1000	1
Pink-Eared Duck	900	1
Marsh Tern Species	839	22
Whiskered Tern	680	9
Hardhead	645	4
Australian Darter	634	67
Little Pied Cormorant	592	44
Purple Swamphen	574	7
Waterbird Species	572	33
Cattle Egret	517	11
Eurasian Coot	500	1
Cormorant Species	460	26
Black-Necked Stork	407	82
Intermediate Egret	291	28
Gull-Billed Tern	237	10
Common Tern	175	6
Great Egret	129	71
Osprey	124	88
Royal Spoonbill	108	4
White Waterbird Species	100	1
White-Bellied Sea Eagle	75	56
Little Egret	64	38
White-Faced Heron	50	18
Pied Cormorant	49	10
Cormorant Spp And/Or Darter	32	3
Brahminy Kite	30	26
White-Necked Heron	30	13
Pied Cormorant Species	23	4
Australian Grebe	23	5
Large Raptor Or Stork Nest	11	9
Great-Billed Heron	9	9
Swamp Harrier	5	3
Gull-Billed Or Caspian Tern	5	4
Chestnut Rail	2	1
White-Browed Crake	1	1
Ibis Species	1	1
TOTAL	**236031**	**2038**

SURVEY BLOCK 7 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Common Tern	8060	50
Wandering Whistling-Duck	7803	5
Grey Teal	7592	7
Magpie Goose	4161	5
Plumed Whistling-Duck	2100	2
Purple Swamphen	609	3
Pink-Eared Duck	500	1
Comb-Crested Jacana	459	6
Rajah Shelduck	412	5
Pacific Black Duck	366	6
Hardhead	301	2
Pied Heron	196	7
Black-Winged Stilt	183	7
Glossy Ibis	164	5
Egret Species	142	5
White Waterbird Species	100	1
Masked Lapwing	99	10
Royal Spoonbill	98	9
Intermediate Egret	98	9
Gull-Billed Tern	94	6
Whiskered Tern	86	8
Little Egret	77	14
Great Egret	75	21
Australian White Ibis	46	8
Green Pygmy-Goose	36	3
Australian Pelican	26	4
Australian Grebe	24	4
White-Winged Black Tern	23	3
Little Black Cormorant	22	3
Australian Darter	18	6
Brolga	17	4
Osprey	16	11
White-Bellied Sea Eagle	10	10
White-Faced Heron	8	6
Australian Pratincole	7	2
Black-Necked Stork	5	4
White-Necked Heron	3	2
Little Pied Cormorant	3	3
Brahminy Kite	3	3
Swamp Harrier	2	2
Nankeen Night Heron	2	2
Pied Cormorant	2	2
Chestnut Rail	1	1
Large Raptor Or Stork Nest	1	1
Great-Billed Heron	1	1
Straw-Necked Ibis	1	1
TOTAL	**34052**	**280**

SURVEY BLOCK 8 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	25660	135
Egret Species	20052	201
Straw-Necked Ibis	10789	27
Australian White Ibis	9484	56
Cattle Egret	8782	13
Brolga	4649	39
Wandering Whistling-Duck	2930	3
Duck Species	2870	5
Pied Heron	2125	16
Glossy Ibis	1711	15
Waterbird Species	1470	14
Nankeen Night Heron	1141	9
Australian Pelican	1077	36
White Waterbird Species	801	4
Ibis Species	607	9
Pacific Black Duck	505	6
Marsh Tern Species	417	5
Rajah Shelduck	323	8
Australian Pratincole	301	2
Cormorant Species	236	7
Masked Lapwing	236	15
Black-Winged Stilt	234	14
Pied Cormorant	220	13
Grey Teal	215	2
Gull-Billed Or Caspian Tern	175	9
Whistling-Duck Species	104	3
Little Black Cormorant	103	4
Black-Necked Stork	95	53
Royal Spoonbill	93	8
Gull-Billed Tern	92	15
Australian Darter	76	17
Great Egret	72	16
Plumed Whistling-Duck	50	1
Cormorant Spp And/Or Darter	50	1
White-Necked Heron	40	12
Pied Cormorant Species	30	2
White-Bellied Sea Eagle	27	19
Osprey	25	21
Brahminy Kite	21	15
Little Pied Cormorant	16	15
Whiskered Tern	15	1
Little Egret	14	12
White-Faced Heron	12	7
Eurasian Coot	10	1
Swamp Harrier	8	4
Great-Billed Heron	5	5
Intermediate Egret	5	4
White-Winged Black Tern	4	4
Chestnut Rail	3	3
Comb-Crested Jacana	2	1
Green Pygmy-Goose	2	1
TOTAL	**97984**	**908**

