TECHNICAL REPORT 73 2003

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

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Cover photograph: Beach Thick-knees. Photo J. McKean/G. Chapman. (Readers Digest Complete Book of Australian Birds).

This report is dedicated to the memory of helicopter pilot

ADRIAN WAGG,

tragically killed in a helicopter crash 5 June 2002.

A skilled pilot, a good bloke and a great help to me over many years.

EXECUTIVE SUMMARY

This is the third report in a series documenting the location and status of selected faunal assemblages on the Northern Territory coastline, offshore islands and Top End wetlands. Previous reports in the series considered waterbird and seabird breeding colonies. This report briefly summarises the status and distribution of selected migratory and resident shorebirds in this large area. More detailed papers on species and areas will be written at a later date.

Prior to 1990 little information existed on the distribution and abundance of shorebirds around the Northern Territory coast and adjacent wetlands. Information gathered during my aerial and ground surveys between 1990 and 2001 has now clearly shown that the coast and coastal wetlands of the Northern Territory have globally significant numbers of many species of shorebirds.

Over the 12 year period I made nearly 13 000 separate records of shorebirds in the survey area. These records totalled around 2.1 million birds. Shorebirds were recorded on all parts of the Northern Territory coast, nearly all islands and most of the wetlands.

Shorebirds were most numerous in Anson and Fog Bays on the west coast; the south shore of Van Diemen Gulf east of Darwin; Boucaut, Castlereagh and Buckingham Bays and the Cadell Straits on the north coast; and the area between the Roper and the Limmen Bight Rivers and the Port McArthur areas on the east coast. Each of these areas, and more, would qualify for nomination to the East Asian-Australasian Shorebird Site Network and/or as Ramsar sites. Especially important in many of these areas were the very high numbers of migratory shorebirds that were present during the Northern Hemisphere breeding season (June to August). These birds are likely to include many immature birds and may include some that are partaking in partial migrations from southern Australia but not going any further.

Areas that my surveys indicated as having relatively few shorebirds included most of the north coast of the Tiwi Islands and Cobourg Peninsula (including the coast to its east), the north west coast of the Gulf of Carpentaria and most of the offshore islands, including Groote Eylandt.

Many of the species discussed in this report were found throughout the survey area and were found in greater numbers than previously suspected. Easily the most abundant species was the Great Knot. This species is likely to have a peak population in excess of 120 000 birds around the Top End coast. Larger, short-term populations of Little Curlew are likely to occur, but these were not recorded in these surveys. The next most abundant species were the Bar-tailed Godwit, Black-tailed Godwit, Greater Sand Plover, Lesser Sand Plover and Red-necked Stint. There are also many other species for which the Top End appears to have a significant proportion of the Australian population. Of the 33 species discussed in this report, as many as 26 species are likely to be present in at least one site along the Northern Territory coast and Top End wetlands in numbers greater than 1% of the estimated minimum flyway population. Species for which the Top End has only a small proportion of the Australian population, include *Snipe spp*., Wood Sandpiper, Sanderling, Sharp-tailed Sandpiper and Curlew Sandpiper.

Most of the species discussed in this report are non-breeding migrants, however there are some that breed in the survey area. Little emphasis was given to searching for single breeding pairs in these surveys and no examples of colonial or even loose aggregations of multiple breeding birds were located. Some resident species (eg Beach Thick-knee and both Oystercatchers) bred in scattered pairs throughout the survey area. Others (eg Red-capped Plover) do breed in the survey area but most of the breeding population probably moves inland and/or south of the study area to nest.

Shorebirds, like most of the other fauna of the Top End of the Northern Territory, are in a very 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 at some stage in the more distant future. It is for this eventuality that we must be prepared. We must therefore ensure the security of the more significant of these areas before problems arise. Locating coastal fauna sites and documenting them in this series of reports is the first step in that process.

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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. David Lawson towards the end, such a large and demanding project would not have been possible to complete.

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.

Aboriginal Land Councils, particularly Dhimurru, and Traditional Owners provide assistance and land access permission over the duration of the project.

Dr. Mike Bamford, Roger Jaensch, Niven McCrie, Dr. Clive Minton, Dr. Robert Taylor, 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

BACKGROUND AND OBJECTIVES

Much of the Northern Territory's Top End (defined here as north of latitude 16° 35' S, which is the southern limit of the Northern Territory coastline) is very 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 Geese 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 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 select a series of important sites for on-going monitoring programs and the third phase 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 coastal and near coastal sites 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 conservation and management priorities. Having said this, there was still a large amount of data collected and it is possible to analyse this data in greater detail than was done to produce this series of summary reports. This will be done in future papers for specific species and/or areas.

The previous two reports in the series detailed the status and distribution of waterbird breeding colonies (Chatto, 2000b) and seabird breeding colonies (Chatto, 2001). This report is the third of the series. It focuses on both migratory and resident shorebirds that occur in the Top End of the Northern Territory.

The main body of this report is divided into three sections. The first section divides the surveyed area into 15 separate blocks that are discussed individually with respect to location and abundance of all species of shorebirds. The second section separately summarises each of the species in terms of their total distribution, peak abundance and to a lesser extent, seasonal variation, over the entire survey area. The third section attempts to provide an estimate of total numbers for each species in the Top End. This approach allows the reader to focus on individual species over the entire Top End or all species in selected areas. This is seen as useful for inter-regional comparisons and assessments of species status, as well as identification of sites warranting special attention or protection.

This report, and others still to come in this series (ie waterbirds, marine turtles and coastal raptors) deal with each of the selected groups of coastal and wetland fauna discuss all records and the full distribution of the species. Significant sites are mentioned, but not discussed in detail. The final report in this series will be a summary of just the significant sites for all of the species covered in the project. This will also include data collected on other species of coastal or wetland wildlife (for example significant flying fox roosts) that was not included in a separate report.

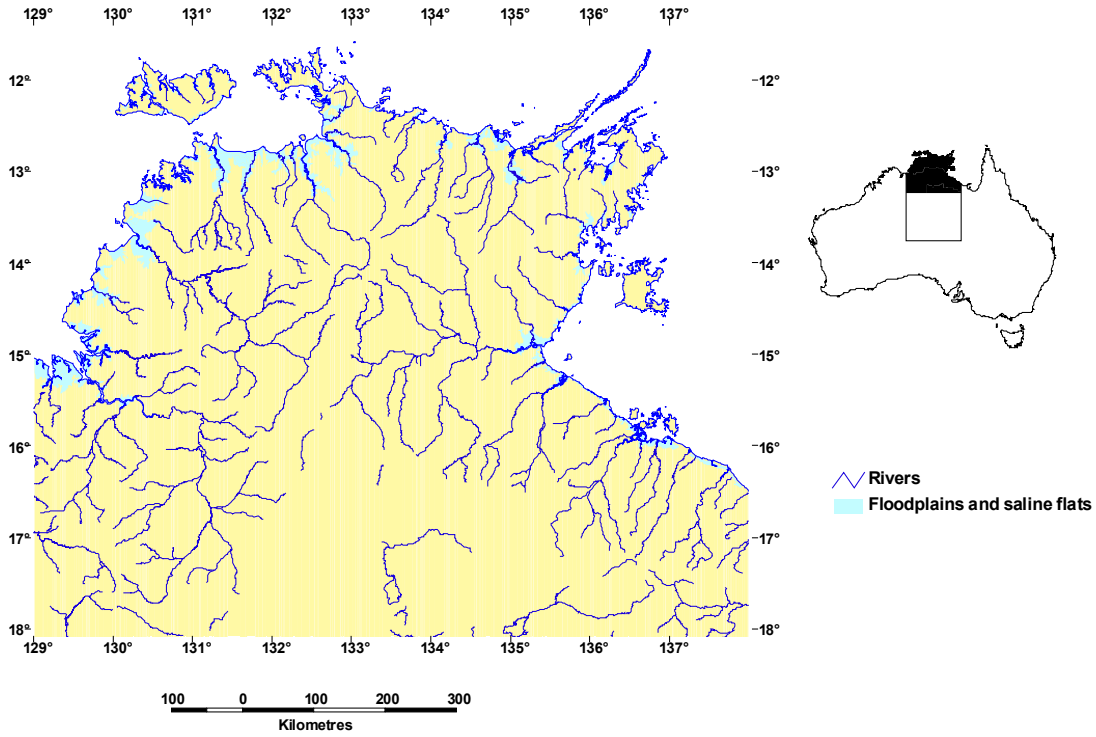


Figure 1. Northern Territory's 'Top End', showing major rivers and wetlands.

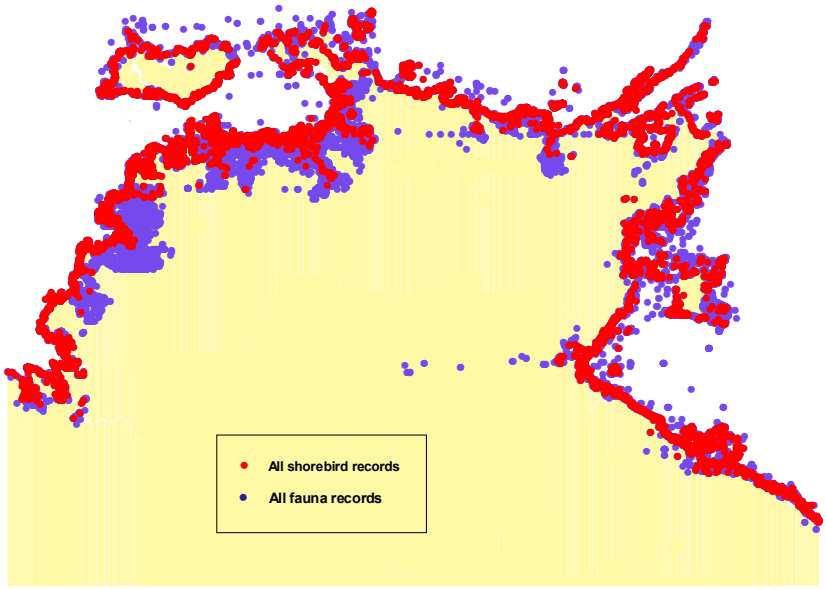


Figure 2. Distribution of all fauna records and all shorebirds records from these surveys.

STUDY AREA AND ENVIRONMENT

The survey area for this series of reports includes the coast, islands and major wetlands of the Top End of the Northern Territory (Figure 1). Habitats of this very large survey area are both extensive and extremely varied. The actual survey area is best shown by a map depicting the records of all fauna made throughout the project (Figure 2). This figure also shows the distribution of all records relating to the species of shorebirds discussed in this report.

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 different 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 Melville 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.

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, that retain water for varying periods. In total these wetland areas cover around one million hectares and have numerous rivers running through them. The wetlands vary from highly saline flats with little vegetation, through to well-vegetated freshwater areas.

Wetlands further inland were only partially sampled for this report. 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 only checked if they occurred on route, because they were not considered likely to contain significant numbers of shorebirds, and the surveying of such a large area with only scattered small wetlands was not considered cost effective.

The key climatic and hydrological features of the Northern Territory coast and Top End wetlands are the 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 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 fairly harsh environment.

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.

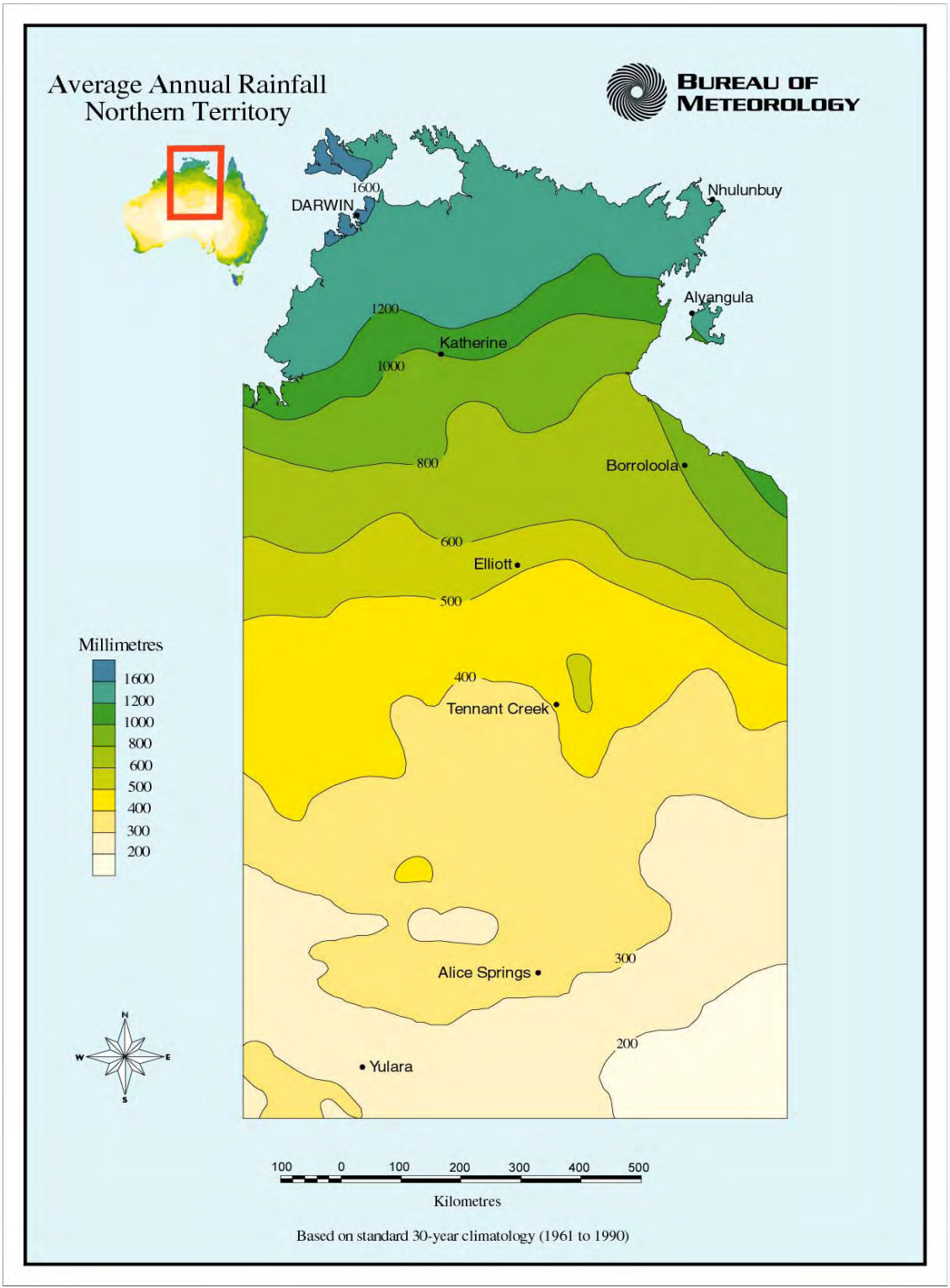


Figure 3. Average annual rainfall isohyets (mm) in the Northern Territory.

SPECIES SELECTED

The birds included in the main analysis of this report are listed below (Table 1 and Table 2). English and scientific names used here are as per Christidis and Boles (1994). Those listed in Table 1 were recorded on three or more occasions. Those listed in Table 2 were recorded two or fewer times during these surveys and/or have previously been recorded in the Top End but were not recorded in these surveys. It is possible that other species recorded elsewhere in Australia or SE Asia may occasionally occur in this relatively under-surveyed part of Australia, but these have not been considered here.

The list of species chosen to be included in this report is taken from those birds listed as shorebirds in Lane (1987) and Watkins (1993) however, not all of these species were included. Black-winged Stilt, Banded Stilt, Painted Snipe (not seen in these surveys), Masked Lapwing, Red-necked Avocet, Oriental Pratincole and Australian Pratincole have not been included in this report. For a number of reasons I consider them more appropriate to be included in the next report in this series which deals with waterbirds. Another species classified as a shorebird by Lane and Watkins, but also not included in this report, is the Bush Thick-knee. Although common in the Top End the number of times it was recorded on wetlands was so low compared to its occurrence away from wetlands its inclusion was not considered useful.

It should be noted that the species included in Table 2 are dealt with in much less detail. These surveys were not designed to spend time on the ground searching flocks for vagrant or rare birds, and they are species that are not easily detected in aerial surveys.

All wildlife recorded in this project, including those shorebirds reported here, was recorded to species level where possible. However, as this was not always possible, particularly from aerial surveys, a series of species combinations was devised to record birds that could not always be identified to species level. With respect to shorebirds, these combinations included the pairing Black-tailed and Bar-tailed Godwits, Marsh Sandpiper and Common Greenshank, Great and Red Knots and Lesser and Greater Sand Plovers. Counts of these groups were then broken down to individual species counts wherever possible ie whenever a sample count of that group was done at that site. An additional group, in fact the one that dominated in terms of the number of records (mostly from aerial surveys), was an overall '*wader spp*.' combination. This included all of the species that were more difficult to identify from the air, which in fact was all shorebirds discussed here except the Beach Thick-knee and both oystercatchers. This larger group of birds is also referred to as Group 1 birds during survey block discussions, while the Beach Thick-knee and both oystercatchers are referred to as Group 2 birds.

Table 1. Species list.

Order	Family	Species	Common name
Charadriiformes	Scolopacidae	*Gallinago spp.*	*Snipe spp.* [M]
		Limosa limosa	Black-tailed Godwit [M]
		L. lapponica	Bar-tailed Godwit [M]
		Numenius minutus	Little Curlew [M]
		N. phaeopus	Whimbrel [M]
		N. madagascariensis	Eastern Curlew [M]
		Tringa totanus	Common Redshank [M]
		T. stagnatilis	Marsh Sandpiper [M]
		T. nebularia	Common Greenshank [M]
		T. glareola	Wood Sandpiper [M]
		T. cinereus	Terek Sandpiper [M]
		T. hypoleucos	Common Sandpiper [M]
		T. brevipes	Grey-tailed Tattler [M]
		Arenaria interpres	Ruddy Turnstone [M]
		Limnodromus semipalmatus	Asian Dowitcher [M]
		Calidris tenuirostris	Great Knot [M]
		C. canutus	Red Knot [M]
		C. alba	Sanderling [M]
		C. ruficollis	Red-necked Stint [M]
		C. acuminata	Sharp-tailed Sandpiper [M]
		C. ferruginea	Curlew Sandpiper [M]
		Limicola falcinellus	Broad-billed Sandpiper [M]
	Burhinidae	*Esacus neglectus*	Beach Thick-knee [R]
	Haematopodidae	*Haematopus longirostris*	Pied Oystercatcher [R]
		H. fuliginosus	Sooty Oystercatcher [R]
	Charadriidae	*Pluvialis fulva*	Pacific Golden Plover [M]
		P. squatarola	Grey Plover [M]
		Charadrius ruficapillus	Red-capped Plover [R]
		C. mongolus	Lesser Sand Plover [M]
		C. leschenaultii	Greater Sand Plover [M]
		C. veredus	Oriental Plover [M]
		Elseyornis melanops	Black-fronted Dotterel [R]
		Erythrogonys cinctus	Red-kneed Dotterel [R]

[M] = Migratory species. [R] = Resident species.

Table 2. Less common species list.

Order	Family	Species	Common name
Charadriiformes	Scolopacidae	*Numenius arquata*	Eurasian Curlew [M]
		Tringa erythropus	Spotted Redshank [M]
		T. ochropus	Green Sandpiper [M]
		T. incanus	Wandering Tattler [M]
		Calidris minuta	Little Stint [M]
		C. subminuta	Long-toed Stint [M]
		C. bairdii	Baird's Sandpiper [M]
		C. melanotos	Pectoral Sandpiper [M]
		Micropalama mimantopus	Stilt Sandpiper [M]
		Philomachus pugnax	Ruff [M]
		Phalaropus lobatus	Red-necked Phalarope [M]
	Charadriidae	*Charadrius hiaticula*	Ringed Plover [M]
		C. dubius	Little Ringed Plover [M]
		C. alexandrinus	Kentish Plover [M]
		C. asiaticus	Caspian Plover [M]

[M] = Migratory species. [R] = Resident species.

METHODS

Survey Types

The most economical and practical way to cover the long coastline, many islands and large areas of wetland of the Top End of the Northern Territory 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 and do total counts used 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. 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 to 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 restriction, 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 may have been less frequently counted from the ground.

With both ground and aerial surveys, all observations of species, counts and general comments 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 latitude and longitude, as called to the tape during the survey. Consequently they are all point records rather than 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 for colonial breeding waterbird and seabird records, and the third and main database was for all other fauna records. The latter database contains all shorebird records. In total this database has approximately 65 000 records, totalling over 5 million individuals. Of this, there are approximately 13 000 records of shorebirds totalling over 2.1 million individuals.