SURVEY BLOCK 8 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Wandering Whistling-Duck	5203	5
Egret Species	4105	7
Common Tern	4017	15
Cattle Egret	4000	3
Glossy Ibis	3471	9
Masked Lapwing	1983	13
Intermediate Egret	1576	10
Plumed Whistling-Duck	1530	2
Gull-Billed Tern	1321	24
Pied Heron	1260	13
Rajah Shelduck	1129	8
Brolga	1124	11
Black-Winged Stilt	1065	11
Pacific Black Duck	845	9
Straw-Necked Ibis	769	10
Australian Pratincole	746	8
Whistling-Duck Species	700	3
Great Egret	615	20
Magpie Goose	500	1
Grey Teal	450	3
Whiskered Tern	331	14
Australian White Ibis	322	18
Australian Pelican	310	11
Little Egret	269	24
Green Pygmy-Goose	115	4
Hardhead	100	1
Pied Cormorant	73	9
Marsh Tern Species	70	2
Little Black Cormorant	68	5
White-Winged Black Tern	62	4
Nankeen Night Heron	61	6
Royal Spoonbill	57	6
Comb-Crested Jacana	48	4
Little Pied Cormorant	43	5
Australian Darter	35	6
Black-Necked Stork	26	16
White-Faced Heron	25	8
Purple Swamphen	20	1
Osprey	18	13
White-Bellied Sea Eagle	16	13
Pink-Eared Duck	14	1
White-Necked Heron	7	3
Brahminy Kite	5	3
Great-Billed Heron	3	3
Red-Necked Avocet	3	1
Swamp Harrier	2	2
Chestnut Rail	1	1
Large Raptor Or Stork Nest	1	1
Australian Grebe	1	1
TOTAL	**38515**	**371**

SURVEY BLOCK 9 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Little Black Cormorant	180	2
Egret Species	71	20
Osprey	62	43
Australian Pelican	58	10
White-Bellied Sea Eagle	20	16
Australian Grebe	20	1
Pied Cormorant	20	1
Black-Necked Stork	16	10
Gull-Billed Or Caspian Tern	10	1
Brahminy Kite	9	8
Little Pied Cormorant	8	3
Australian White Ibis	6	1
Royal Spoonbill	6	1
White-Faced Heron	4	3
Cormorant Species	3	1
Great-Billed Heron	3	3
Australian Darter	3	1
Rajah Shelduck	2	1
Green Pygmy-Goose	2	1
Large Raptor Or Stork Nest	2	2
Comb-Crested Jacana	1	1
Chestnut Rail	1	1
Common Tern	1	1
Glossy Ibis	1	1
Little Egret	1	1
Magpie Goose	1	1
Straw-Necked Ibis	1	1
Gull-Billed Tern	1	1
TOTAL	**513**	**137**

SURVEY BLOCK 9 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Osprey	20	11
Chestnut Rail	15	4
White-Bellied Sea Eagle	10	7
White-Faced Heron	4	1
Little Black Cormorant	3	2
Australian Darter	3	1
Common Tern	2	1
Great Egret	2	1
White-Winged Black Tern	2	2
Brahminy Kite	1	1
Gull-Billed Tern	1	1
Nankeen Night Heron	1	1
Pied Heron	1	1
Large Raptor Or Stork Nest	1	1
Black-Winged Stilt	1	1
Brolga	1	1
Grey Teal	1	1
TOTAL	**69**	**38**

SURVEY BLOCK 10 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	555531	43
Wandering Whistling-Duck	43062	6
Egret Species	19743	219
Brolga	6758	48
Glossy Ibis	3073	13
Pacific Black Duck	2571	13
Duck Species	2221	12
Black-Winged Stilt	2124	37
Australian White Ibis	1768	55
White Waterbird Species	1400	3
Black And/Or Whistling-Duck	1000	1
Grey Teal	985	9
Red-Necked Avocet	671	6
Little Black Cormorant	524	6
Australian Pelican	496	54
Pied Heron	473	11
Straw-Necked Ibis	424	14
Waterbird Species	304	83
Gull-Billed Tern	281	35
Masked Lapwing	279	23
Nankeen Night Heron	253	4
Cattle Egret	227	6
Osprey	223	169
Ibis Species	203	4
Marsh Tern Species	186	6
Pied Cormorant	182	19
Rajah Shelduck	157	19
Royal Spoonbill	122	4
White-Bellied Sea Eagle	119	99
Gull-Billed Or Caspian Tern	119	12
Cormorant Species	116	3
Black-Necked Stork	102	46
White-Winged Black Tern	55	5
Little Egret	45	12
Brahminy Kite	40	36
Australian Darter	33	18
Great Egret	30	23
Large Raptor Or Stork Nest	29	28
White-Faced Heron	23	8
Purple Swamphen	21	2
Great-Billed Heron	14	14
Green Pygmy-Goose	12	2
Whistling-Duck Species	11	3
White-Necked Heron	10	2
Chestnut Rail	8	6
Intermediate Egret	5	4
Swamp Harrier	5	5
Little Pied Cormorant	3	3
Whiskered Tern	1	1
TOTAL	**646042**	**1254**

SURVEY BLOCK 10 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	22400	8
Brolga	9868	16
Black-Winged Stilt	4721	15
Glossy Ibis	3387	9
Egret Species	2680	10
Grey Teal	1925	12
Australian White Ibis	1915	11
Pacific Black Duck	1809	11
Wandering Whistling-Duck	1603	6
Duck Species	1510	4
Pied Heron	1240	16
Straw-Necked Ibis	1001	4
Plumed Whistling-Duck	1000	1
Whiskered Tern	883	10
Intermediate Egret	874	11
Masked Lapwing	684	17
Gull-Billed Tern	671	14
Marsh Tern Species	550	6
Black And/Or Whistling-Duck	500	1
Australian Pelican	363	10
Rajah Shelduck	396	8
Green Pygmy-Goose	251	4
Great Egret	227	17
Nankeen Night Heron	208	4
Whistling-Duck Species	201	2
Little Egret	179	21
White-Winged Black Tern	126	3
Australian Pratincole	101	6
Pink-Eared Duck	80	2
Little Black Cormorant	74	4
Comb-Crested Jacana	61	3
Australian Darter	49	5
Osprey	41	31
White-Necked Heron	35	2
White Waterbird Species	35	1
Red-Necked Avocet	30	1
Little Pied Cormorant	27	4
White-Bellied Sea Eagle	21	16
Royal Spoonbill	20	1
Black-Necked Stork	13	9
White-Faced Heron	11	5
Waterbird Species	10	1
Swamp Harrier	7	4
Great-Billed Heron	3	3
Large Raptor Or Stork Nest	3	3
Australian Grebe	2	2
Brahminy Kite	2	2
Chestnut Rail	2	2
TOTAL	**61799**	**358**

SURVEY BLOCK 11 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Common Tern	5500	2
Little Black Cormorant	481	4
Osprey	192	150
Egret Species	181	61
Waterbird Species	91	51
Pied Cormorant	72	13
White-Bellied Sea Eagle	57	49
Little Pied Cormorant	51	8
Australian Pelican	43	11
Large Raptor Or Stork Nest	35	35
Black-Winged Stilt	35	2
Black-Necked Stork	34	24
Australian Darter	29	20
Pacific Black Duck	24	3
Masked Lapwing	23	8
Cormorant Species	22	2
Brahminy Kite	12	11
Brolga	12	5
Rajah Shelduck	10	1
Great Egret	9	7
White-Faced Heron	8	6
Duck Species	6	1
Gull-Billed Tern	6	5
Australian White Ibis	5	1
Little Egret	4	4
Chestnut Rail	1	1
Cattle Egret	1	1
White-Winged Black Tern	1	1
Gull-Billed Or Caspian Tern	1	1
TOTAL	**6946**	**488**

SURVEY BLOCK 11 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
White-Winged Black Tern	800	3
Common Tern	667	7
Osprey	27	17
White-Bellied Sea Eagle	14	9
Gull-Billed Tern	4	2
Australian Darter	4	1
Nankeen Night Heron	3	3
Whiskered Tern	2	1
Large Raptor Or Stork Nest	2	2
Brahminy Kite	2	2
Great Egret	1	1
Egret Species	1	1
TOTAL	**1527**	**49**