Survey Effort

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 just shorebirds. Consequently, it is difficult to accurately quantify survey effort in relation to species, areas or dates. Nevertheless in approximate terms I spent around 2000 hours, over more than 600 different days between 1990 and 2001, conducting aerial and ground surveys that involved at least some emphasis on shorebird work. The approximate percentage of all survey hours involved in shorebird surveys each month is shown in Figure 4.

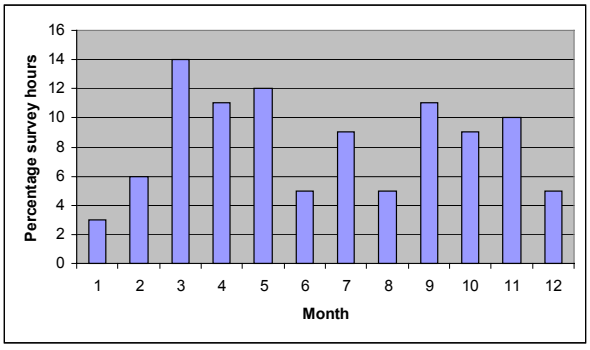


Figure 4. Percentage of total survey hours for each month.

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%. Such figures can only be used as a guide, and attempting to directly relate survey hours to species or area counts for comparative purposes would not be wise.

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. waterbirds, 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 shorebirds were likely to be an important part of the surveys, attempts were made to focus on the important times of these species. For resident species this included wet and dry season surveys, while for migratory species attempts were made to include surveys during four main time periods. They include (i) the late March to early May departure time, (ii) the only month of the year (June) when it was likely that all departing birds had left but no post-breeding birds had returned, (iii) the late July to October arrival time, and (iv) the late October to early December period which I was attempting to cover the approximate time when most of the birds had returned after breeding but had not moved further south on their migration. Obviously these periods can never be completely definable because of the variation in arrival and departure times of different species (and even of adults and juveniles of the same species), and the possibility of partial migrations of birds from southern Australia that failed to continue migration out of Australia. Effort was also made to try to beat the first of the monsoonal rains with regard to surveys done later in the year because these rains greatly increased the dispersal of birds over areas that became too large to cover.

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 is to get each of the main species groups documented in this series of reports as soon as possible.

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 (ie latitude and longitude reading) 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 many species (of all fauna, not just shorebirds) mixed in with each other as I flew along 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 9 500 aerial records and 3 400 ground records relating to shorebirds were made during the project.

'Counts' (or total numbers) are simply the total numbers of individuals counted. Although many accurate counts were made during ground surveys, most of the counts made during this project are based on estimations. 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 sites. Estimates in these surveys were made as either a single minimum number or a range estimate (eg 1 000 - 3 000). This minimum estimate, or the midpoint of the range estimate, was taken to represent the number

counted for that record. Throughout the surveys there were over 420 000 shorebirds counted from ground surveys and 1.7 million from aerial surveys.

There was not the time nor money to attempt calibrating mixed species counts from the varied survey methods used during this project. The question of acceptance of discussions relating to numbers then becomes one of the degree of accuracy involved in these estimations. To this I suggest that the actual estimates are firstly, more likely to be under-estimates (thus further increasing the significance of shorebirds in the Top End than mentioned here) and secondly not likely to be excessively inaccurate.

In relation to the first point, 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.

In relation to the second point, my justification that these numbers are not excessively inaccurate is based on more than 23 years of experience in estimating numbers of varying types of fauna during aerial and ground surveys. These have been done as an employee of a state wildlife agency in Victoria and the Northern Territory. During this time I have refined my skills/accuracy in such estimations by frequently counting groups of birds in the field after first making an estimate, and also comparing estimates with numbers counted from photographs. Calibration flights carried out in the early days of the aerial surveys of Magpie Geese showed I needed to multiply my counts by a factor of 2.3 which was the lowest of all aerial survey staff working on these surveys (Saalfeld, 1990). However, these counts were heavily biased by a high environmental factor (the geese being difficult to see in tall floodplain reeds) and so my calibration factor would have been considerably less in the open areas usually used by shorebirds (Saalfeld, *pers. comm*.).

An aerial survey done with the very experienced Dr. Clive Minton showed my estimations of shorebird numbers along the coast between Darwin and the Western Australian border were very similar to his estimations. There were tens of thousands of migratory shorebirds along this coast during the survey.

In doing surveys of species that readily take to the air in flocks, there is the possibility of double counting. Care was taken not to do this, and although it cannot be said that it never happened, it can be said that it would be a very minor percentage in amongst a large number of counts done over the years. The main reason for circling an area, or flying over it two or more times, was to increase species identification. Additional birds were only added to the count if it was certain they had not been counted on the first flyover.

Quality of Analysis

As previously stated, this project was designed to collect baseline data on the distribution and status of a large range of coastal and wetland fauna. This data was collected over an extensive area that had received few previous surveys. The planning and collecting of this data was primarily based on it being used for ongoing management and as a baseline for future research. Hence, analysis of the data beyond these primary purposes is kept simple and results can only be taken as approximations in terms of numbers, or likely indications in terms of movement or seasonal trends. Part of the reason for this is the large range of methods of data collection that were needed to cover all species and areas, but there are many other caveats that make detailed analysis of these shorebird surveys difficult.

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

(i) the lack of detailed knowledge about the local, national and international movements of migratory shorebirds using the Top End,

(ii) the intermittent movements of resident Australian species in and out of the Top End in relation to varying seasonal conditions here or elsewhere, and
(iii) the fact that most species gather in large, patchily distributed, high tide roosts which, if not located during a given survey, may significantly influence counts.

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 factor that could counterbalance 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 may 'smooth out' errors in terms of average numbers.

Data Presentation

Within Survey Block Section

This section discusses Top End shorebird distribution and status in terms of 15 individual survey blocks. Each block has the same method of presentation. The location of the block, along with a brief habitat description, is first described. This is followed by a presentation of survey effort in terms of a monthly breakdown within the survey block and an overall comparison with other survey blocks. A summary of the number of records and numbers of shorebirds totalled form all surveys for the survey block is given, and these are then represented a percentage of other survey blocks.

Basic ecological differences between group 1 and group 2 species meant they were treated differently.

Group 1 Species. Although aerial surveys provide the most comprehensive coverage in terms of potentially estimating the number of shorebirds for the block, most group 1 species could not be counted to species level from this form of surveying. Ground counts on the other hand were more accurate in terms of species identification and numbers. Consequently, rather than directly attempt to estimate the number of each group 1 species in the block from either type of survey, the results of all ground counts were used calculate a average percentage abundance for each species over the period of the project. These are represented by pye chart for each survey block. With so many species, those in lower abundances are not going to be clearly seen on such a chart, but the main aim of these charts is to give the reader a quick and easy indication of the main species in the block. The full percentage abundance figures are given in tables in Appendix A. It is possible that some species (eg Little Curlew) may have had short but large population increases that were missed, but it is expected that so many surveys at many different times of the year would smooth out potential errors in terms of an average abundance.

In addition, an approximate peak estimate of all group 1 birds combined for the survey block is given. This was taken from the survey(s) that gave highest numbers for that block during the project. Because individual species identification is not an issue for this, the more extensive aerial surveys are mostly used to derive these estimations. There were no single surveys of any survey block in which the entire area of potential shorebird habitat was covered in the one survey. Consequently the peak estimate of all group 1 species was compiled from separate surveys of individual sections of the block, or from the most extensive single survey of the block when numbers were high. When more than one survey was involved most of the total was taken from surveys done at the same time of the year. If this was unable to be done the level of approximation further increases because of the inability to guarantee no movement between sections and varying numbers of birds present at the different times of the year. If

counts from two sections at different times of year are added to give a survey block total then it is almost certain that one of these times will be when numbers are less than their peak for that section. Consequently, the overall survey block total, which is given as a minimum estimate, will still be likely to be under the their true numbers. Within each survey block an explanation of which surveys were used to derive this figure is given, along with a brief discussion of potential biases.

Species such as Whimbrel, Common Sandpiper, Terek Sandpiper and Grey-tailed Tattler had reasonable numbers feeding and/or roosting in the many thousands of kilometres of mangrove lined creeks and channels around the Top End. These habitats were not as well surveyed so may have led to their average percentage abundances being under-estimated for the block. Other species, such as Little Curlew and Oriental Plover, are also likely to be under-estimated because of their frequent presence on the dry, often burnt, floodplain areas. These were also habitats given less priority because of the low densities and diversities of birds on them, and the added problem of the difficulty of seeing them from the air against the background.

Also within this section the largest single flocks (based on single records) of each species are presented. These were nearly all high tide roosting flocks. Such counts were only presented if they were (i) in the top five highest records for that species from all surveys over all blocks or (ii) when they are greater than 1% of the Australian and/or international population estimates for those species (Watkins 1993). These records will generally represent less than the total number of that species in that area because they will not include additional different records of small counts also made from that area in that survey.

Group 2 Species. Similar details are discussed for group 2 as for group 1 species, but whereas an average percentage abundance was derived for group 1 species, an actual estimate of the number of each of the group 2 species is given for each survey block. This is deduced directly from survey counts. Unlike group 1 species, group 2 species were not as well represented in ground counts and so were analysed primarily from aerial surveys. Group 2 species could be treated differently because they were in smaller numbers, could easily been seen and identified in the more comprehensive aerial surveys and were generally more sedentary in terms of their distribution with the survey block. The minimum estimate of the peak number of these species was taken directly from the survey(s) with the highest numbers, as it was for the combined group 1 species estimate.

A second approach was also used to estimate Beach Thick-knee totals because of the more rigid territoriality of this species, at least during the day. There is some nocturnal movement to congregate around turtle hatching beaches (pers. obs.), but pairs are frequently seen in the same general area over multiple surveys during the day. Consequently a population estimate for this species was derived from the establishment of the territories of individual pairs compiled from the many surveys over the years. This approach was not taken with the oystercatchers because they are more frequently seen in large daytime groups.

As discussed in the individual species sections these surveys did not detect an obvious seasonal variation in numbers for any group 2 species around the Top End coast as a whole, or within any survey block.

At the end of each survey block discussion is a table with a summary of some of the more important aspects of that survey block. Details shown in this table should take into account relevant discussion and explanation from the survey block summary.

Within Individual Species Section

This section discusses each of the individual species separately in terms of their Top End distribution and status. Details include geographic distribution, numbers, seasonality and breeding. In the case of species that do not breed in Australia the discussion on breeding refers to observations of breeding plumage.

Groups 1 and 2 species are discussed first and then there are some very brief comments on species that have only rarely been recorded in the Top End, some on my surveys but most from other sources.

Much of the methods explanation 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.

In relation to presenting information on numbers, a graph is shown giving the percentage breakdown of that species over all survey blocks. Although the distribution maps (discussed below) show a similar thing in terms of the distribution of records, these graphs are presented because they give more insight into the importance of each block in relation to total numbers of that species.

Examples of the more important areas for each species are briefly summarised. These are mainly based on extracting the largest single records from the database. As smaller records for the same species in that area were not considered, these figures may not represent all that species present at the time.

As mentioned previously it is difficult to estimate the number of each shorebird species using the Top End. Nevertheless, because of the frequent use of total population estimates in shorebird research and management, and some obvious underestimations in previously quoted estimates of numbers for some species in the Northern Territory, an attempt is made here to produce such figures. These figures will be very approximate and will more likely be under rather than over the real figures, but will certainly improve previous figures for some species. This figure was calculated for each species in each individual survey block by applying the percentage abundance of each group 1 species to the estimated highest number of group 1 species in that block. Estimates from each of the blocks are then totalled and presented for each species in this section as a minimum estimate of the peak Top End population. All totals are shown in Table 17 and individual breakdown of species by survey block is shown in Appendix B.

Comments made on seasonality are drawn from general field notes, other published data and a series of three individual analyses run on the data obtained during this project (Appendix C). The first of these analyses involved the monthly breakdown of the average number of birds per record for each species. This gives and indication as to the whether flock sizes on average are increasing or decreasing which could be due to large numbers of birds arriving or departing. Such conclusions need to be taken in conjunction with other data relating to seasonal movements because an increase/decrease in numbers may also be reflected in more or less flocks as well as changes in flock size.

The second and third analyses involved using the monthly total numbers and number of records of each species as a percentage of all group 1 species counts and records respectively. This assumes a large increase in the percentage of that species compared to the total of all species combined may represent a real increase in numbers of that species. These also can only be taken as a general indication because of other influencing factors. For example, the particular locations of surveys in the different months would have an effect on the species that are not evenly distributed throughout the survey area.

A second possible limitation with this form of analysis, if taken on its own, is that a large high or low representation of a particular species could be a result of an opposite change for all other species. For example a later departing species may suddenly appear high on a percentage basis because most of the other birds have left when in reality its numbers may not have changed greatly. Nevertheless this should be able to be detected in similar analysis for these other species.

Analysis of the third histogram for each of the species (ie the number of records of the species as a percentage of all group 1 species combined) can be used to give an indication of whether the overall distribution of each species has changed markedly during the year. For example, a histogram that is reasonably even throughout the year suggests a consistent number of records during each month, even though the counts within these records may vary. With the geographical and temporal extensiveness of the surveys in this project, such a histogram suggests that, even though the total numbers of a species may have varied during the year, the overall distribution is unlikely to have changed greatly because

birds are still regularly being recorded in surveys. Any marked change in distribution is likely to have been reflected as a high or low bar on the histogram depicting the relative number of records of the species.

Little effort was made during these surveys to study breeding plumage for migratory species or to actively search for nests of resident species. The small amount of discussion on breeding plumage in this section is taken only from the occasional field notes made when time was taken to observe breeding plumage in members of a flock. Species with more obvious colour changes were more likely to have been noted.

Breeding of resident shorebirds was recorded as confirmed when nests or young were observed at a site, or likely when the activity of pairs strongly suggested breeding when I was present. All nesting was of single pairs, and I found no evidence of colonies or large nesting aggregations of any species.

At the end of each individual species section is a table with a summary of some of the more important aspects of those species. Details shown in this table should take into account relevant discussion and explanation from the species summary. In this table 'status' is represented by ✔ symbols. Three ticks indicate 'Large numbers', two ticks indicate 'Moderate numbers', one tick indicates 'Low numbers' and R indicates 'Rarely or not at all'.

Distribution Maps

Distribution maps, in both the survey block and individual species sections, show all records made over the entire period of the surveys.

Maps within the survey block section have symbols separated into blue for group 1 species and red for group 2 species. Group 1 records are further divided by using small solid dots for individual records of less than 2 000 individuals and larger open circles for records of 2 000 or more individuals. The latter indicate where the more important roosts are located. Because these records only relate to single records of 2 000 or more it is possible that there are other areas that may support 2 000 or more birds. For example, two or more very close (geographically) records of just under 2 000, perhaps separated by another record when calling onto the tape, would not register as such a site, but that site may still have totalled more than 2 000 birds. Given the large number of surveys over the years however, it is unlikely that there would be many such sites that would not have had a count of 2 000 or more at some stage during the survey period.

Another point in regard to the 2 000+ records is that they can vary between 2 000 and 20 000 shorebirds. There is certainly value in knowing which sites were towards either end of this range but creating too many more symbols would have cluttered the small maps. More important sites are discussed in the text but greater emphasis (in both text and maps) will be give to such sites in the final report in this series which will concentrate only on the more important fauna sites of the Top End coast and wetlands. This final report will also include species (for example important flying fox sites) not covered in the individual groups of fauna discussed in the other reports in this series.

Maps within the individual species section have solid circles for confirmed records of that species (eg Great Knot), as well as additional open circles as records of the relevant species group (ie *knots spp*.) where appropriate. These are included to give an indication of likely additional distribution of the individual species. For these distribution maps both aerial and ground records are used that 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, the confirmed distribution records of these species is still quite comprehensive at a Top End scale.

Two sizes of symbol are used for each single species map. These are based on numbers involved in that record. The larger symbols (both open and solid) are the largest 10% of the counts. For example if there were 100 records of a particular species then there would be ten larger dots and ninety smaller ones. This means that larger dots for species like Great Knots will represent counts in the thousands but for species such as Common Sandpipers may only represent counts under ten. Such a breakdown was not done for Beach Thick-knees because they were always recorded in groups of 1-3 birds.

Plate 1. Being retrieved after another count on a swamp in the middle of nowhere, March 1999. (Actually in from Joseph Bonaparte Gulf). Photo R. Chatto.

Plate 2. Another method of accessing sites on large floodplains in the wet season. Wildman River area, April 1991. Photo R. Chatto.

SHOREBIRDS – 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 5). Rectangular blocks were used to enable easier querying of the database. With this in mind the positioning of blocks was then based on areas for which some separation between significant coastal wader habitat could be achieved. Obviously the geography of the land doesn't always fit into nice 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.

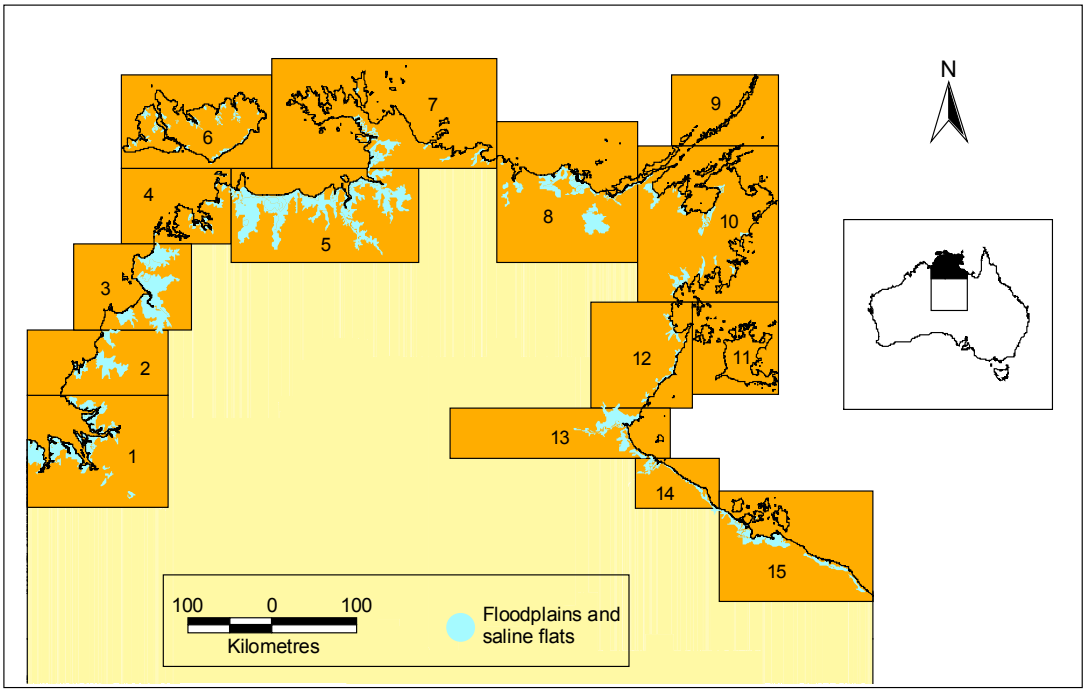


Figure 5. Location of individual survey blocks.

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).

The combination of these habitat types is also shown in Figure 5. 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 Lat.	Southern Lat.	West Long.	East Long.
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 Bays	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 approximate survey effort (Figure 6) and the number of ground sites (Figure 7) that were surveyed in each block in relation to shorebird/waterbird dominated surveys. As mentioned in the 'Methods' section, the number of hours spent specifically on shorebird surveys is very difficult to assess in light of all the other species covered in this project. This is particularly so for separation of shorebird and waterbird survey time so they are lumped together. It can be seen that survey effort was not uniform across all survey blocks. Some survey blocks (eg 4, 5 and 10) received much more surveying than others (eg 1, 13 and 14).

Although the number of ground surveys per block is reasonably accurate, differences in the amount of time spent specifically doing shorebird work on each ground count could not be recorded. 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.