SURVEY BLOCK 12 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Magpie Goose	7823	10
Duck Species	3800	3
Black-Winged Stilt	2923	30
Egret Species	2897	138
Common Tern	2500	1
Grey Teal	2100	2
Wandering Whistling-Duck	2040	2
Australian Pelican	1526	23
Marsh Tern Species	903	6
Pied Cormorant	855	25
Whistling-Duck Species	451	2
Pied Heron	442	5
Australian White Ibis	369	15
Red-Necked Avocet	351	3
Gull-Billed Or Caspian Tern	288	19
Brolga	227	7
White Waterbird Species	150	1
Straw-Necked Ibis	123	5
Cattle Egret	101	3
Pacific Black Duck	100	1
White-Faced Heron	94	24
Gull-Billed Tern	85	37
Black-Necked Stork	79	45
Little Pied Cormorant	74	11
Rajah Shelduck	58	4
Australian Darter	56	14
Waterbird Species	50	11
Little Egret	50	9
Masked Lapwing	47	7
Glossy Ibis	34	6
Whiskered Tern	33	5
White-Bellied Sea Eagle	23	18
Osprey	23	19
Pied Cormorant Species	20	1
Cormorant Spp And/Or Darter	16	2
Cormorant Species	16	5
Great-Billed Heron	9	6
Great Egret	9	4
Brahminy Kite	6	6
White-Necked Heron	4	3
Royal Spoonbill	3	3
Intermediate Egret	2	2
Large Raptor Or Stork Nest	2	2
Little Black Cormorant	1	1
White-Winged Black Tern	1	1
Green Pygmy-Goose	1	1
TOTAL	**30765**	**548**

SURVEY BLOCK 12 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Black-Winged Stilt	412	4
Grey Teal	200	1
Cormorant Species	55	1
Australian Pratincole	30	1
Masked Lapwing	30	1
Glossy Ibis	15	1
Pacific Black Duck	15	1
Whiskered Tern	12	2
Gull-Billed Tern	11	2
Brahminy Kite	8	5
Black-Necked Stork	5	3
Pied Heron	3	1
Intermediate Egret	2	1
White-Bellied Sea Eagle	2	2
Egret Species	1	1
Chestnut Rail	1	1
White-Faced Heron	1	1
Australian White Ibis	1	1
Great-Billed Heron	1	1
TOTAL	**805**	**31**

SURVEY BLOCK 13 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Black-Winged Stilt	19881	43
Magpie Goose	6902	7
Egret Species	6844	135
Red-Necked Avocet	3270	7
Australian Pelican	1882	25
Glossy Ibis	1341	9
Duck Species	1251	5
Marsh Tern Species	1221	6
Whiskered Tern	634	10
Grey Teal	613	6
White-Winged Black Tern	501	3
Pied Heron	443	7
Pied Cormorant	363	12
Royal Spoonbill	301	2
Waterbird Species	296	12
Brolga	285	13
Gull-Billed Tern	162	20
Australian White Ibis	148	10
Masked Lapwing	105	2
Gull-Billed Or Caspian Tern	70	16
Black-Necked Stork	47	27
Cattle Egret	40	2
Little Black Cormorant	32	4
Straw-Necked Ibis	26	2
Osprey	25	14
Great Egret	22	18
Australian Darter	20	7
White-Bellied Sea Eagle	19	9
Intermediate Egret	16	3
Cormorant Species	14	3
Little Pied Cormorant	13	2
White-Faced Heron	11	8
Little Egret	8	4
Brahminy Kite	7	5
Large Raptor Or Stork Nest	6	5
White-Necked Heron	3	3
Comb-Crested Jacana	2	2
Wandering Whistling-Duck	2	2
Rajah Shelduck	2	1
Green Pygmy-Goose	2	2
Nankeen Night Heron	2	2
Great-Billed Heron	2	2
Pacific Black Duck	1	1
Whistling-Duck Species	1	1
Ibis Species	1	1
Plumed Whistling-Duck	1	1
TOTAL	**46838**	**481**

SURVEY BLOCK 13 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Red-Necked Avocet	1000	1
Black-Winged Stilt	500	2
Grey Teal	200	1
Australian White Ibis	200	1
Gull-Billed Tern	122	9
Pied Cormorant	100	1
Masked Lapwing	55	2
Australian Pelican	44	3
Brolga	30	1
Common Tern	11	1
Whiskered Tern	9	3
Little Egret	5	4
Egret Species	5	2
Black-Necked Stork	3	3
White-Bellied Sea Eagle	3	2
Marsh Tern Species	2	1
Great Egret	2	2
Osprey	1	1
TOTAL	**2292**	**40**