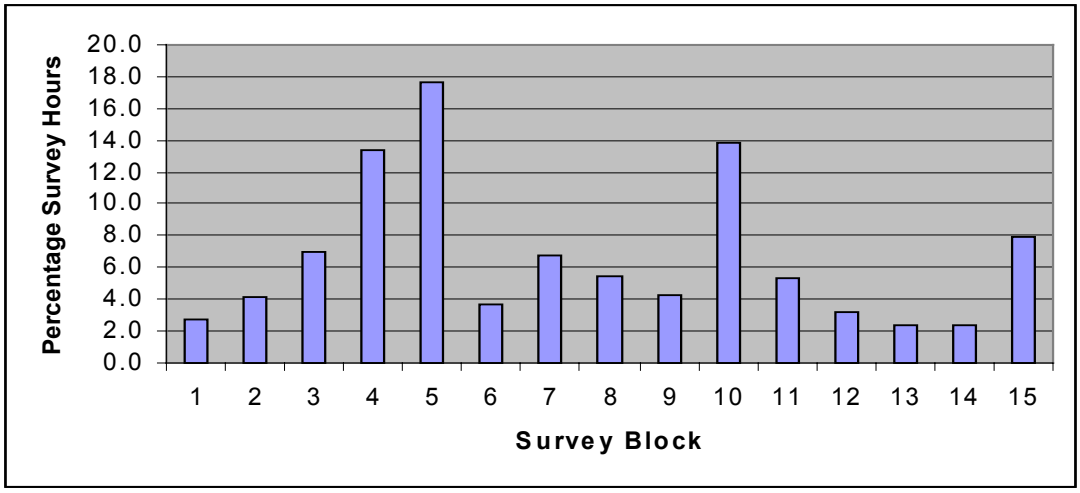


Figure 6. Percentage of survey hours for each survey block.

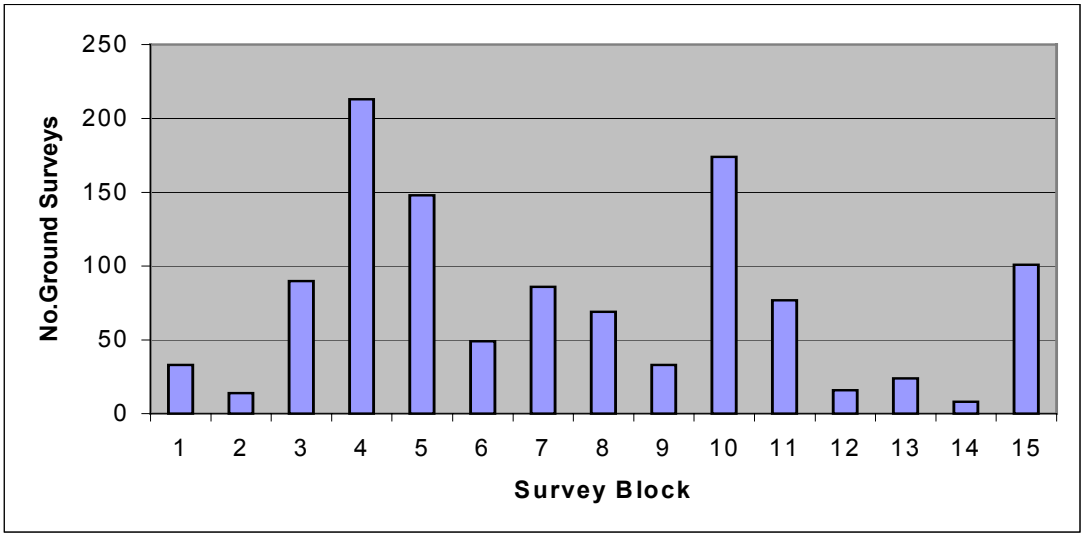


Figure 7. Total number of ground sites surveyed in each survey block.

Individual Survey Block Summaries

Survey Block 1

Location

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 boarder. 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 shorebird 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. The majority of the freshwater wetlands are in the north east and south west of the survey block with the better ones being found around the Legune Station area and the wetlands inland from Fossil Head.

Survey Effort

The survey block, being so far from Darwin, and not showing large numbers of shorebirds 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 2.7% of all survey blocks) of surveys dominated by shorebird/waterbird work during the period of this project. These surveys were spread over 13 separate days.

Although this survey block did not receive as much survey time as most other blocks, the four main periods for migratory birds and the wet and dry seasons are all at least partially covered (Figure 8). 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.

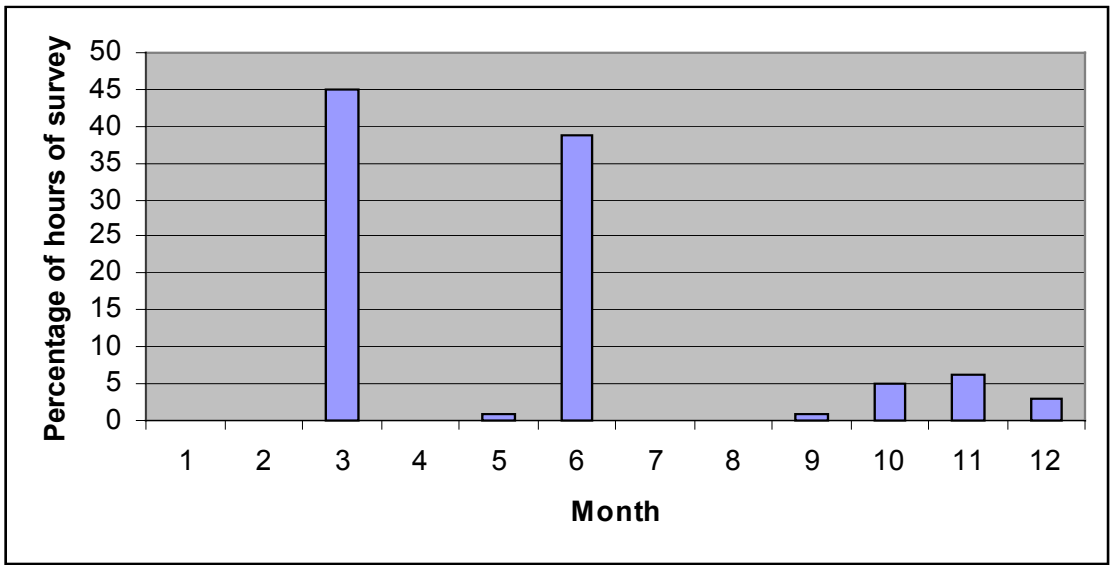


Figure 8. Average percentage of surveys hours relating to shorebirds for survey block 1.

Results and Discussion

Most of Joseph Bonaparte Gulf had not received any shorebird 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 shorebirds.

Even though the survey block has a large amount of apparently useable shorebird habitat, it is not one of the better areas for shorebirds around the Northern Territory coast. During the full period of this project there were a total of 431 combined aerial and ground records of shorebirds totalling over 29 217 individuals (Figure 9). They represented only 3.3% of the records and 1.4% of the total numbers of shorebirds recorded in the fifteen survey blocks. However, the relatively low survey effort should be taken into consideration.

Most shorebirds were found around the coastal mudflats. Few sites had high densities, either in feeding or roosting situations, compared to many other places around the Northern Territory coast. The freshwater wetlands in the north east and south west of the survey block, also did not support large numbers of the shorebird species covered in this report. These wetlands, however, did have large numbers of waterbirds (including Black-winged Stilts) that will be covered in the next report in this series.

Despite the relatively small survey effort, timing was appropriate and I consider the results adequately reflect the relative significance of this block.

Twenty-five species of shorebird (23 group 1 and 2 group 2) were recorded throughout the project in this survey block (Appendix A).

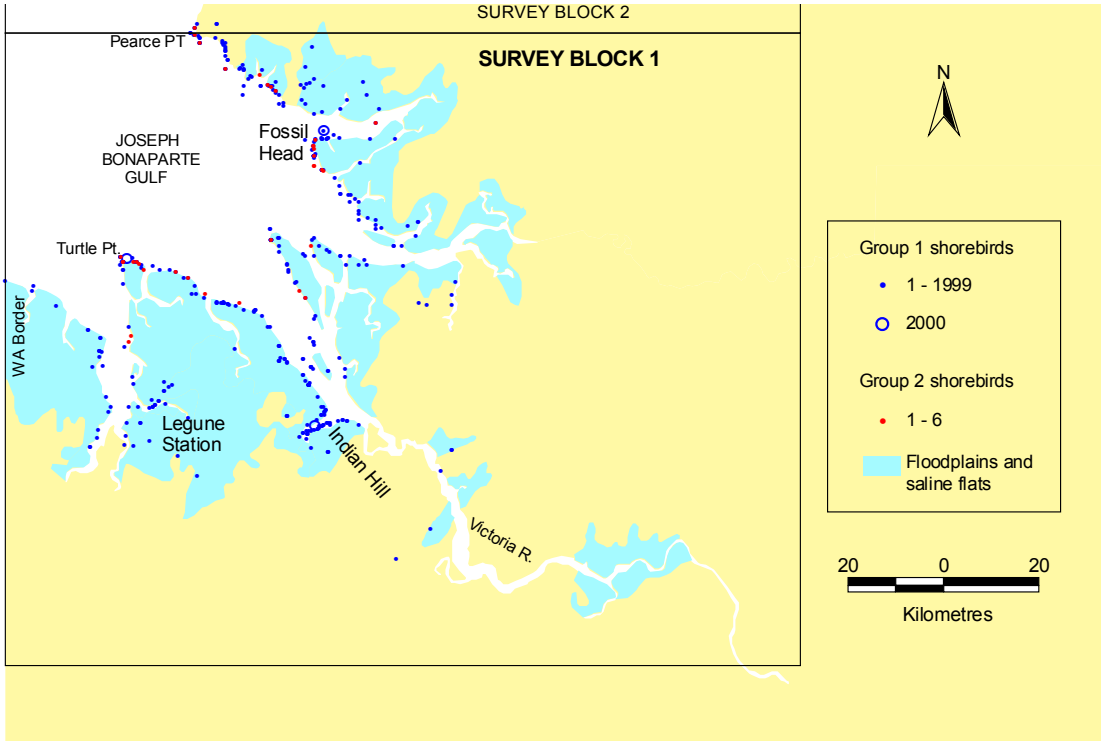


Figure 9. Distribution of shorebird records for survey block 1.

Group 1 Species. In general, this group of shorebird species made little use of the large saline mudflats adjacent to the coast, whether wet or dry. The majority of species preferred to feed or roost along the coast. This may seem surprising given the large amount of apparently suitable habitat, but this is not an uncommon situation around the Northern Territory. For example the huge areas of open saline flats in the south east of the Top End (see survey block 15) are similar in supporting relatively low densities of shorebirds.

Three significant group 1 species roosts (containing 2 000 or more birds) were located during these surveys (Figure 9). They were located at the mouth of New Moon Inlet, which is just south of Fossil Head, at Turtle Point and near Indian Hill. The Turtle Point roost was the largest, and the area between there and the Indian Hill site tended to have the highest density of feeding shorebirds in the survey block.

It is also interesting to note that a ground count at Turtle Point totalled 1 600 migratory shorebirds in early March 1999 but then 2 700 in late June 1999. Obviously only two counts of shorebirds done at different times is not necessarily informative due to potential local movements of birds, but it does support my view that over-wintering numbers of migratory shorebirds can be quite high in the Top End. This is also raised for other survey blocks and is discussed in more detail later in this report.

No single survey covered all of the coastal and wetland habitats in this survey block. The only aerial survey to cover nearly all the coastline was in March 1992, but no inland wetlands were visited on this survey. Just under 7 000 group 1 shorebirds were recorded on this survey. None of the other partial coastal surveys suggested that numbers would have been much higher if full block coverage was achieved on these particular surveys.

Coverage of inland wetlands was fairly poor in this survey block. The most comprehensive coverage of inland wetlands was done via a helicopter survey in June 1999. This survey only targeted selected sites rather than attempting a total coverage. Few group 1 shorebirds were counted from the five sites sampled in this survey. Jaensch (1994) did surveys of some of the wetlands in the southern part of the survey block at a more appropriate time for these species (September) but found only high tens to low hundreds at most of the eight sites he surveyed. With the above in mind, and given the March 1992 survey missed some coast and most of the adjacent saline wetlands, a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 10 000.

Four aerial surveys that covered only the coastline and that can be roughly compared were done in March 1995, October 1995, November 1998 and December 1992. (Unfortunately there was no June survey to perhaps support the above suggestion that was based on the ground counts at Turtle Point). Two of these surveys stopped at Turtle Point (on a clockwise route from Pearce Point) so comparison is only made for that section of the route. Totals (of all group 1 species combined) show relatively consistent numbers in the later three months and a total nearly twice as high in the March survey. This may indicate that numbers, especially of the migratory species, are higher in this area in the build up to migration from Australia than they are at the time of the year when they arrive from the Northern Hemisphere.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 10.

The most abundant group 1 shorebirds recorded in this survey block were Terek Sandpipers, closely followed by Greater Sand Plovers. However, this may not be a true reflection of the situation. With the relatively low number of ground survey sites in this area it is possible that other roosts that were not surveyed may have had larger numbers of other species. The least abundant, of those species confirmed present, were Black-tailed Godwits, Curlew Sandpipers, *Snipe spp*. and Black-fronted Dotterels.

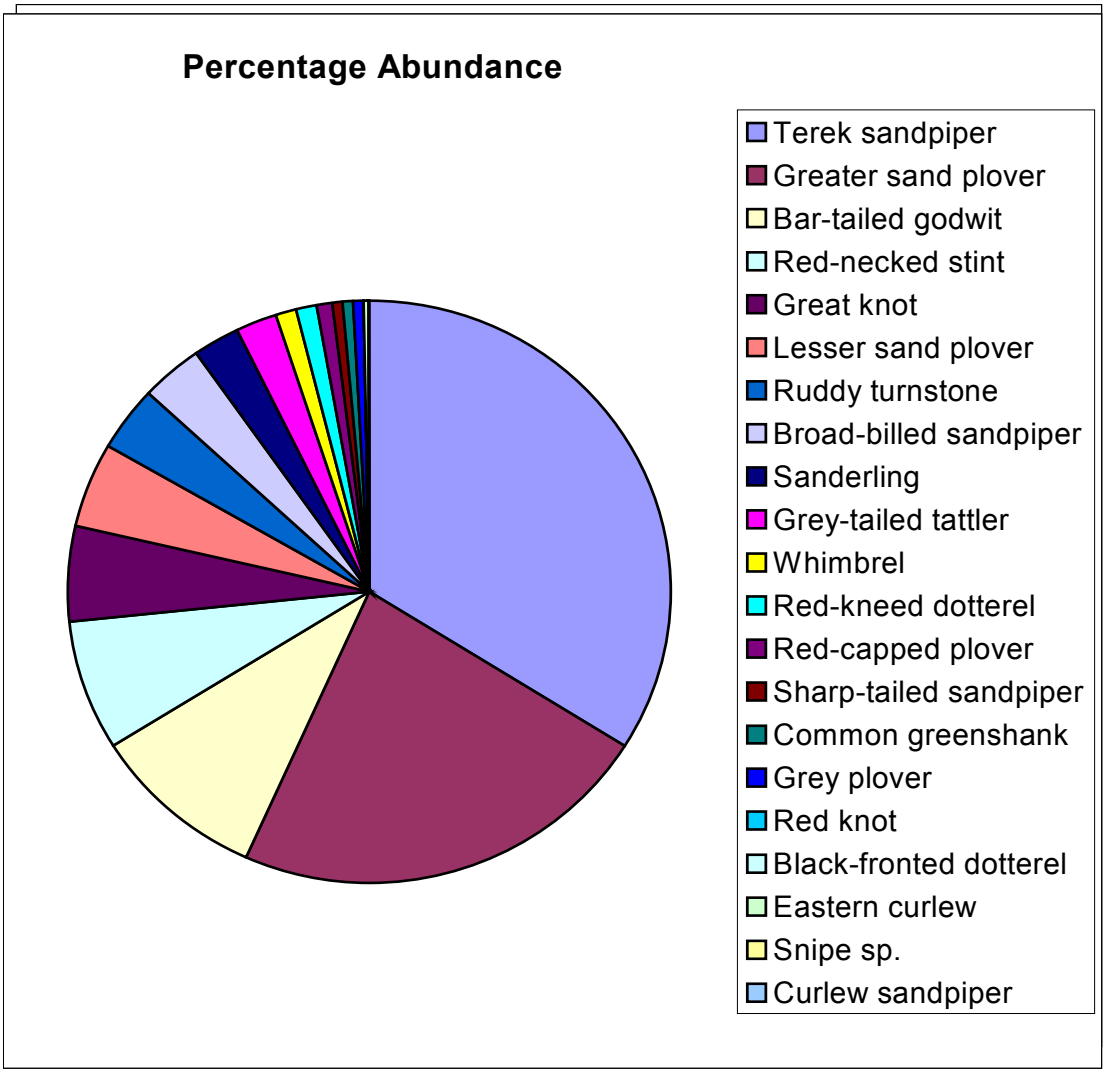


Figure 10. Average percentage abundance of group 1 species in survey block 1.

Oriental Plovers, Pacific Golden Plovers, Asian Dowitchers, Common Sandpipers, Wood Sandpipers, Marsh Sandpipers, Common Redshanks and Little Curlews were not recorded at all in this survey block while the species recorded on the largest number of separate occasions during ground surveys were Common Greenshanks and Red-necked Stints.

The lack of Black-tailed Godwits (among quite good numbers of Bar-tailed Godwits) and Marsh Sandpipers, which were both commonly recorded along the coast to the north of this block, is surprising. Black-tailed Godwits are a species easily recognisable from the air but were only seen in one aerial count. Large groups of Black-tailed Godwits were recorded during March and June (the main survey periods for this survey block) around other areas of the Northern Territory coast, including just north of this survey block. Great Knots, dominant around most of the Northern Territory coast, were also surprisingly low in numbers in this survey block.

This survey block had nine single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 4). The examples given in this table are all single records, as explained in the methods. (There were four separate sites involved for the Terek Sandpiper records.)

No breeding records were made for Red-capped Plovers, Black-fronted or Red-kneed Dotterels.

Table 4. Significant single records for survey block 1. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Terek Sandpiper	June	1000	✔	✔	1
Terek Sandpiper	March	500	✔	✔	Not in top 5
Terek Sandpiper	July	300	✔	✘	Not in top 5
Terek Sandpiper	July	200	✔	✘	Not in top 5
Ruddy Turnstone	June	200	✔	✘	=3
Sanderling	March	100	✔	✘	=3
Broad-billed Sandpiper	March	200	✔	✔	1
Lesser Sand Plover	June	300	✔	✔	Not in top 5
Greater Sand Plover	June	700	✘	✘	3

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were not particularly well represented in this survey block while Sooty Oystercatchers were not recorded at all.

Beach Thick-knees were recorded on nine occasions from the ground and 13 from the air, totalling 31 individuals. The highest number recorded in a single survey in this block was 11 birds in June 1999. This survey covered less than half of the total coastline so this number would be an underestimate. Assessment of the spatial distribution of all Beach Thick-knee records, based on a pair for each territory as was discussed in the methods, suggests a population of around 10 pairs for this survey block.

Pied Oystercatchers were recorded on five occasions from the ground and nine from the air, totalling 25 individuals. The highest number recorded in a single survey was 10 birds in June 1999. This survey covered less than half of the total coastline so this number would be an underestimate. Nevertheless, it is unlikely that the highest number of Pied Oystercatchers to be present in this block during these surveys would be much more than the low tens.

One pair of Beach Thick-knee was located breeding (egg) in March 1999. An early July 1999 visit showed three birds in the same area, presumably two adults and the juvenile.

SURVEY BLOCK 1 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Turtle Point	Terek Sandpiper	Terek Sandpiper (4)	Group 1 – 10 000
Indian Hill	Greater Sand Plover	Ruddy Turnstone (1)	
Fossil Head/New Moon Inlet	Bar-tailed Godwit	Sanderling (1)	Group 2 – 40
	Red-necked Stint	Broad-billed Sandpiper (1)	
	Great Knot	Lesser Sand Plover (1)	
		Greater Sand Plover (1)	

Survey Block 2

Location

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 a small estuary located about half way between Cape Dombey and Cape Scott. 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 zone of this survey block.

This survey block has a relatively short section of coastline of approximately 200 kilometres 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 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 and this is where the majority of shorebirds of this survey block were found. The remainder of the coastline consists of long stretches of sandy beach, backed by small cliffs and/or forest. Much of this habitat is not really suitable for most species of shorebirds.

Survey Effort

The survey block received approximately 75 hours of surveys dominated by shorebird/waterbird work during the period of this project. These were spread over 32 separate days. The number of hours represents approximately 4.7% of all survey blocks. Most survey time for this survey block was in March. No surveys were carried out in June but the remaining months were similarly represented, albeit by the relatively small amount of surveying (Figure 11). Although aerial survey dominated the effort in this area, there were 14 separate ground surveys done involving 11 different and well spread sites.

Relative to the other survey blocks this block had only a small number of ground surveys, so many of the shorebird records were from aerial observations and not recorded to species level. Consequently, individual species, particularly group 1 species, will not be well represented on their distribution maps.

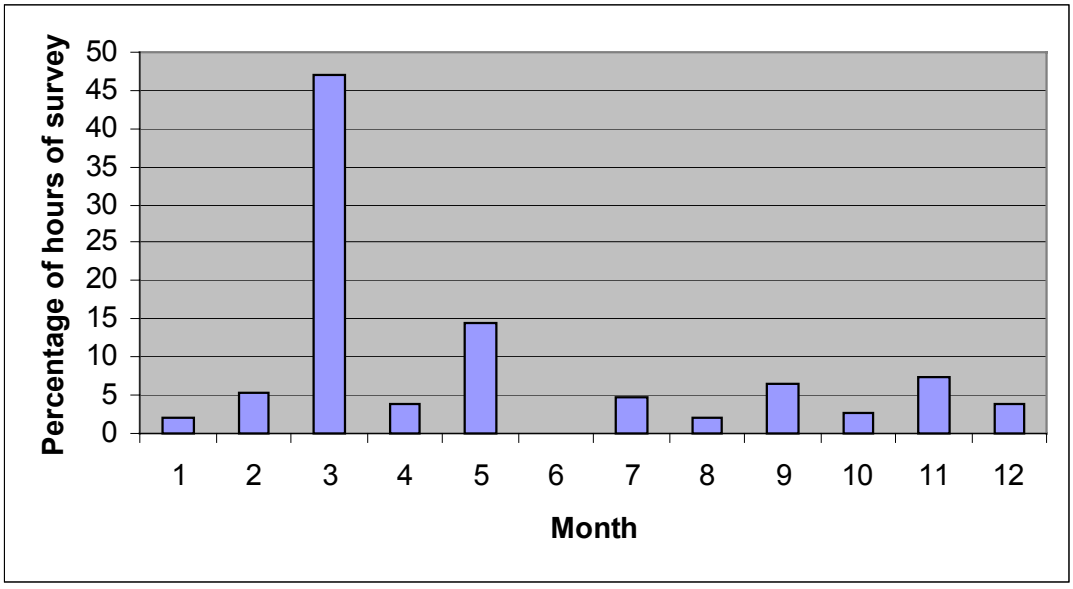


Figure 11. Average percentage of surveys hours relating to shorebirds for survey block 2.

Results and Discussion

This survey block was another section of the Northern Territory coast that has had little prior shorebird surveying. During the full period of this project there were 450 separate shorebird records made, totalling over 80 815 birds (Figure 12). The number of records represented 3.5% of the records and 3.9% of the total numbers of shorebirds recorded in the fifteen survey blocks.

The majority of shorebirds in this survey block were distributed along the coast and adjacent saline wetlands. One of the more important areas within this survey block is Hyland Bay. Considering only the coast and immediately adjacent saline wetlands, the highest single-survey count of all shorebirds combined was in this bay. Nearly 8 000 shorebirds were recorded in a mid-March 1992 survey and just over 5 500 in a mid-September 1995 survey. Both these counts were from aerial surveys in which greater than 75% but less than 100% of the potential habitat was surveyed.

Twenty-one species of shorebirds (19 group 1 and 2 group 2) were recorded throughout the project in this survey block (Appendix A).

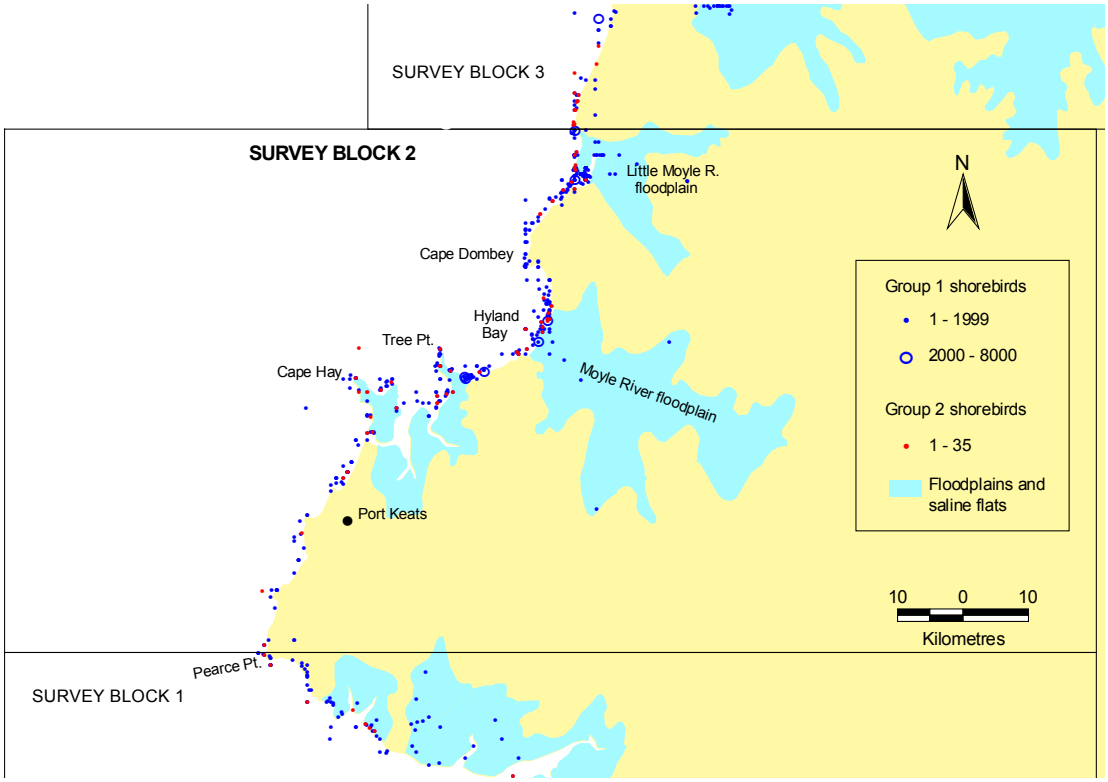


Figure 12. Distribution of shorebird records for survey block 2.

Group 1 Species. Most of the group 1 shorebirds were recorded along the coast of the northern half of this survey block. There were seven significant roosts (containing 2 000 or more birds) for these species (Figure 12). These were located near the mouths of the two rivers and at the southern end of Hyland Bay. This is where the main areas of the exposed mudflat are within this survey block. The main feeding areas were in Hyland Bay, from about 5 kilometres south of Cape Dombey to about 5 kilometres north of Tree Point, and the eastern part of the bay between Cape Hay and Tree Point.

There were no surveys that covered all of the coastal and wetland habitats. The largest number of group 1 shorebirds recorded in a single survey in this block was just under 18 000 birds. This was done in March 1992. Other surveys indicated the remainder of the coast could support low thousands of group 1 shorebirds at this time of the year. With this in mind, a conservative estimate of the largest

number of group 1 shorebirds to have been present in this survey block during the project would be at least 20 000. Additions from inland wetlands were not included in this figure, but as discussed below, would not be very high.

Four aerial surveys that covered nearly the entire coastline, and that can be roughly compared, were done in March 1992, May 1993, October 1995 and December 1992. The approximate totals for these four surveys were 17 600, 2 200, 6 200 and 11 700 respectively. No inland wetlands were done on these surveys. As with the previous survey block these figures suggest that numbers, especially of migratory species, are higher in this area in the build up to migrating north than they are at the time of the year when they arrive back from the Northern Hemisphere after breeding. This is further supported by the inclusion of two large flocks of around 8 000 and 5 000 birds that made up a significant part of the March total. As this was a mid-March survey these could have been flocks congregating in preparation to migrating. A low May total suggests that most of the migratory species leave this survey block. The increase in numbers from the (late) October count to the (mid) December count could indicate a continued build up of numbers with not a high proportion moving locally around the coast or further south in Australia. Perhaps the lower number of Red Knots in this survey block (which, as shown in some other survey blocks, such as 3 and 15, move out of the area again after arriving in September/October) may influence this observation.

This was the only survey block that did not have any ground surveys of inland wetlands. Coverage of inland wetlands was only via incidental records collected on two aerial (transect type) surveys done primarily to count Magpie Geese. These were both done in the late wet season while still very flooded and prior to the normal dry season increases in resident shorebirds. They did not reveal large numbers of shorebirds. Dry season surveys of the inland wetlands would almost certainly increase the numbers of resident shorebirds for this survey block.

Plate 3. Mouth of the Moyle River in Hyland Bay, May 2000. One of the better areas for shorebirds in survey block 2. Photo R. Chatto.

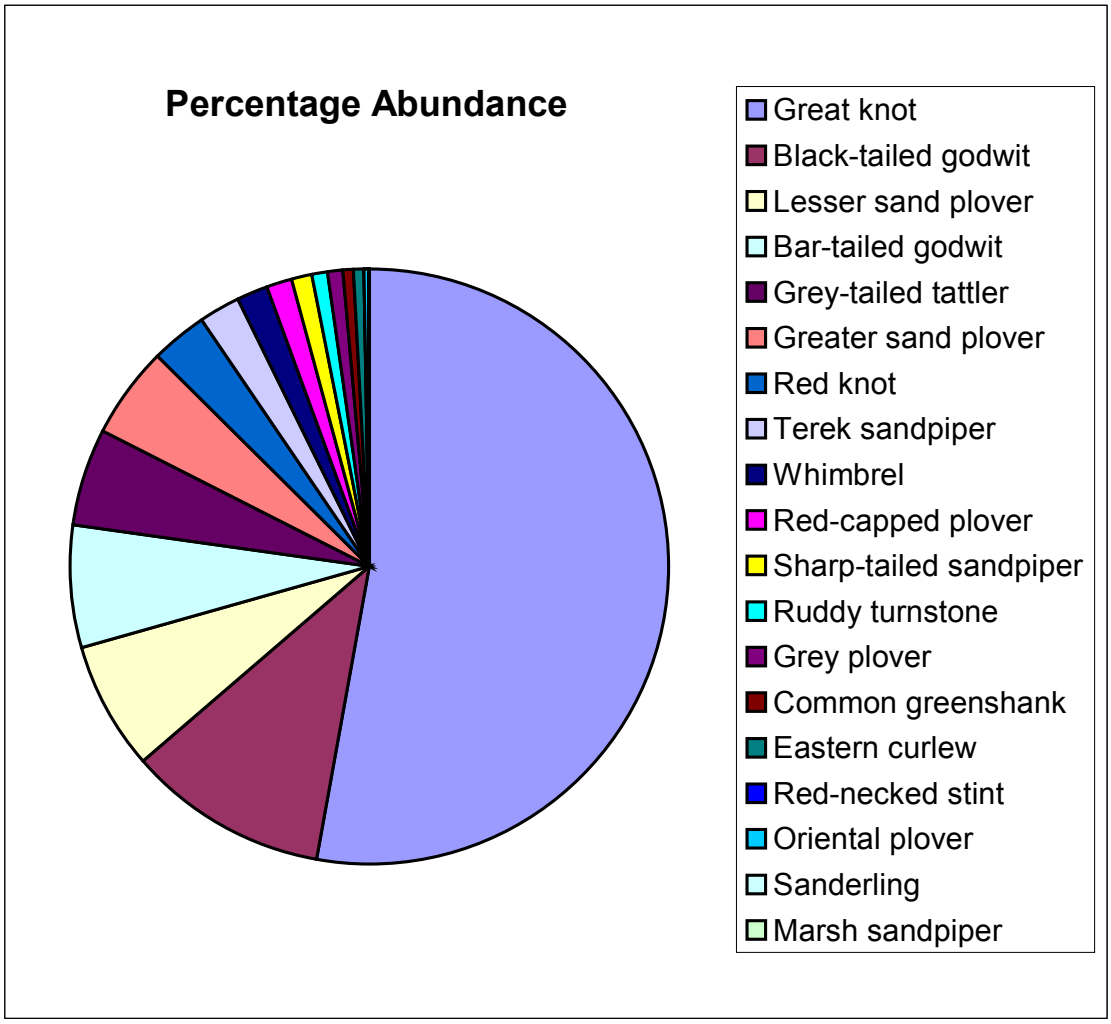


Figure 13. Average percentage abundance of group 1 species in survey block 2.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure13.

The most abundant group 1 species was clearly the Great Knot, but this was largely due to two relatively large *knot spp*. records among the relatively small number of records for this survey block. Lesser Sand Plovers, both godwits and Grey-tailed Tattlers were the next most abundant species recorded. The least abundant of those recorded were Marsh Sandpipers, Sanderlings and Oriental Plovers.

Eleven species were not recorded at all in this block, perhaps a consequence of the small number of ground surveys. The species recorded on the highest number of individual occasions were the knots and the sand plovers; however, no species was recorded on more than 10 separate occasions.

There were no large single records for individual species, but two that were of some significance were 300 Grey-tailed Tattlers in mid August 1992 and 100 Common Greenshanks in mid September 1995. There were no single records in this survey block that were in excess of any of the Australian or international 1% criteria.

No breeding records were made for Red-capped Plovers, Black-fronted Dotterels or Red-kneed Dotterels.

Group 2 species. Beach Thick-knees and Pied Oystercatchers were reasonably well represented in this survey block but no Sooty Oystercatchers were recorded.

Beach Thick-knees were recorded on four occasions from the ground and 19 from the air, totalling 32 individuals. The largest number recorded in a single survey was four and this was recorded on a number of occasions. Distributional records (assuming pairs are relatively sedentary to a home range) suggest an estimate of 10 pairs for this survey block.

Pied Oystercatchers were recorded on two occasions from the ground and 25 from the air, totalling 181 individuals. The largest number recorded in a single survey was 43 (March 1992) with a single flock of 35 recorded near the mouth of the Little Moyle River estuary. The largest number of Pied Oystercatchers present in this block during these surveys is likely to be around 50 birds.

No breeding records were made for any group 2 species.

SURVEY BLOCK 2 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Little Moyle R. Estuary	Great Knot	Nil	Group 1 – 20 000
Hyland Bay	Black-tailed Godwit		
South of Tree Pt.	Lesser Sand Plover		Group 2 – 70
	Bar-tailed Godwit		
	Grey-tailed Tattler		

Plate 4. Coast north of Pearce Point, May 2000. Type of coastline in survey block 2 with few shorebirds. Photo R. Chatto.

Survey Block 3

Location

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 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 area. The coastal resort of Dundee Beach in the northern part of Fog Bay has a resident population as well many visiting tourists. Although most activity revolves around boat fishing there is considerable vehicle and quad bike driving on the beach between Dundee and the Finniss River. 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, Renolds 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 shorebird habitat with approximately 300 kilometres of coastline and 2500 square kilometres of wetland. Freshwater wetland areas include the extensive floodplains of the Daly, Reynolds and Finniss Rivers. There is a large amount of intertidal mudflat, backed by extensive mangroves and open saline wetlands, in Anson Bay (mostly in the southern section and north of the Daly River mouth), Fog Bay (southern section) and around parts of the Perron Islands.

Survey Effort

This survey block received considerably more survey effort than the previous two. Approximately 120 hours of surveys dominated by shorebird/waterbird work were done in this survey block during the period of this project. This represented approximately 7% 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. However, the four main periods for migratory birds and the wet and dry seasons were also all fairly well covered (Figure14). There were 90 separate ground surveys involving 56 different and well-spread sites.

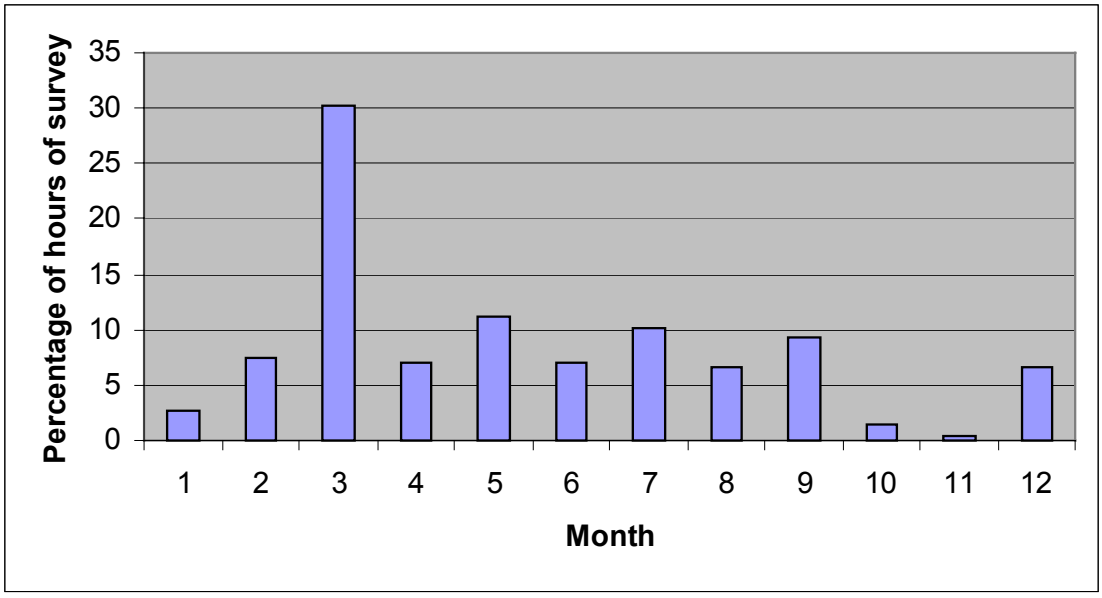


Figure 14. Average percentage of surveys hours relating to shorebirds for survey block 3.

Results and Discussion

There were 1 911 separate shorebird records, totalling over 563 062 birds (Figure 15). They represented 14.7% of the records and 26.8% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project. The large numbers of shorebirds recorded for this block is reflective of the large area of shorebird habitat and the high percentages are also partly due to the large amount of survey effort in this block.

The most important area for shorebirds in this block, and one of the more important areas around the Top End coast, is the Fog Bay region. This bay is actually spread over two survey blocks (3 and 4). The highest count from a single survey for the whole of the Fog Bay coast and adjacent wetlands was in excess of 38 000 in late October 1995. The second highest count was in excess of 28 500 in mid September 1995. Both of these counts were from aerial surveys where greater than 75% but less than 100% of the potential habitat was covered. Both of these counts, over-wintering counts in excess of 5 000 and several single species counts in excess of the 1% criteria (see below) easily qualify this area for potential listing under the East Asian-Australasian Shorebird Site Network. This site is discussed in greater detail in Chatto (2000a).

Another important area within this survey block is the Anson Bay area. Including North Perron Island, the highest single survey shorebird count for this coast was in excess of 27 000 in late October 1995. The second highest count was in excess of 22 000 in mid March 1991. Both of these counts were from aerial surveys where greater than 75% but less than 100% of the potential habitat was covered. Both of these counts, over-wintering counts in excess of 5 000 and several single species counts in excess of the 1% criteria (see below) also qualify this area for potential listing under the East Asian-Australasian Shorebird Site Network. A field note made in mid April 1992 suggested the numerically dominant shorebirds in the southern part of Anson Bay were Great Knot and both species of godwit.