SURVEY BLOCK 14 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Pied Cormorant	5339	37
Egret Species	1177	103
Grey Teal	1050	4
Black-Winged Stilt	435	12
Australian Pelican	433	17
Cormorant Species	360	6
Cormorant Spp And/Or Darter	200	2
Duck Species	200	1
Masked Lapwing	154	13
Gull-Billed Or Caspian Tern	137	11
Black-Necked Stork	109	66
Pacific Black Duck	100	1
White-Faced Heron	77	17
Waterbird Species	60	10
Australian White Ibis	52	3
Common Tern	50	1
Little Egret	32	3
White-Bellied Sea Eagle	26	18
Osprey	26	22
Little Pied Cormorant	25	6
Marsh Tern Species	23	4
Little Black Cormorant	21	2
Nankeen Night Heron	21	3
Pied Cormorant Species	21	2
Wandering Whistling-Duck	20	1
Gull-Billed Tern	17	8
Australian Darter	14	6
Brahminy Kite	11	6
White Waterbird Species	10	1
Great Egret	7	6
Great-Billed Heron	4	4
Brolga	4	2
Large Raptor Or Stork Nest	2	2
Glossy Ibis	1	1
Swamp Harrier	1	1
TOTAL	**10219**	**402**

SURVEY BLOCK 14 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Common Tern	688	2
Black-Winged Stilt	220	2
Pied Cormorant	200	1
Egret Species	100	1
Australian Pelican	30	1
White-Faced Heron	12	3
Gull-Billed Tern	12	3
Whiskered Tern	4	2
Osprey	4	3
Little Egret	4	3
Brahminy Kite	2	1
White-Bellied Sea Eagle	1	1
Red-Necked Avocet	1	1
Australian White Ibis	1	1
TOTAL	**1279**	**25**

SURVEY BLOCK 15 – AERIAL SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Egret Species	4695	227
Black-Winged Stilt	4209	29
Australian Pelican	3672	85
Pied Cormorant	2534	78
Brolga	2416	32
Grey Teal	1338	15
Cormorant Species	1319	43
White-Faced Heron	1134	55
White-Winged Black Tern	1101	7
Duck Species	813	6
Pacific Black Duck	782	14
Cormorant Spp And/Or Darter	661	8
White Waterbird Species	550	5
Australian White Ibis	544	34
Magpie Goose	400	2
Marsh Tern Species	371	4
Glossy Ibis	367	7
Waterbird Species	212	31
Pied Cormorant Species	198	15
Australian Darter	146	25
Little Egret	142	15
Black-Necked Stork	128	81
Little Black Cormorant	116	8
Masked Lapwing	115	14
Gull-Billed Or Caspian Tern	114	16
Royal Spoonbill	108	5
Great Egret	106	24
Red-Necked Avocet	100	1
Little Pied Cormorant	95	15
White-Necked Heron	90	8
White-Bellied Sea Eagle	81	66
Osprey	80	69
Straw-Necked Ibis	53	3
Pied Heron	46	5
Great-Billed Heron	26	24
Nankeen Night Heron	26	7
Brahminy Kite	26	20
Gull-Billed Tern	25	11
Whiskered Tern	20	2
Large Raptor Or Stork Nest	12	12
Ibis Species	11	2
Black Swan	5	1
Rajah Shelduck	4	1
Swamp Harrier	1	1
Wandering Whistling-Duck	1	1
Plumed Whistling-Duck	1	1
Intermediate Egret	1	1
TOTAL	**28995**	**1136**

SURVEY BLOCK 15 – GROUND SURVEY RECORDS		
SPECIES	**TOTAL NUMBERS**	**TOTAL RECORDS**
Black-Winged Stilt	1363	11
Common Tern	1082	10
Grey Teal	1078	10
Pacific Black Duck	612	10
Australian Pelican	557	11
Green Pygmy-Goose	504	7
Wandering Whistling-Duck	470	6
Whiskered Tern	308	12
Plumed Whistling-Duck	280	3
Gull-Billed Tern	277	16
Hardhead	263	4
Red-Necked Avocet	228	4
Australian White Ibis	171	7
Marsh Tern Species	100	2
Comb-Crested Jacana	79	3
Brolga	75	10
Masked Lapwing	61	7
Little Pied Cormorant	61	7
Little Egret	52	10
Magpie Goose	50	2
Straw-Necked Ibis	35	3
Great Egret	31	12
White-Winged Black Tern	27	2
White-Faced Heron	26	6
Australian Darter	21	5
Duck Species	20	1
Pink-Eared Duck	20	1
Intermediate Egret	20	5
Pied Cormorant	19	7
Australian Pratincole	17	3
Australian Grebe	16	3
White-Necked Heron	16	3
Royal Spoonbill	16	3
Osprey	13	7
White-Bellied Sea Eagle	12	10
Cattle Egret	12	3
Pied Heron	12	3
Black-Necked Stork	8	5
Chestnut Rail	7	2
Little Black Cormorant	6	2
Purple Swamphen	5	1
Black Swan	4	1
Egret Species	3	1
Great-Billed Heron	3	3
Eurasian Coot	2	2
Black Bittern	2	2
Nankeen Night Heron	2	2
Rajah Shelduck	2	1
Large Raptor Or Stork Nest	1	1
Brahminy Kite	1	1
Swamp Harrier	1	1
Yellow-Billed Spoonbill	1	1
TOTAL	**8052**	**255**