Twenty-nine species of shorebirds (26 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

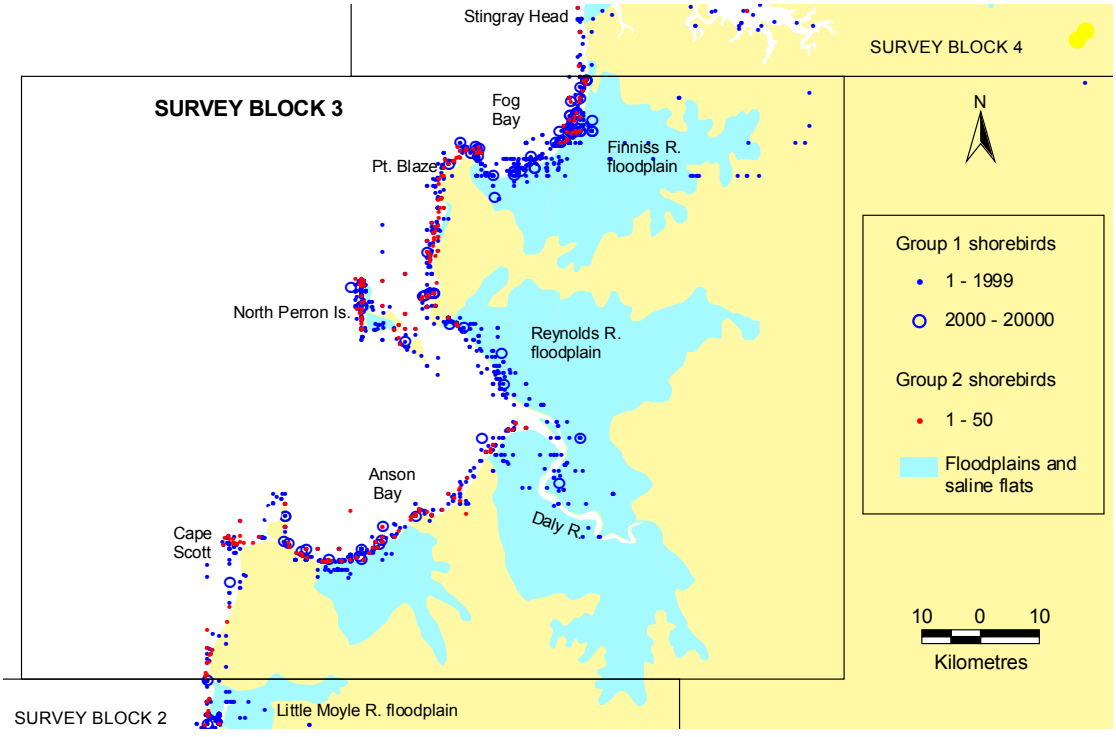


Figure 15. Distribution of shorebird records for survey block 3.

Group 1 Species. Except for the very south and a small part of the middle of Anson Bay, group 1 birds were recorded in reasonable numbers all around the coast of this block (Figure 15). The sections with the lower densities of shorebirds were along dune or sandstone backed beaches that had little intertidal mudflat, and forest rather than wetland inland from the beach. These were mainly on the coast south of Point Blaze and Cape Scott. The larger numbers of group 1 birds were found in Fog Bay, south of Stingray Head, around the Perron Islands, and in the northern and southern parts of Anson Bay. Unlike the previous two survey blocks, there were also high densities of these birds in the wetlands adjacent to the rivers for considerable distances inland. This is especially the case with the Daly River. There were numerous significant roosts (containing 2 000 or more birds) for these species located during these surveys (Figure 15). These roosts/flocks were on both coastal and wetland habitats.

There were no counts that covered all of the coastal and wetland habitats in this block in the one survey, although some covered most of the coastline. There were no surveys that covered anywhere near all of the inland wetlands in a single survey. The highest number of shorebirds recorded along the coast in a single survey was in late October 1995. This aerial survey covered most of the coast and recorded just under 63 000 group 1 shorebirds. An aerial survey of the wetlands just in, and parallel to, the coast in mid March 1992 recorded in excess of 4 000 group 1 shorebirds, however most of these wetlands would have been dry in the October survey. It is likely that there will be some group 1 shorebirds on the drying floodplains further inland during October. However, their numbers would not be high, as any large groups would have been seen during floodplain surveys targeting waterbirds. With all this in mind a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 65 000.

There were eleven aerial surveys that covered only the coastline and that could be roughly compared. These were in January (1994), February (1993 & 96), March (1991, 92 & 93), May (1993), July (1993), September (1993 & 95), October (1995) and December (1992). The 1995 October survey was done with Dr. Clive Minton. Where a month had more than one survey the totals are averaged. The totals for these surveys were approximately 26 000 (January), 19 000 (February), 19 000 (March), 18 000 (May), 9 000 (July), 27 000 (September), 63 000 (October) and 28 000 (December) respectively. These figures suggest a different story to the previous, more southerly, survey blocks.

The number of group 1 shorebirds (dominated by the migratory species) appears to increase greatly from early September through to late October. The arrival of large numbers of knots in this region at around this time may have an influence on these figures. Numbers then drop some time between October and December and continue to decline through the wet season. Part of this may be due to some species being attracted away from the coast into the increasing amount of floodplain becoming inundated as the wet season continued. Another reason could be due to large numbers of Red Knots arriving and then moving on again. This is discussed further in the individual species section for Red Knots.

These figures also suggest that, unlike survey blocks 1 and 2, there is no build up in numbers around March. The relatively high May count compared to the previous two blocks suggests that birds, (perhaps because of being further north) may leave a little later. The much lower relative count in July indicates that most migratory species leave this survey block. This is also suggested by arranging single counts in order from the highest to the lowest. This shows that all but two of the top thirty records for this survey block were between September and April.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 16.

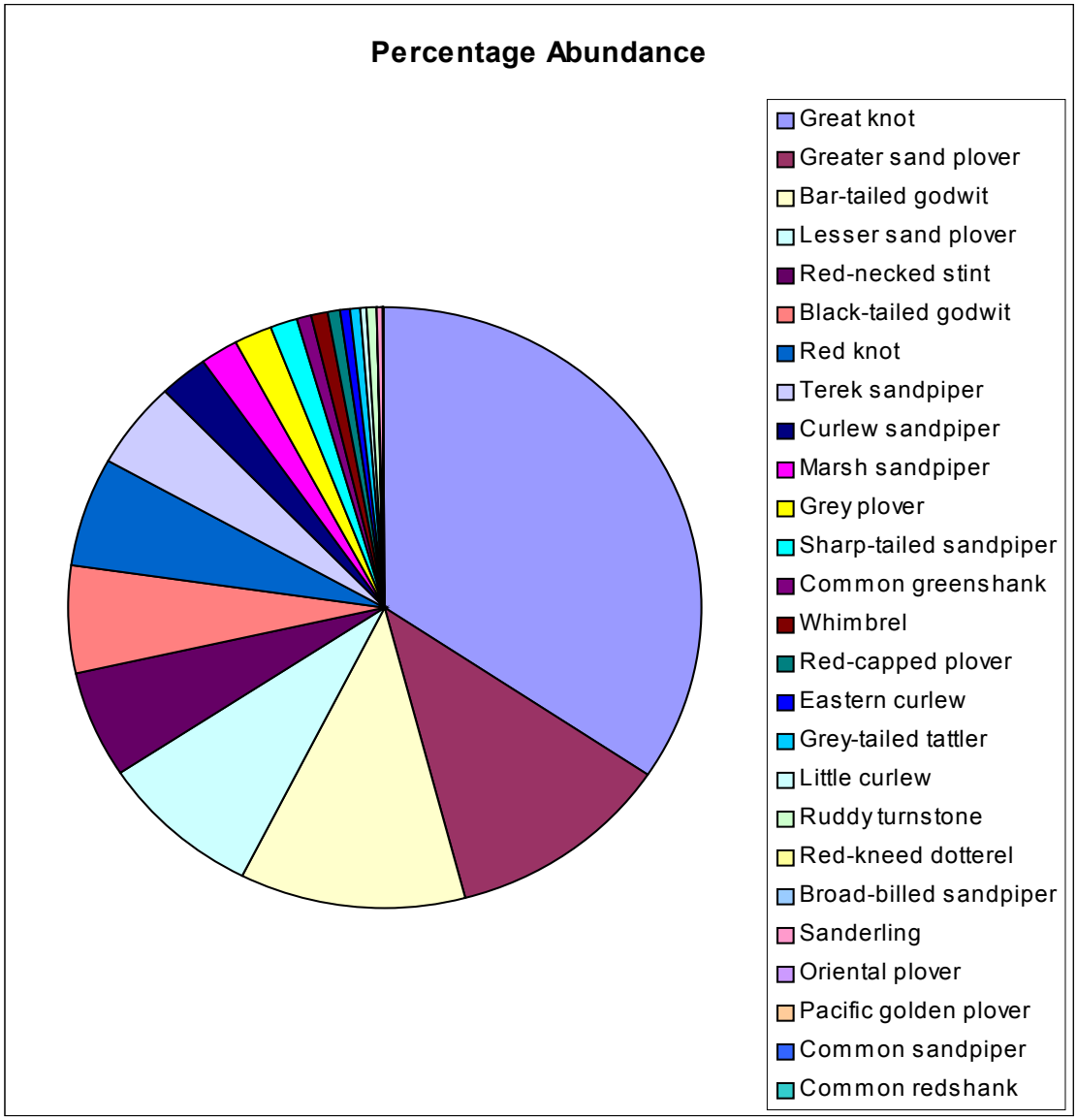


Figure 16. Average percentage abundance of group 1 species in survey block 3.

The most abundant group 1 shorebird recorded in this survey block was clearly the Great Knot. Their average percentage abundance was more than three times the next most abundant species, which were Greater Sand Plovers and Bar-tailed Godwits. The least abundant species recorded were Common Redshanks, Common Sandpipers and Pacific Golden Plovers.

The species recorded on the greatest number of separate occasions during ground surveys were Great Knots, both sand plover species and Bar-tailed Godwits. Both godwits also had reasonably high numbers of aerial records. Asian Dowitchers, Black-fronted Dotterels, *Snipe spp*. and Wood Sandpipers were not recorded at all in the survey block.

This survey block had 38 single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 5). The examples given in this table are all single records, as explained in the methods.

Table 5. Significant single records for survey block 3. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Black-tailed Godwit	October	2000	✔	✔	=5
Black-tailed Godwit	July	1500	✔	✔	Not in top 5
Black-tailed Godwit	December	900	✔	✘	Not in top 5
Bar-tailed Godwit	June	2000	✔	✘	=3
Bar-tailed Godwit	August	2000	✔	✘	=3
Little Curlew	October	3000	✔	✔	=2
Whimbrel	September	200	✔	✘	=4
Marsh Sandpiper	December	800	✔	✘	2
Marsh Sandpiper	April	400	✔	✘	Not in top 5
Marsh Sandpiper	December	230	✔	✘	Not in top 5
Marsh Sandpiper	May	143	✔	✘	Not in top 5
Marsh Sandpiper	December	100	✔	✘	Not in top 5
Common Greenshank	September	200	=	✘	Not in top 5
Terek Sandpiper	December	800	✔	✔	2
Terek Sandpiper	July	750	✔	✔	4
Terek Sandpiper	July	600	✔	✔	Not in top 5
Terek Sandpiper	February	500	✔	✔	Not in top 5
Terek Sandpiper	July	500	✔	✔	Not in top 5
Terek Sandpiper	September	200	✔	✘	Not in top 5
Terek Sandpiper	December	200	✔	✘	Not in top 5
Terek Sandpiper	September	184	✔	✘	Not in top 5
Great Knot	September	5000	✔	✔	=1
Great Knot	December	5000	✔	✔	5
Great Knot	August	4000	✔	✔	5
Red Knot	September	1200	✘	✘	3
Red Knot	August	1000	✘	✘	=5
Red Knot	September	1000	✘	✘	=5
Sanderling	December	40	✘	✘	5
Red-necked Stint	December	1500	✘	✘	1
Curlew Sandpiper	December	700	✘	✘	4
Broad-billed Sandpiper	December	100	✔	✘	=3
Grey Plover	December	500	✔	✔	2
Grey Plover	September	120	✔	✘	Not in top 5
Lesser Sand Plover	December	500	✔	✔	=4
Lesser Sand Plover	July	200	=	✘	Not in top 5
Greater Sand Plover	July	1800	✔	✔	1
Oriental Plover	September	40	✘	✘	2
Red-kneed Dotterel	July	100	✘	✘	=3

The number of separate sites involved for species in the above table where more than one count is listed are: Black-tailed Godwit (2), Bar-tailed Godwit (2), Marsh Sandpiper (4), Terek Sandpiper (4), Great Knot (1), Red Knot (2), Grey Plover (1) and Lesser Sand Plover (2).

Although, as stated, the searching of flocks for rare species was not something done in this project, it is probable that a single specimen of Ruff was recorded in this survey block. It was seen in the wetlands adjacent to the Daly River on 12 May 1993 and it was the only record of this species made during these surveys. It was not viewed well, or for long, but it appeared to have the juvenile brownish tinge to its plumage as per Marchant and Higgins (1993). However, Minton (*pers. comm.*) suggests that it is unlikely to be in juvenile plumage at this time, and its leg colour was more red/orange than green/yellow so it could have been immature rather than juvenile.

In relation to arrival and departure times, most comments will be left to the individual species sections, but a couple of points relating to this area are worth mentioning here. The situation with Red Knot is perhaps the most obvious. When individual Red Knot records over the whole survey period for this block are placed in order of highest to lowest, only three of the top 20 records were between September and April. Further, the top 10 are all between June and mid September, suggesting that the many may call in here from their northern migration to feed but then continue their migration. As further evidence of this, a single Red Knot caught in a cannon net at Fog Bay in August 1996 had originally been banded in New Zealand. Another interesting observation concerns Black-tailed Godwits. Only 2 (both July) of the top 10 counts for this species were not in November or December, whereas in survey block 2 most of the higher count records are in August and September. This suggests that this species may initially land on the southern part of the western Top End coast and then move north around the coast.

Red-capped Plovers were recorded breeding in mid June and mid July.

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were well represented in this survey block but Sooty Oystercatchers were not abundant.

Beach Thick-knees were recorded on 11 occasions from the ground and 68 from the air, totalling 117 individuals. The highest number recorded at a single site was three while the highest survey total was 15, in a September 1995 survey. This survey covered most of the survey block coast, but as it was an aerial survey, birds could have been missed. The distributional records suggest a population of around 24 pairs for this survey block.

Pied Oystercatchers were recorded on 11 occasions from the ground and 128 from the air, totalling 526 individuals. The highest number recorded in a fairly comprehensive single survey was 65 in October 1995, with a single flock of 30 recorded on the mainland opposite North Perron Island. The population of Pied Oystercatchers in this block is therefore likely to be around this figure or a little higher, given that some may have been missed in this survey.

Sooty Oystercatchers were recorded once from the ground and three times from the air, totalling nine individuals. The highest number recorded at a single site was only three while the highest survey total was also only three, in a June 1996 survey. It is unlikely that the population of Sooty Oystercatchers in this survey block would be much more than 10.

Pied Oystercatchers were recorded breeding in two separate locations, both in September.

SURVEY BLOCK 3 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Fog Bay	Great Knot	Bar-tailed Godwit (2)	Group 1 – 65 000
North Perron Island	Greater Sand Plover	Black-tailed Godwit (2)	
Coast north of Daly River	Bar-tailed Godwit	Little Curlew (1)	Group 2 – 130
Daly River wetlands	Lesser Sand Plover	Whimbrel (1)	
Southern Anson Bay	Red-necked Stint	Marsh Sandpiper (4)	
		Common Greenshank (1)	
		Terek Sandpiper (4)	
		Great Knot (1)	
		Broad-billed Sandpiper (1)	
		Grey Plover (1)	
		Lesser Sand Plover (2)	
		Greater Sand Plover (1)	

Survey Block 4

Location

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 west, and 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 the easily the most populated, and therefore 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. Being a survey block that lacks the large floodplains that are present in most other blocks, this block does not have a large area of freshwater wetland. With around 400 square kilometres of wetland it has one of the lesser amounts of wetland of all the blocks. The majority of this is in the form of small wetlands to the east and south east of Darwin.

Survey Effort

This survey block received approximately 240 hours of survey time. This represented approximately 13.4% of the hours of survey in all survey blocks combined. These hours were spread over 153 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 only of short duration. The survey block also had a relatively high survey effort compared to the other areas. It also 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 17). In total there were approximately 183 separate ground surveys involving 51 different sites, although some sites were quite close together.

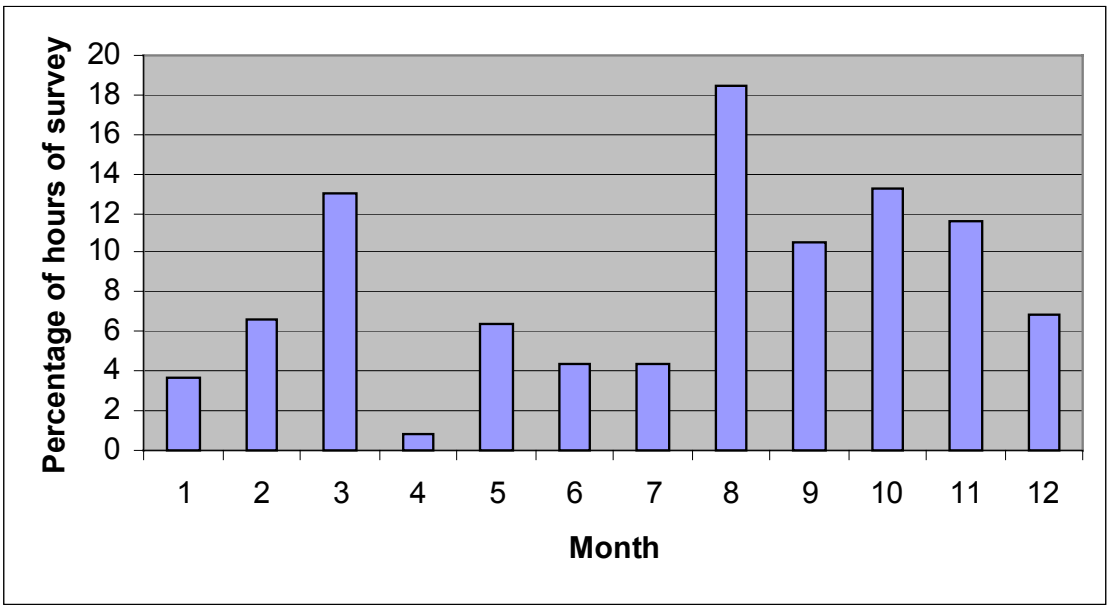


Figure 17. Average percentage of surveys hours relating to shorebirds for survey block 4.

Results and Discussion

Shorebirds were widely distributed throughout this survey block. However, as much of the coast is thickly lined with mangroves, overall densities of shorebirds were not generally high. There were 1 787 separate shorebird records totalling over 153 691 birds (Figure 18). They represented 13.8% of the records and 7.3% of the total numbers of shorebirds recorded in the fifteen survey blocks.

Shorebirds were recorded around most of the coastline, though high densities were mostly confined to the islands off Bynoe Harbour and the coast to the east of Darwin. The number of shorebirds in Bynoe and Darwin Harbours could only be described as modest compared to these better areas. The coast between the two harbours had relatively low densities of shorebirds, as did the coastline of the eastern part of this survey block. Wetlands in this survey block also had relatively low numbers of shorebirds.

The most important part of this survey block for shorebirds is the coast between Lee Point and Tree Point, just to the east of Darwin. The highest single survey shorebird count for this area, including coast and adjacent wetland, was in excess of 7 000 in mid November 1995. The second and third highest counts were both in excess of 6 000, one in mid September 1993 and the other in mid January 1994. All of these counts were from aerial surveys where greater than 75% but less than 100% of the potential habitat was covered. Although this area does not qualify for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts there are several single species counts in excess of the 1% criteria (see below) which could qualify the area for potential listing.

The next most important area for shorebirds in this block was Bare Sand Island and the associated chain of islands to the south east. There was some feeding habitat around these islands but they were also important as roost sites for birds feeding in Fog Bay and Bynoe Harbour. The largest count of shorebirds for this Bare Sand Island area was around 14 500 in September 1993.

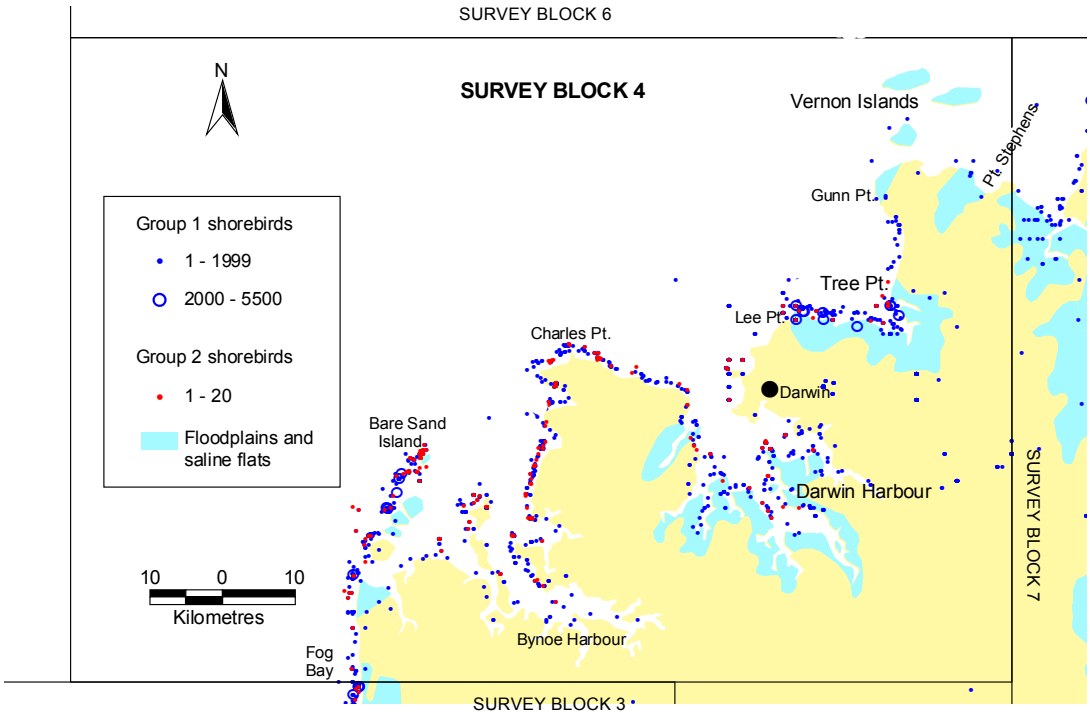


Figure 18. Distribution of shorebird records for survey block 4.

The largest single count for Darwin Harbour was just over 3 000 in mid November 1994. This was recorded during an aerial survey covering greater than 75% but less than 100% of the potential shorebird habitat. Darwin harbour is not a highly significant area for shorebirds (except perhaps in a small way for Whimbrels and Terek Sandpipers) and is mentioned here because of the importance of the area for future development and other human activities, rather than high numbers of birds.

Thirty-two species of shorebirds (29 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. The largest numbers of group 1 shorebirds were recorded around the islands to the south of Bare Sand Island (off Bynoe Harbour) and along the coast between Lee and Tree Points (just to the east of Darwin). Overall shorebirds counts in these areas were mentioned above. Most of the birds in these counts were group 1 species. To have such large numbers of shorebirds so close to a capital city is noteworthy. There were a number of significant roosts (containing 2 000 or more birds) in these areas (Figure 18).

Although being close to Darwin meant that there were a lot of small local wetland surveys done and it was the starting point for surveys to the east or the west, there were no counts of the whole block in the one survey. Attempting to suggest approximate peak numbers for this block requires totalling surveys of a number of individual sections. Surveys of the various sections of coast done in early September 1993 (coast west of Bynoe Harbour and coast east of Darwin Harbour) and mid November 1994 (Darwin and Bynoe Harbours) totalled over 27 000 group 1 shorebirds. Shorebirds on all inland wetlands were not counted in one survey but their numbers would be minimal compared to the coast. As such a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 28 000.

When the migratory shorebird records for this block are arranged in numerically descending order, all but two of the top 20 counts are between September and April. This suggests that this survey block is another that does not hold the high over-wintering numbers of migratory shorebirds.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 19.

Plate 5. Looking along the coast between Lee and Tree Points, east of Darwin, August 1995. Photo R. Chatto.

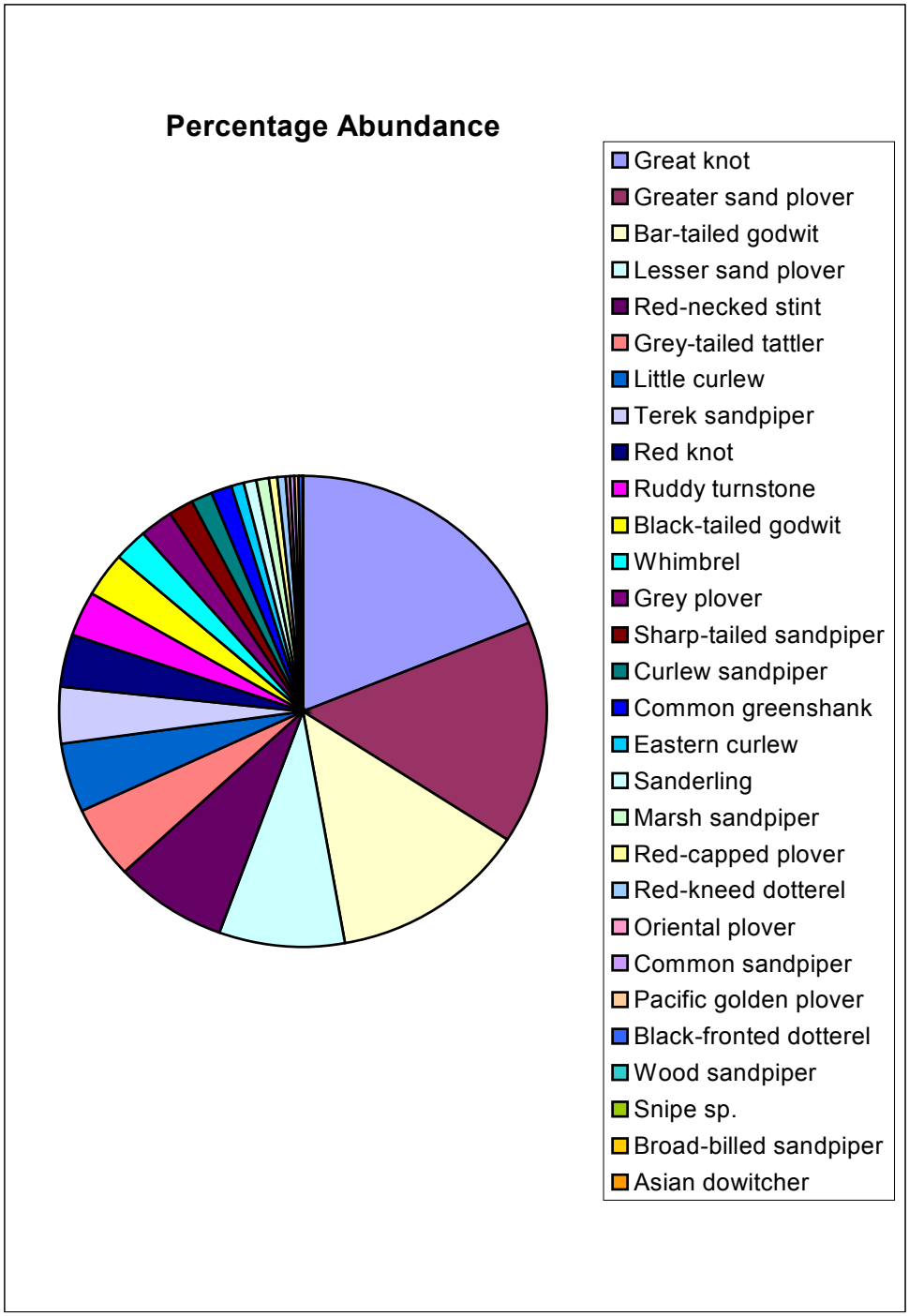


Figure 19. Average percentage abundance of group 1 species in survey block 4.

The most abundant group 1 shorebirds recorded in this survey block were Great Knots, Greater Sand Plovers, and Bar-tailed Godwits. Of those species confirmed Asian Dowitchers, Broad-billed Sandpipers, *Snipe spp*., and Wood Sandpipers were the least abundant.

The species recorded most often during ground surveys were both sand plover species and Common Greenshanks. Whimbrels, especially, but also Eastern Curlews and Bar-tailed Godwits also had reasonably high numbers of aerial records. Only Common Redshanks were not recorded at all in the survey block during these surveys. However, McCrie (*pers. comm*.) reports occasional birds seen around Darwin, the most recent being at the Leanyer Sewage Ponds in October 1999.

This survey block had 12 single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 6). The number of separate sites involved for species in this table, where more than one count is given are: Whimbrel (2) and Terek Sandpiper (2).

A single record of two Long-toed Stints was made in a swamp near Darwin in July 1994.

There were no breeding observations recorded during these surveys for Red-capped Plovers, Black-fronted or Red-kneed Dotterels, however, Red-capped Plovers are known to breed on beaches in the survey block during the dry season.

Table 6. Significant single records for survey block 4. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Whimbrel	August	300	✔	✘	3
Whimbrel	September	100	=	✘	Not in top 5
Terek Sandpiper	August	300	✔	✘	Not in top 5
Terek Sandpiper	August	255	✔	✘	Not in top 5
Terek Sandpiper	September	255	✔	✘	Not in top 5
Common Sandpiper	November	10	✘	✘	1
Grey-tailed Tattler	September	400	✔	✘	Not in top 5
Ruddy Turnstone	September	300	✔	✔	2
Sanderling	November	200	✔	✔	1
Grey Plover	August	300	✔	✔	=3
Lesser Sand Plover	October	200	=	✘	Not in top 5
Oriental Plover	November	100	✘	✘	1

Plate 6 The important shorebird roost site of Tree Point, August 1995. In excess of 3 000 shorebirds roost here at times. Photo R. Chatto.

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were well represented in this survey block but Sooty Oystercatchers were not abundant.

Beach Thick-knees were recorded on 24 occasions from the ground and 109 from the air, totalling 200 individuals. The highest number recorded in a single survey was 43. This was in a mid November 1994 survey which only covered Darwin and Bynoe Harbours, but it did target Beach Thick-knees. For this survey a helicopter was used to repeatedly fly over possible sightings or likely areas for Beach-thick Knees. It was the only survey that concentrated on locating Beach Thick-knees during the project. It showed that Beach Thick-knee counts done under normal aerial survey conditions could have been recording as few as half of the birds present. Sometimes no birds would be seen in the initial fly over and it was only after several aerial circles that birds would be sighted. This was particularly the case when the birds were breeding. (This is further evidence as to why the best way to estimate survey block totals for this species is to base it on home range counts over many surveys). Using the number of pairs of birds from the figures for Darwin and Bynoe Harbours, combined with Beach Thick-knee territorial counts for the rest of the survey block, gives an estimated population of Beach Thick-knees for this block of around 35 pairs.

Pied Oystercatchers were recorded on 29 occasions from the ground and 27 from the air, totalling 185 individuals. Combining surveys of Darwin and Bynoe Harbour in March 1995 (26 birds), and March 1992 for most of the remaining sections of the survey block (17 birds) suggests a highest total of at least 40 birds for this block.

Sooty Oystercatchers were recorded in 15 ground and four aerial counts totalling 46 individuals. The largest number recorded at a single site was eight while the highest survey total was 15 in a September 1999 survey. This latter count was done in an extensive survey around the islands out from Bynoe Harbour. Although this is only a small proportion of the survey block, it is the main area for Sooty Oystercatchers. The number of birds in the remainder of the survey block would bring the total for this block to around the mid to high twenties.

Breeding records for resident shorebirds in this survey block included: July and September for Beach Thick-knees, and August and September for both Pied and Sooty Oystercatchers.

SURVEY BLOCK 4 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Bare Sand & surrounding Islands	Great Knot	Whimbrel (2)	Group 1 – 28 000
	Greater Sand Plover	Terek Sandpiper (2)	
	Bar-tailed Godwit	Grey-tailed Tattler (1)	Group 2 – 130
Lee Pt. to Tree Pt.	Lesser Sand Plover	Ruddy Turnstone (1)	
	Red-necked Stint	Sanderling (1)	
		Grey Plover (1)	

Survey Block 5

Location

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, Wildman, South Alligator and East Alligator, the latter being 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 people visitation down.

This survey block has extensive shorebird 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 the Wildman and Mary Rivers. (The Wildman River lies between the Mary and West Alligator Rivers). The vast majority of the coastline consists of intertidal mudflats, backed by extensive mangroves and open saline wetlands.

Survey Effort

This block received approximately 320 hours of surveys during the period of this project. This represented approximately 17.6% of the hours of survey in all survey blocks combined. Surveys were spread over 89 separate days. All months received some surveying in this survey block with April receiving the most (Figure 20). Although a little lighter in January, February and June, all other months received a reasonable amount of survey. Consequently the four main periods for migratory birds and the wet and dry seasons are all fairly well covered. There were 138 separate ground surveys involving 69 different and well-spread sites.

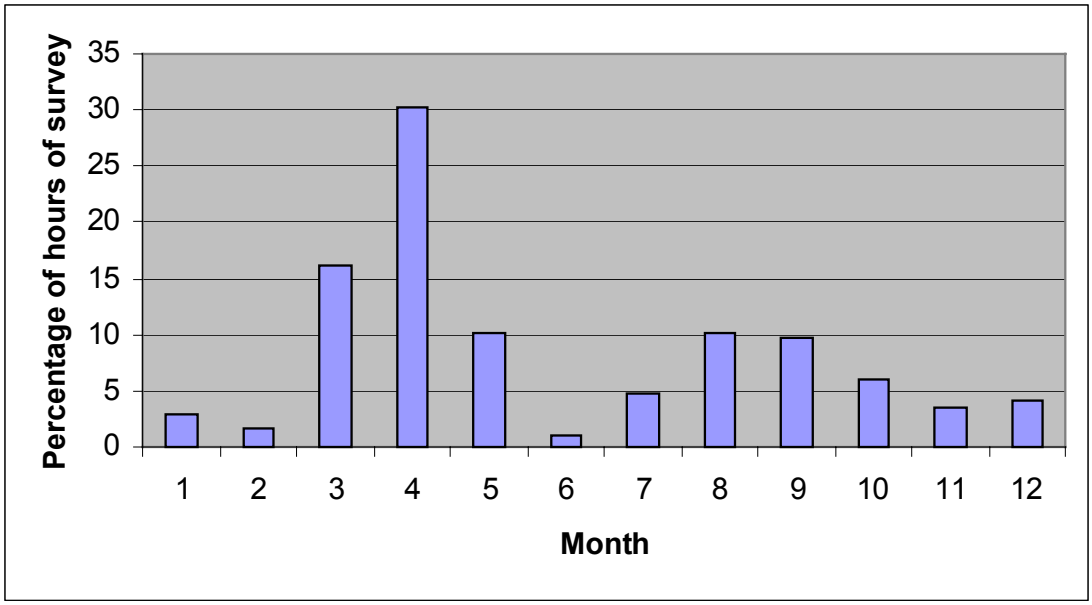


Figure 20. Average percentage of surveys hours relating to shorebirds for survey block 5.

Results and Discussion

Shorebirds were spread throughout the entire survey block, with most wetlands and the entire coastline having varying densities of birds. This survey block has a large amount of shorebird habitat and this is reflected in the high numbers of shorebirds recorded during these surveys. There were 1 574 separate shorebird records made, totalling over 215 938 birds (Figure 21). They represented 12.1% of the records and 10.3% of the total numbers of shorebirds recorded in the fifteen survey blocks.

There were three separate areas along the coast of this survey block that were significant for shorebirds. The most important of these was Chambers Bay. A single aerial survey, covering between 50% to 75% of the potential habitat of the coast and adjacent saline wetlands recorded in excess of 14 000 shorebirds in early September 1993. The second highest count was nearly 10 000 in mid August 1992. This involved ground counts from seven sites but little aerial counting between sites and would have covered less than 25% of the potential habitat. Although the coastal area does not qualify for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts, there are several single species counts in excess of the 1% criteria (see below) and counts of in excess of 5 000 during the over-wintering season, which could qualify the area for potential listing. Inclusion of the downstream floodplains of the Adelaide and Mary Rivers to this coastal area would then certainly give numbers in excess of the 20 000 birds necessary to qualify the overall area.

Finke Bay also had good numbers of shorebirds. The highest count there was just under 9 000, recorded from an aerial survey in September 1993. Both this and Chambers Bay are combined and discussed in greater detail in Chatto (2000a).

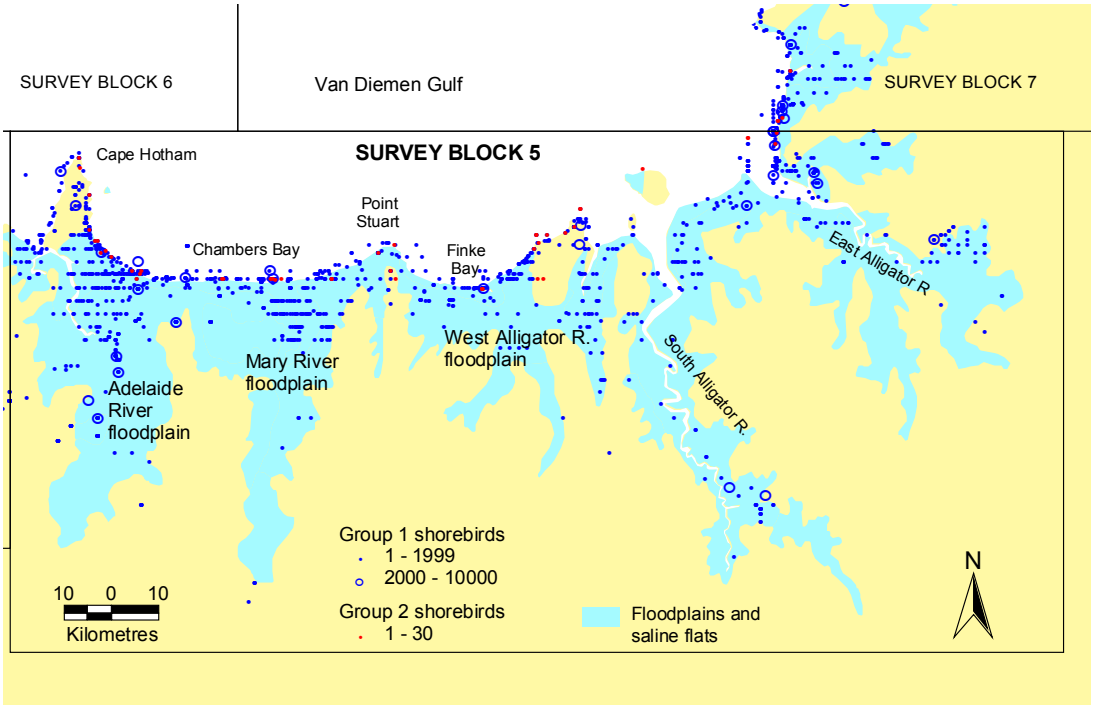


Figure 21. Distribution of shorebird records for survey block 5.

Another area of high significance for shorebirds was the coast between the South Alligator River and Minimini Creek in the eastern part of the survey block. (Part of this area is in survey block 7). The largest single counts of shorebirds along this coast and adjacent saline wetlands were both around 12 500. One was in late April 1992 and involved three ground site counts and in the vicinity of 25% to 50% potential area coverage, while the other was an aerial survey in late March 1992 covering around 50% to 75% of the potential habitat. Although this area does not qualify for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts, it is likely that the necessary number of birds could be located if full area coverage was done. It would also qualify on the basis of several single species counts in excess of the 1% criteria (see below) and counts of in excess of 5 000 during the over-wintering season made during these surveys.

Inland wetlands associated with all the major rivers of this survey block, particularly those between the South and East Alligator Rivers, are also important for shorebirds. No specific mention is made of these here because they have been previously documented by other authors (eg Bamford, 1990 and Morton *et al*, 1991).

Although this survey block was one of the most extensively surveyed of all blocks, the inland wetlands from the Adelaide to the East Alligator Rivers were only surveyed once in the October/November period. This is an important time for Little Curlews moving through on their southern migration and the huge numbers that have been reported in the past were not seen in this survey, although less than 25% of the wetlands would have been surveyed. This is discussed in more detail below.

Twenty-nine species of shorebirds (27 group 1 and 2 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. There were numerous significant roosts (containing 2 000 or more birds) spread throughout the survey block (Figure 21). Most of these were at either end of the survey block, and, except for the Adelaide River floodplain, mostly on or near the coast.

There were quite a few aerial surveys that covered most of the coastline of this survey block but none that covered anywhere near all of the inland wetlands in a single survey. In order to approximate a total of group 1 birds for this survey block the combination of surveys done in March, September and October has to be added together. With the differing months and years involved this is clearly only going to be a very approximate estimate. An aerial survey of the coast and adjacent saline wetlands in September 1993 recorded around 24 500 group 1 shorebirds. An aerial survey of the freshwater wetlands on the upstream Adelaide River, South Alligator and East Alligator River floodplains in October 2001 totalled around 18 000 birds, however this was only a single meandering flight that covered well under 25% of the wetland area. Magpie Goose surveys of the downstream Adelaide and Mary River floodplains and the upstream Wildman and West Alligator River floodplains in March of 1991 and 1992 averaged around 15 000 shorebirds. These surveys still do not account for all shorebird habitats within the survey block. There were no detailed surveys to assess shorebird numbers in some areas, such as the downstream Wildman and West Alligator floodplains. Nevertheless, the number of birds in these areas is not likely to be high. With all of the above in mind a conservative estimate of a peak number of group 1 shorebirds in this survey block would be at least 110 000.