APPENDIX B
SUMMARY OF RECORDS, COUNTS AND NUMBER OF SPECIES BY SURVEY BLOCK

Survey Block Number	Total Number of Records	% Records of all Survey Blocks	Total Count (all records combined) of Waterbirds	% Total Count of all Survey Blocks	Number of Species (of waterbirds considered in this report) in Survey Block
1	772	2.6	91921	3.5	46
2	908	3.0	22396	0.9	37
3	4182	14.0	230371	8.8	45
4	2866	9.6	114255	4.4	55
5	11739	39.2	905301	34.5	53
6	629	2.1	4946	0.2	38
7	2318	7.7	270083	10.3	46
8	1279	4.3	136499	5.2	46
9	175	0.6	582	0.0	31
10	1612	5.4	707841	27.0	43
11	537	1.8	8473	0.3	25
12	579	1.9	31570	1.2	37
13	521	1.7	49130	1.9	38
14	427	1.4	11498	0.4	27
15	1391	4.6	37047	1.4	48
Total	**29935**	**100.0**	**2621913**	**100.0**	

APPENDIX C
MINIMUM NUMBERS ALLOCATED (I.E. SET AS THRESHOLDS) FOR INDIVIDUAL SPECIES COUNTS TO REPRESENT A SIGNIFICANT RECORD

Species	Count No. Allocated as Significant for Species
Magpie Goose	3000
Plumed Whistling-Duck	1000
Wandering Whistling-Duck	1000
Black Swan	Not Considered
Radjah Shelduck	300
Green Pygmy-Goose	200
Pacific Black Duck	500
Grey Teal	1000
Garganey	Not Considered
Pink-Eared Duck	500
Hardhead	200
Australian Grebe	50
Australian Darter	300
Little Pied Cormorant	300
Little Black Cormorant	300
Pied Cormorant	300
Australian Pelican	500
White-Faced Heron	100
Little Egret	200
White-Necked Heron	30
Great-Billed Heron	Not Considered
Pied Heron	500
Great Egret	100
Intermediate Egret	300
Cattle Egret	500
Nankeen Night Heron	300
Glossy Ibis	500
Australian White Ibis	500
Straw-Necked Ibis	500
Royal Spoonbill	100
Yellow-Billed Spoonbill	Not Considered
Black-Necked Stork	10
Osprey	Not Considered
Brahminy Kite	Not Considered
White-Bellied Sea-Eagle	Not Considered
Swamp Harrier	Not Considered
Brolga	500
Chestnut Rail	Not Considered
Purple Swamphen	200
Eurasian Coot	500
Comb-Crested Jacana	100
Black-Winged Stilt	1000
Red-Necked Avocet	500
Masked Lapwing	300
Australian Pratincole	300
Gull-Billed Tern	300
Common Tern	500
Whiskered Tern	300
White-Winged Black Tern	500
Whistling-Duck Spp.	1000
Duck Spp.	1000
Cormorant And/Or Darter Spp.	300
Egret Spp.	500
Marsh Tern Spp.	300
Gull-Billed And/Or Caspian Tern Spp.	100
Waterbird Spp.	1000

APPENDIX D
SIGNIFICANT AREAS FOR WATERBIRDS AND SHOREBIRDS

(see methods/data presentation/significant waterbird areas for explanation)

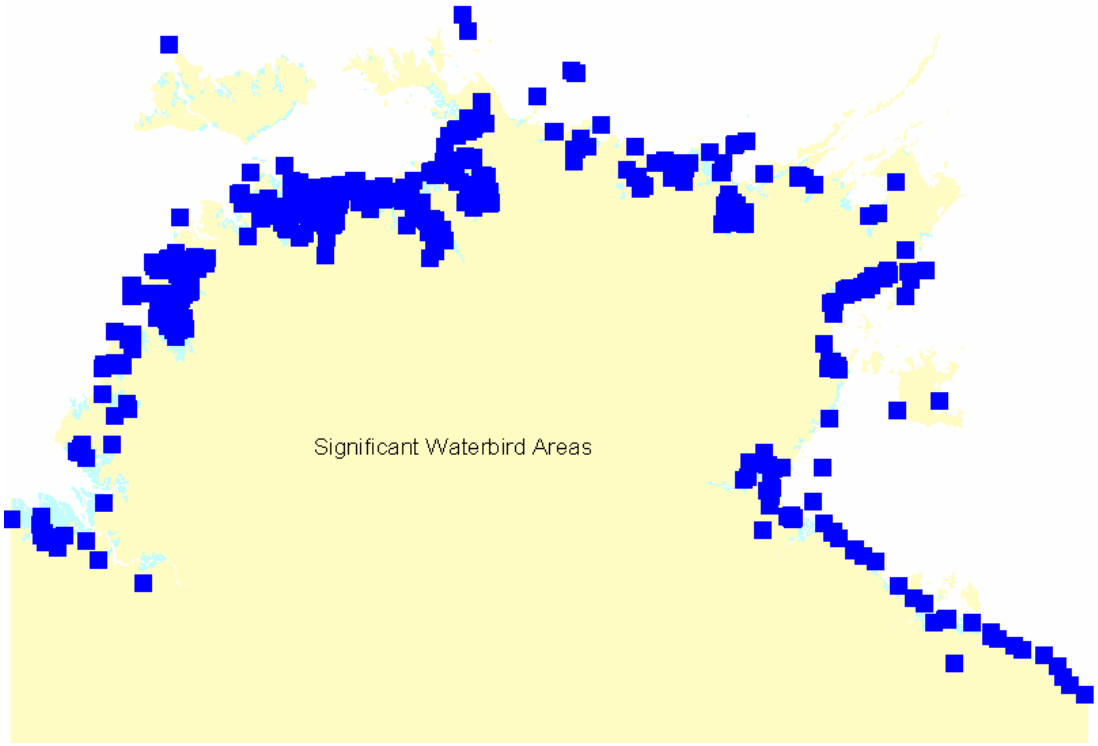

Figure D1 Waterbird Significant Areas.