Although this total does include low thousands of Little Curlew recorded in my surveys, it does not include observations of the huge temporary influxes of this species that have been reported in the past. Morton *et al* (1991) reported approximately 300 000 Little Curlew passing through the wetlands in Kakadu during October in the early 1980's, and Bamford (1990) reported 50 000 Little Curlew in Kakadu in the late dry seasons of 1987, 1988 and 1989. Smith (1971) reported around 250 000 Little Curlew migrating over Fogg Dam near Darwin in October 1966, but this may be a bit of an over estimate.

There were five comparable aerial surveys along the coastline of this block. These were done in March 1992, May 1993, July 1993, September 1993 and December 1992. The approximate totals for these

surveys were 14 200, 11 500, 3 500, 23 000 and 16 800. These figures suggest a build up in numbers between July and September as migrating birds arrive, followed by a slight drop over the wet season as some birds continue migration or move into freshly inundated wetlands. There is then an exodus of birds from May to July. The high May count was early in the month and could be due to large numbers of Sharp-tailed Sandpipers. This species tends to leave later than most other migrating birds, so counts may have been influenced by flocks building up prior to migration. This is further supported by the fact that the top four single ground counts for Sharp-tailed Sandpipers were between 23 April and 10 May 1993. This is further discussed in the individual species section of this report.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 22.

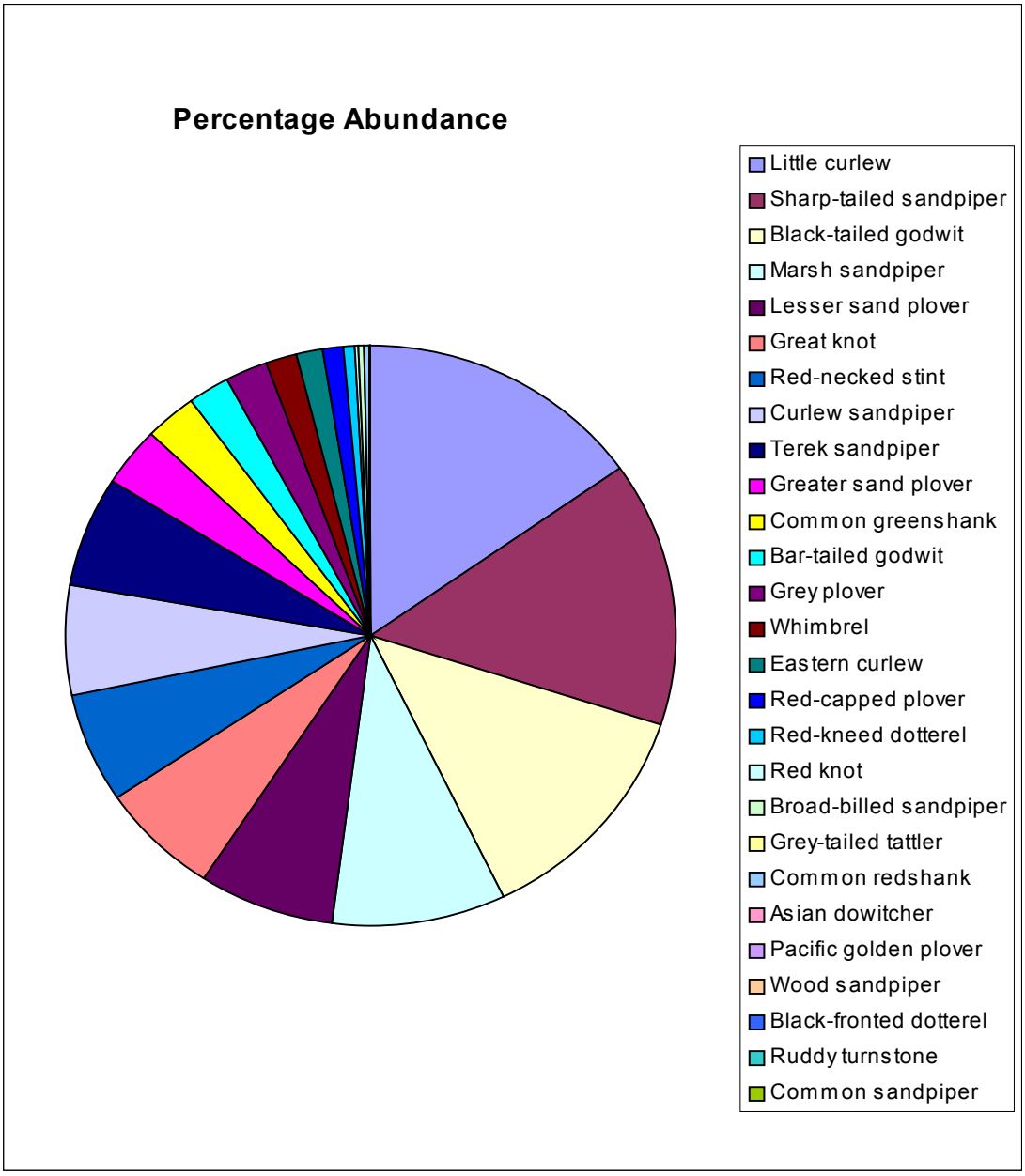


Figure 22. Average percentage abundance of group 1 species in survey block 5.

Table 7. Significant single records for survey block 5. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Black-tailed Godwit	July	2000	✔	✔	=5
Black-tailed Godwit	May	2000	✔	✔	=5
Black-tailed Godwit	September	1600	✔	✘	Not in top 5
Black-tailed Godwit	May	1000	✔	✘	Not in top 5
Black-tailed Godwit	December	900	✔	✘	Not in top 5
Little Curlew	October	10000	✔	✔	1
Little Curlew	October	3000	✔	✔	2
Little Curlew	October	2050	✔	✔	3
Little Curlew	October	2000	✔	✔	4
Whimbrel	September	1000	✔	✔	1
Whimbrel	September	200	✔	✘	=4
Whimbrel	September	100	✔	✘	Not in top 5
Eastern Curlew	September	500	✔	✔	1
Eastern Curlew	August	250	✔	✔	Not in top 5
Common Redshank	September	30	?	?	1
Common Redshank	December	20	?	?	2
Common Redshank	April	20	?	?	3
Common Redshank	December	10	?	?	4
Marsh Sandpiper	April	1600	✔	✔	1
Marsh Sandpiper	May	500	✔	✘	4
Marsh Sandpiper	July	498	✔	✘	5
Marsh Sandpiper	October	400	✔	✘	Not in top 5
Marsh Sandpiper	September	360	✔	✘	Not in top 5
Marsh Sandpiper*	April	350	✔	✘	Not in top 5
Common Greenshank	September	450	✔	✔	2
Common Greenshank	August	300	✔	✘	5
Common Greenshank	July	200	✔	✘	Not in top 5
Common Greenshank	September	200	✔	✘	Not in top 5

This survey block had a quite different range of species among the most abundant compared to most other survey blocks. The most abundant migratory shorebird recorded in this survey block was clearly the Little Curlew. Nearly all of the 54 records of this species (certainly all of the larger counts) were made in October and/or November. Most of these were made in October 2001 when a more concentrated effort was made on this species. The next most abundant species were Sharp-tailed Sandpipers, Black-tailed Godwits and Marsh Sandpipers.

The species recorded on the greatest number of separate occasions during ground surveys were Marsh Sandpiper, Sharp-tailed Sandpipers and Common Greenshanks. Whimbrels, Eastern Curlews and Little Curlews also had reasonably high numbers of aerial records. Sanderlings, Oriental Plovers and *Snipe spp*. were not recorded at all in the survey block.

This survey block had 66 single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 7). The number of separate sites involved for species where more than one count is listed in this table are: Black-tailed Godwit (5), Little Curlew (4), Whimbrel (3), Eastern Curlew (1), Common Redshank (2), Marsh Sandpiper (8), Common Greenshank (3), Terek Sandpiper (5), Sharp-tailed Sandpiper (2), Curlew Sandpiper (2), Grey Plover (4), Lesser Sand Plover (2) and Red-kneed Dotterel (2).

Red-capped Plovers were recorded breeding in July and September.

Table 7 (cont.). Significant single records for survey block 5. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Terek Sandpiper	September	900	✔	✔	2
Terek Sandpiper	August	750	✔	✔	4
Terek Sandpiper	August	750	✔	✔	Not in top 5
Terek Sandpiper	September	600	✔	✔	Not in top 5
Terek Sandpiper	December	500	✔	✔	Not in top 5
Terek Sandpiper	December	400	✔	✔	Not in top 5
Terek Sandpiper	April	400	✔	✔	Not in top 5
Terek Sandpiper	September	250	✔	✘	Not in top 5
Asian Dowitcher	May	15	?	?	3
Red-necked Stint	September	850	✘	✘	5
Sharp-tailed Sandpiper	May	3000	✔	✔	1
Sharp-tailed Sandpiper	April	2400	✔	✔	2
Sharp-tailed Sandpiper	May	2000	✔	✔	3
Curlew Sandpiper	August	750	✘	✘	3
Curlew Sandpiper	May	660	✘	✘	5
Broad-billed Sandpiper	July	100	✔	✘	=3
Pacific Golden Plover	April	20	✘	✘	=2
Grey Plover	August	750	✔	✔	2
Grey Plover	August	300	✔	✔	=3
Grey Plover	September	200	✔	✔	Not in top 5
Grey Plover	September	150	✔	✔	Not in top 5
Grey Plover	September	100	✔	✔	Not in top 5
Red-capped Plover	September	460	✘	✘	1
Lesser Sand Plover	April	400	✔	✔	Not in top 5
Lesser Sand Plover	April	300	✔	✔	Not in top 5
Lesser Sand Plover	July	200	✔	✘	Not in top 5
Red-kneed Dotterel	July	200	✘	✘	1
Red-kneed Dotterel	October	100	✘	✘	3

* There were a further ten records (involving another six sites) all greater than the Australian 1% level that have not been included in the above table.

Group 2 Species. Beach Thick-knee and Pied Oystercatcher were reasonably well represented in this survey block but Sooty Oystercatchers were not recorded.

Beach Thick-knees were recorded on one occasion from the ground and 15 from the air, totalling 29 individuals. The highest number recorded in a single survey was 10 birds. This was in a mid November 1993 survey and it covered most, but not all, of the coastline so a minimum estimated population would be a little higher than this. Distributional records suggest a population of around eight pairs.

Pied Oystercatchers were recorded on 10 occasions from the ground and 16 from the air, totalling 154 individuals. The highest number of 47 birds was recorded in a May 1993 survey. This was a survey that covered most of the coastline so a minimum estimated population of Pied Oystercatchers for this block would be around 50 birds.

Confirmed evidence of breeding was recorded for Pied Oystercatcher in September 1993.

SURVEY BLOCK 5 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Chambers Bay	Little Curlew	Black-tailed Godwit (5)	Group 1 – 110 000
Finke Bay	Sharp-tailed Sandpiper	Little Curlew (4)	
Mouth of East Alligator R.	Black-tailed Godwit	Whimbrel (3)	Group 2 – 66
Adelaide River wetlands	Marsh Sandpiper	Eastern Curlew (1)	
South & East Alligator R. wetlands	Lesser Sand Plover	Marsh Sandpiper (8)	
		Common Greenshank (3)	
		Terek Sandpiper (5)	
		Sharp-tailed Sandpiper (2)	
		Broad-billed Sandpiper (1)	
		Grey Plover (4)	
		Lesser Sand Plover (2)	

Plate 7. Part of Chambers Bay showing the mixture of habitats from the intertidal zone (mudflats extend out for half a kilometre or more) to the freshwater wetlands that make the area so important for shorebirds, March 1991. Photo R. Chatto

Survey Block 6

Location

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 island, 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. Melville and Bathurst Islands are separated by the extensively 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 are also 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 by people.

This survey block has a large amount of shorebird 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 wetlands or floodplains that are associated with most other survey blocks.

Survey Effort

Compared to other survey blocks, this block had one of the lesser amounts of survey effort. It received approximately 66 hours of surveys during the period of this project. This represented approximately 3.7% of the hours of survey in all survey blocks combined. These surveys were spread over only 14 separate days. There were several months where there was little or no surveying done, however the months with the higher amounts of surveying covered the four main periods for migratory birds, and the wet and dry seasons (Figure 23). There were 49 separate ground surveys involving 30 different and well-spread sites.

Results and Discussion

Shorebirds were well spread around the coast with the south coast of Melville Island having the highest densities. Except for wetlands adjacent to this south coast of Melville Island, surveys of the saline wetlands extending inland from the coast around the Tiwi Islands did not reveal high numbers of shorebirds.

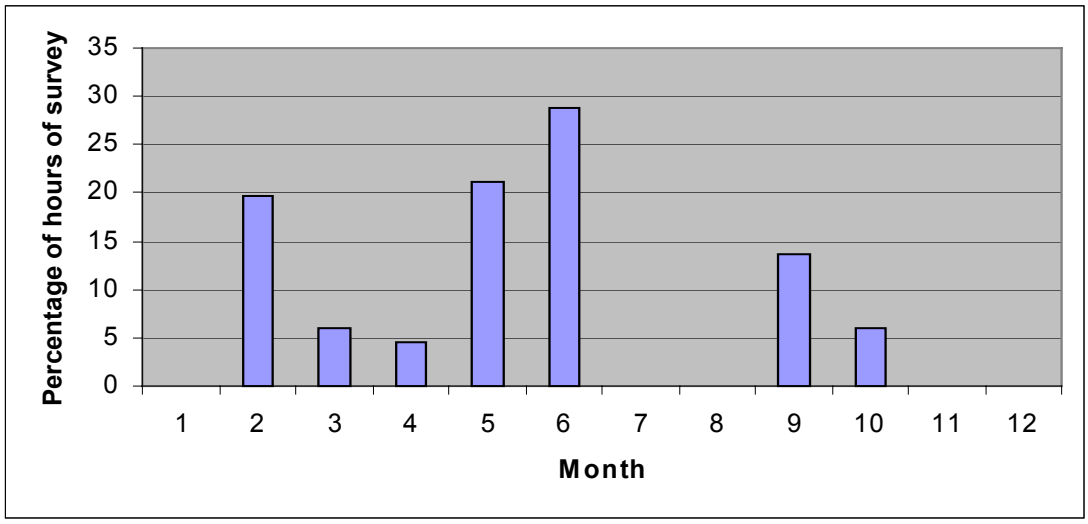


Figure 23. Average percentage of surveys hours relating to shorebirds for survey block 6.

The Apsley Straits were only partially surveyed on the one occasion (June, 1999). Although this survey was primarily to search for waterbird colonies, observations did not reveal high densities of shorebirds in the areas that were flown. However, there were large areas of potentially suitable habitat that were not covered. Given the large amount of potentially suitable habitat in the Apsley Straits, it is possible that additional surveys, either of the whole area or at a different time, may have detected considerable numbers of shorebirds.

Within this survey block there were 672 separate shorebird records that totalled over 90 581 birds (Figure 24). They represented 5.2% of the records and 4.3% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

As mentioned, the most important single section of this survey block for shorebirds was the south east coast of Melville Island. The largest count for this area from a single survey was in excess of 12 500 in late October 1993. The second largest count was nearly 11 500 in late March 1994. Both counts were from aerial surveys and covered greater than 75% but less than 100% of the potential habitat. Although this area does not qualify for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts, it is likely that full coverage of the coast and the inclusion of the adjacent wetlands would record in excess of 20 000 birds present. A similar detailed coverage during the over-wintering period would likely record counts of in excess of 5 000 birds.

Twenty-five species of shorebirds (22 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. Group 1 shorebirds were located all around the Melville and Bathurst Island coasts, but there were few records from wetlands in from the coast. Most birds were found along the southern coast of Melville Island and there were numerous significant roosts (containing 2 000 or more birds) spread along this coast (Figure 24). There were also other such roosts on the north east of Melville Island and the south west of Bathurst Island.

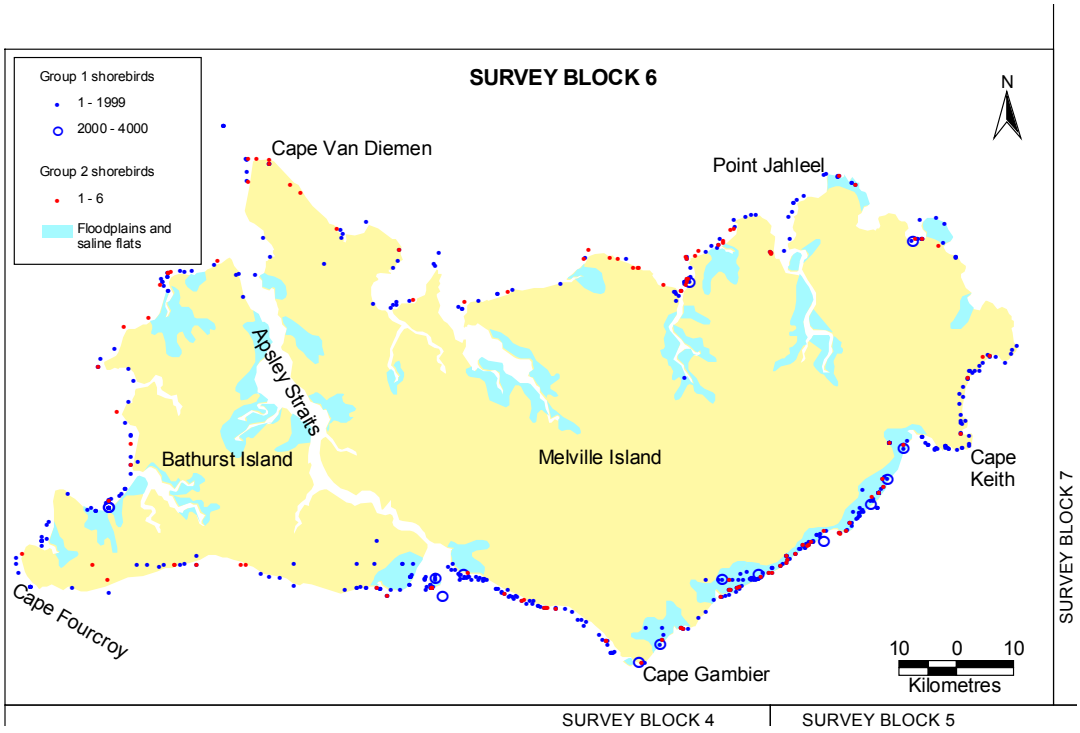


Figure 24. Distribution of shorebird records for survey block 6.

No counts covered the entire block in the one survey, however there were four aerial surveys that covered most of the external coastline without including the Apsley Straits. These particular surveys did not consider the wetlands in from the coast, but as mentioned, these areas (except for those in the south east) were generally not found to have high densities of shorebirds during other surveys.

The largest count of the four aerial surveys was around 33 000 birds in October 1993. Adding to this a conservative estimate for the number of shorebirds along the Apsley Straits and the inland wetlands of the south east, an estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 40 000.

The four coastal surveys mentioned above were done in February 1996, March 1994, June 1996 and October 1993. Numbers of group 1 shorebirds counted on these surveys were around 10 000, 20 000, 5 000 and 33 000, respectively. These figures suggest that this survey block has a higher number of shorebirds (particularly migratory waders) in the arrival season compared to the departure season.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 25.