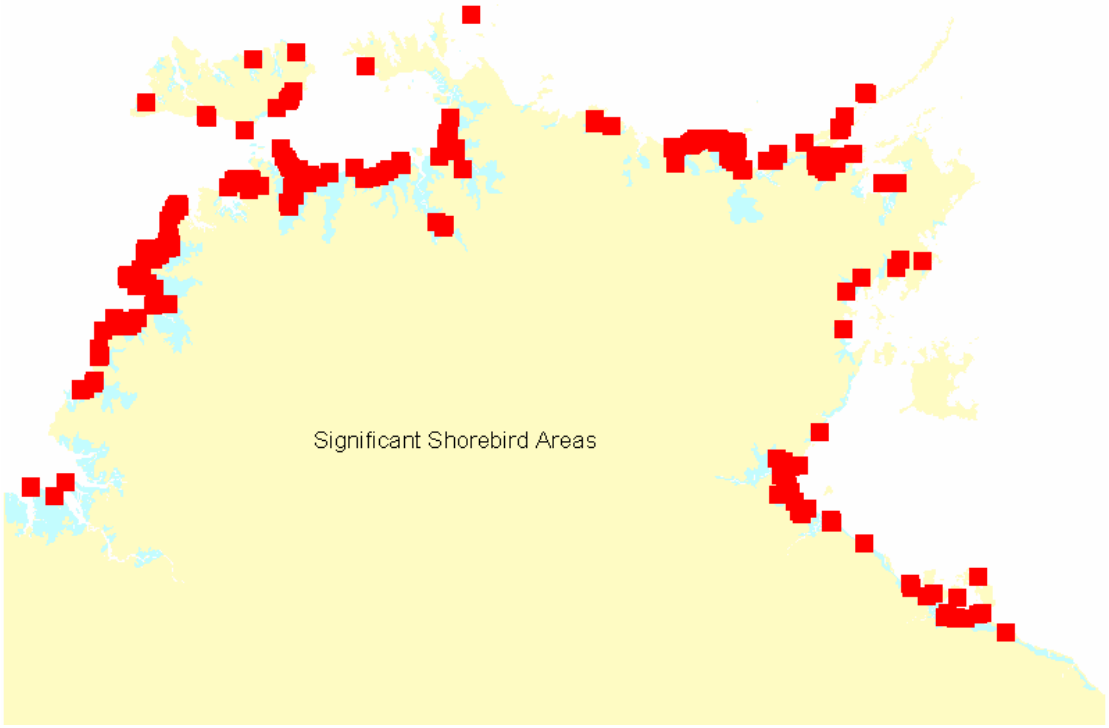

Figure D2. Shorebird Significant Areas.

APPENDIX E
SUMMARY OF INDIVIDUAL SPECIES COUNTS AND RECORDS

(Table 1 Species only).

Appendix E. Summary of individual species counts and records (Table 1 Species only).

Species	No. of Ground Records *	% Of All Ground Records	Total Numbers Counted *	% of Total Waterbird Species Counts Combined	No. of Aerial Records **
Magpie Goose	241	4.0	123863	20.4	2101
Plumed Whistling-duck	44	0.7	40168	6.6	75
Wandering Whistling-duck	154	2.5	58851	9.7	149
Black Swan	3	<0.1	10	<0.1	2
Rajah Shelduck	178	2.9	7006	1.2	416
Green Pygmy-goose	201	3.3	9192	1.5	102
Pacific Black Duck	178	2.9	17017	2.8	156
Grey Teal	121	2.0	60374	10.0	107
Garganey	9	0.1	66	<0.1	0
Pink-eared Duck	20	0.3	3900	0.6	7
Hardhead	45	0.7	4233	0.7	8
Australian Grebe	120	2.0	1708	0.3	9
Australian Darter	105	1.7	805	0.1	380
Little Pied Cormorant	172	2.8	1428	0.2	287
Little Black Cormorant	114	1.9	3077	0.5	157
Pied Cormorant	29	0.5	406	0.1	301
Australian Pelican	101	1.7	5198	0.9	608
White-faced Heron	97	1.6	340	0.1	289
Little Egret	241	4.0	8214	1.4	201
White-necked Heron	97	1.6	435	0.1	157
Great-billed Heron	21	0.3	28	<0.1	106
Pied Heron	179	2.9	15679	2.6	465
Great Egret	278	4.6	6882	1.1	354
Intermediate Egret	317	5.2	19855	3.3	113
Cattle Egret	135	2.2	13310	2.2	293
Nankeen Night Heron	53	0.9	1065	0.2	112
Glossy Ibis	152	2.5	32533	5.4	422
Australian White Ibis	224	3.7	7376	1.2	1548
Straw-necked Ibis	162	2.7	5350	0.9	493
Royal Spoonbill	117	1.9	2182	0.4	93
Yellow-billed Spoonbill	11	0.2	26	<0.1	3
Black-necked Stork	163	2.7	351	0.1	923
Osprey	117	1.9	173	<0.1	666
Brahminy Kite	42	0.7	85	<0.1	250
White-bellied Sea-Eagle	139	2.3	202	<0.1	480
Swamp Harrier	29	0.5	34	<0.1	43
Brolga	127	2.1	15155	2.5	403
Chestnut Rail	21	0.3	61	<0.1	12
Purple Swamphen	17	0.3	3726	0.6	17
Eurasian Coot	13	0.2	5190	0.9	3
Comb-crested jacana	187	3.1	3796	0.6	26
Black-winged Stilt	194	3.2	27647	4.6	635
Red-necked Avocet	25	0.4	6487	1.1	40
Masked Lapwing	318	5.2	10329	1.7	441
Australian Pratincole	110	1.8	3996	0.7	19
Gull-billed Tern	191	3.1	11214	1.8	251
Common Tern	108	1.8	20754	3.4	13
Whiskered Tern	274	4.5	17458	2.9	117
White-winged Black Tern	76	1.3	29221	4.8	177
Total	**6 070**	**100.0**	**606456**	**100.0**	**14030**

* Includes all surveys combined and calculation of combined *spp.* records into individual species. (See Methods Section, Page 18).

** Does not include aerial records for combined *spp.* and individual species not modified by *spp.* conversions. (*Spp.* records are mentioned in text.)