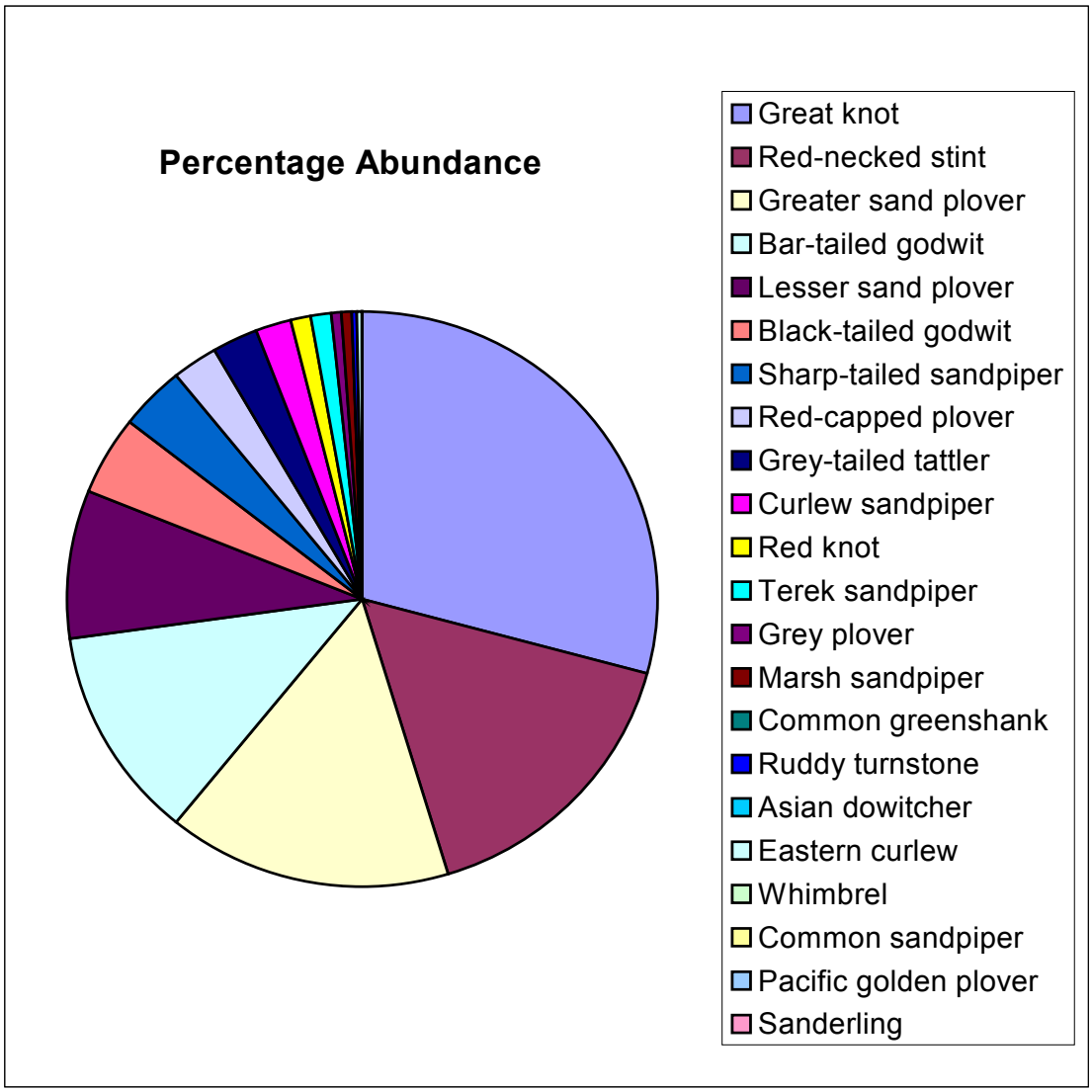


Figure 25. Average percentage abundance of group 1 species in survey block 6.

The most abundant migratory shorebird recorded in this survey block was the Great Knot. This species was recorded as being nearly twice as abundant as the next highest species, which were Red-necked Stints and Greater Sand Plovers. Bar-tailed Godwits and Lesser Sand Plovers were the next most numerous. These five species constituted over 80% of the numbers of the group 1 shorebirds counted, so there were a number of species at the lower end of the abundance scale.

Except for one count of 600 Greater Sand Plovers (June 1999), there were no significant high counts of single flocks of individual species. Although this count was the fourth highest for this species, from all surveys during this project, it is still well below the Australian 1% level.

The species recorded on the greatest number of separate occasions during ground surveys were Greater Sand Plovers, Great Knots and Red-necked Stints. Whimbrels, Bar-tailed Godwits and Eastern Curlews had reasonably high numbers of aerial records. There were several species not recorded but there were a limited number of ground surveys dedicated to shorebirds in this survey block - seabird and marine turtle ground surveys taking a higher priority.

Red-capped Plovers were recorded breeding in one mid September survey.

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were reasonably well represented in this survey block but Sooty Oystercatchers were much less abundant.

Beach Thick-knees were recorded on seven occasions from the ground and 42 from the air, totalling 68 individuals. The highest number recorded in a single survey was 18 in a mid September1996 survey. This survey covered less than half the coast however it was a helicopter air/ground survey and thus fairly good for detecting Beach Thick-knees. A conservative estimate, based on this and other surveys, for the population of Beach Thick-knees for this block would be around 40 birds, but distributional records suggest a population of around 26 pairs.

Pied Oystercatchers were recorded on six occasions from the ground and 59 from the air, totalling 133 individuals. The highest number recorded in a single survey was 32 in a February 1996 survey. This was a survey that covered most of the coastline so would have included most of the Pied Oystercatcher habitat. Similar aerial surveys done in March 1994 and June 1996 revealed 26 and 20 birds respectively. This indicates the population to be reasonably stable and unlikely to be higher in number than the low 30's.

Sooty Oystercatchers were recorded on three occasions from the ground and six from the air, totalling 16 individuals. The highest number recorded in a single survey was three in a March 1994 survey. As mentioned, this survey covered most of the coastline so would have included most of the Sooty Oystercatcher habitat. Consequently there are only a few pairs at most in this survey block.

SURVEY BLOCK 6 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
SE coast Melville Is.	Great Knot Red-necked Stint Greater Sand Plover Bar-tailed Godwit Lesser Sand Plover	Nil	Group 1 – 40 000 Group 2 – 60

Survey Block 7

Location

This survey block extends from the mouth of the East Alligator River, around the Cobourg Peninsula and along the northern coast to 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 120 hours of surveys during the period of this project. This represented approximately 6.7% of the hours of survey in all survey blocks combined. These surveys were spread over only 50 separate days. All months had some surveys but there was a large variation between months (Figure 26). February, April, June, October and November received the highest amount of survey time while January and July received very little. There were 86 separate ground surveys involving 65 different and well-spread sites.

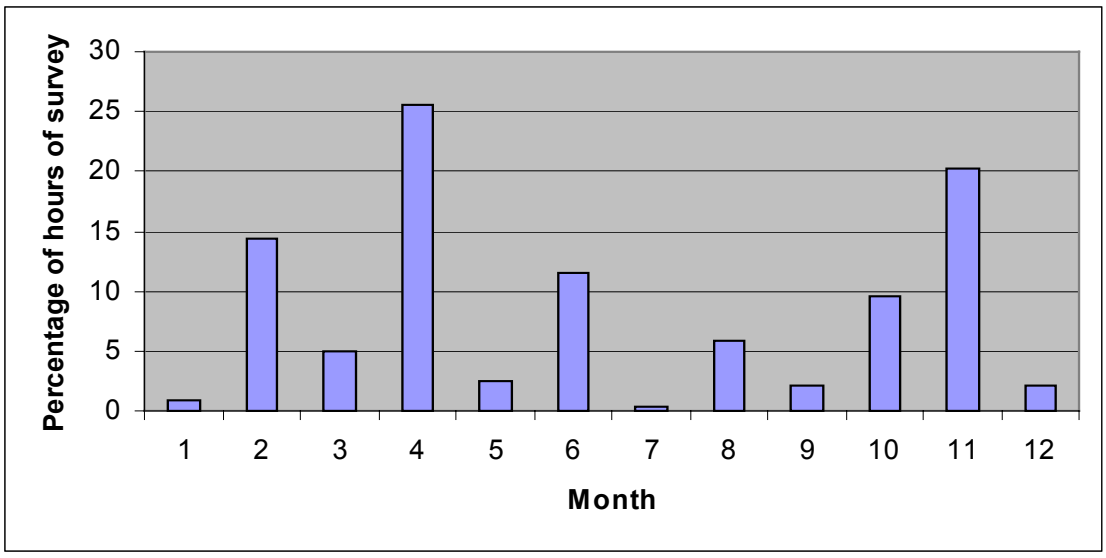


Figure 26. Average percentage of surveys hours relating to shorebirds for survey block 7.

Results and Discussion

Shorebirds were distributed all around the coast and near coastal wetlands of this survey block, particularly the coast and large floodplains in the south west, the coast abutting Van Diemen Gulf and around Junction Bay in the east. The only areas that had poor shorebird representation were Croker Island (some of coast not done at all) and the coast running south east from Cape Cockburn. This latter area consists of sand and rocky beach that is backed by cliffs and forest.

Within this survey block 1 195 separate shorebird records totalled over 114 860 birds (Figure 27). They represented 9.2% of the records and 5.5% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

There were no areas within this survey block that had counts high enough to qualify for listing under the East Asian-Australasian Shorebird Site Network. The area that would come closest is Junction Bay. The highest single survey shorebird count for this area was nearly 9 500 in early September 1993. The second highest count was nearly 8 500 in mid February 1996. Both these counts were made during aerial surveys covering more than 75% but less than 100% of the potential habitat.

Twenty-five species of shorebirds (22 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

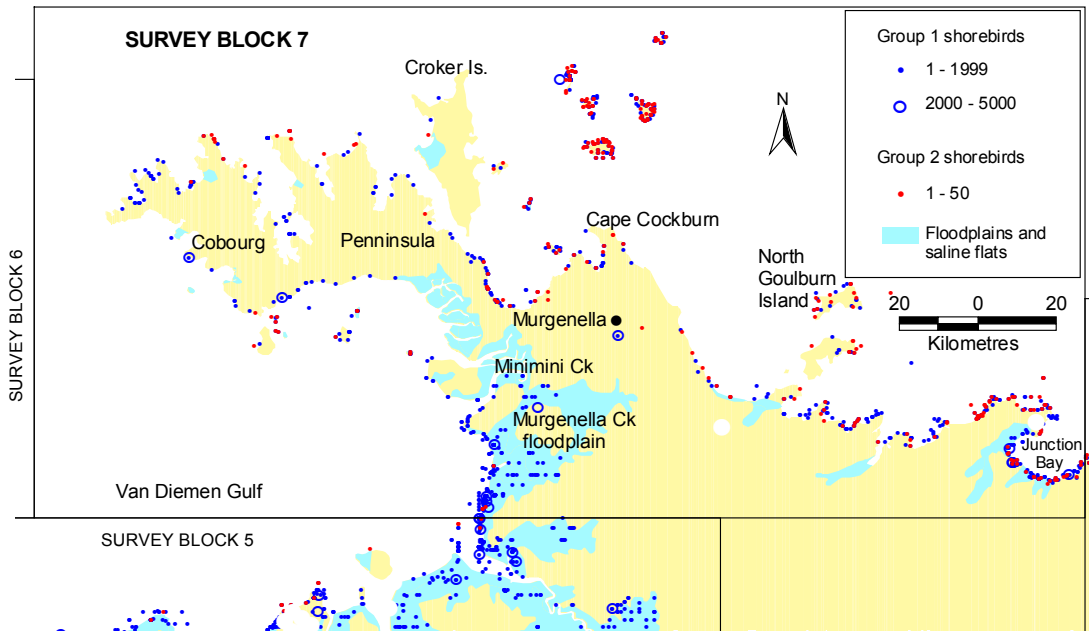


Figure 27. Distribution of shorebird records for survey block 7.

Group 1 Species. Although shorebirds were spread throughout this survey block, significant roosts (containing 2 000 or more birds) were restricted to a few locations (Figure 27). Most of these were along the coast and/or adjacent wetlands in the far south-west and eastern sections of the block.

This survey block is a very complex one, both in terms of habitat variations and geographic spread. These factors increase the number of surveys needed to cover the whole survey block in order to derive a total number of group 1 shorebirds. Two periods of the year were used for this survey block. For the northern coast and associated islands, surveys in September and October 1993 were used. These counted around 13 300 birds for the eastern half of the north coast, 4 500 for the islands to the north and east of Croker Island, 1 000 for North Goulburn and South Goulburn Islands and 12 200 for Cobourg Peninsula and the islands to the south. Similar detailed surveys were not available at the same time of the year for the remainder of the survey block, so surveys from around March and April 1992

are used for this area. These totalled around 13 600 birds. Figures given below suggest more birds in this block in the March period than the September period. Thus if September and October surveys quoted above were done in March the numbers could have been higher. Further evidence to suggest that this combined total is likely to be an underestimate is that Croker Island and the wetlands in from the coast in the eastern part of the survey block are not included, although these areas do not have high numbers of shorebirds. Based on the above, a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 45 000.

To assess different surveys on a comparative basis, the survey block is considered in two sections. The first section is the coast that runs south of Minimini Creek inside Van Diemen Gulf in the south west of the block. This had roughly comparable aerial surveys done in January 1994 (6 500 birds), March 1992 (7 000), April 1991 (3 600), May 1993 (2 600), July 1993 (1 000), September 1993 (2 100) and December 1992 (4 100). These figures suggest higher numbers around the time that birds are departing to the north to breed rather than their arrival time. The September count seems a little low compared to the other counts, but as totals are relatively low, missing a single roosting flock on such a survey could have a significant effect on total numbers.

The other area in which seasonal comparison is attempted is the coast to the east of Cobourg Peninsula. (Cobourg was only given a complete survey on one occasion so no comparisons are made for this part of the survey block). This eastern coast had a November count of around 13 300 group 1 shorebirds. It was also surveyed three other times in a roughly similar manner, but all were in the month of April. Although not exactly the same area was done each time the counts can still be broadly compared in terms of obvious differences. These counts showed between a third and half the number of group 1 shorebirds present in April, indicating a possible departure of birds since November from this part of the survey block at least.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 28.

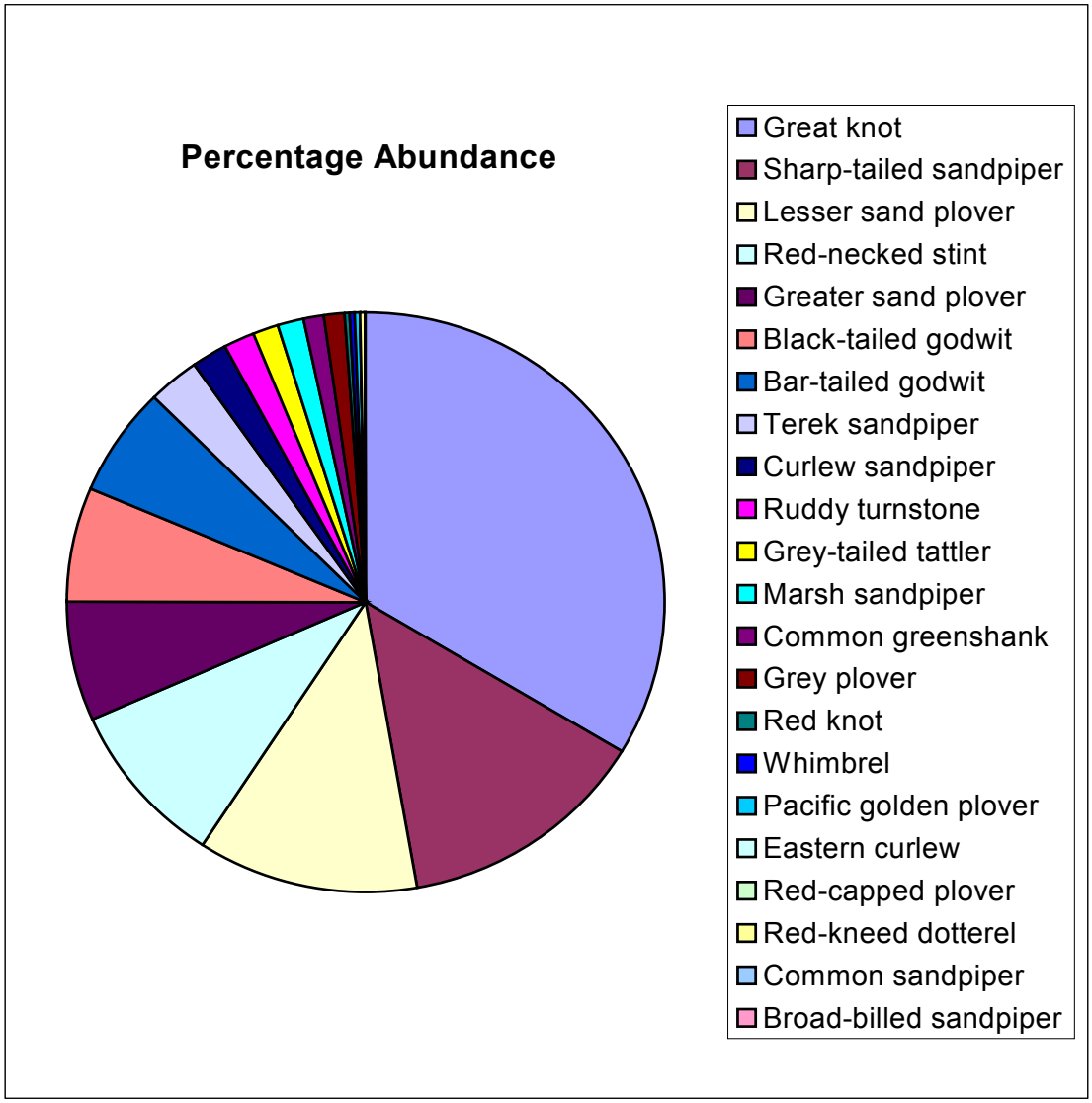
Plate 8. Typical cliffy shoreline with few shorebirds along the coast to the south east of Cape Cockburn, April 1992. Photo R Chatto.

The most abundant migratory shorebird recorded in this survey block was the Great Knot. This was nearly three times as abundant as the next species, the Sharp-tailed Sandpiper. The next most abundant species were both sand plover species, Red-necked Stints, and both godwits.

The species recorded most often during ground surveys were Greater and Lesser Sand Plovers, Great Knots and Bar-tailed Godwits. Whimbrels and Eastern Curlews were also recorded on a high number of aerial counts. There were a number of species not recorded at all in the block.

This survey block had eight single flock records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 8).

Figure 28. Average percentage abundance of group 1 species in survey block 7.



The number of separate sites involved for species where more than one count is listed in Table 8 are: Pacific Golden Plover (2) and Lesser Sand Plover (2).

Another count of 1 000 mixed sand plovers (October) must contain numbers of one or both species higher than the international 1% level

Two records at different locations were made of Red-capped Plovers with small chicks in early November 1991 and mid November 2000.

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were reasonably well represented in this survey block but Sooty Oystercatchers were much less abundant.

Beach Thick-knees were recorded on 21 occasions from the ground and 112 from the air, totalling 195 birds. As with the group 1 shorebirds in this survey block there was no single survey to anywhere near cover the whole area so Beach Thick-knee numbers are drawn from a number of surveys of different sections, all done in the months of October or November. The number of birds calculated by this method is around 64 birds, but distributional records suggest a population of around 57 pairs.

Pied Oystercatchers were recorded on seven occasions from the ground and 110 from the air, totalling 468 individuals. Using the same surveys as was used for the first Beach Thick-knee estimate gives a minimum estimate of 150 Pied Oystercatchers in this survey block.

Sooty Oystercatchers were recorded on two occasions from the ground and nine from the air, totalling 17 individuals. The minimum estimate for Sooty Oystercatchers in this survey block is 20.

Probable Beach Thick-knee breeding was recorded at two locations in February 1996 and April 1994.

Table 8. Significant single records for survey block 7. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Marsh Sandpiper	April	150	✔	✘	Not in top 5
Terek Sandpiper	April	250	✔	✔	Not in top 5
Ruddy Turnstone	October	200	✔	✘	3
Sharp-tailed Sandpiper	April	1000	✘	✘	=4
Pacific Golden Plover	October	20	✘	✘	=2
Pacific Golden Plover	October	20	✘	✘	=2
Lesser Sand Plover	April	500	✔	✔	=4
Lesser Sand Plover	April	400	✔	✔	Not in top 5

SURVEY BLOCK 7 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Coast south of Murgenella Creek	Great Knot	Marsh Sandpiper (1)	Group 1 – 45 000
	Sharp-tailed Sandpiper	Terek Sandpiper (1)	
	Lesser Sand Plover	Ruddy Turnstone (1)	Group 2 – 284
Junction Bay	Red-necked Stint	Lesser Sand Plover (2)	
	Greater Sand Plover		

Survey Block 8

Location

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 main 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 by people. One Aboriginal pastoral property is located in the Arafura Swamps, which are the 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 100 hours of surveys during the period of this project. This represented approximately 5.4% of the hours of survey in all survey blocks combined. These surveys were spread over 28 separate days. The majority of survey effort in this block occurred in the dry season (March to July) and November, with the other months receiving little or no survey time (Figure 29). There were 69 separate ground surveys involving 42 different and well-spread sites.

Results and Discussion

Shorebirds were reasonably well distributed all around the coast, islands and near coastal wetlands of this survey block. There were 865 separate shorebird records totalling over 321 962 birds (Figure 30). They represented 6.7% of the records and 15.5% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project. Though the number of individual records was not high the number of shorebirds counted was the second highest for all blocks.

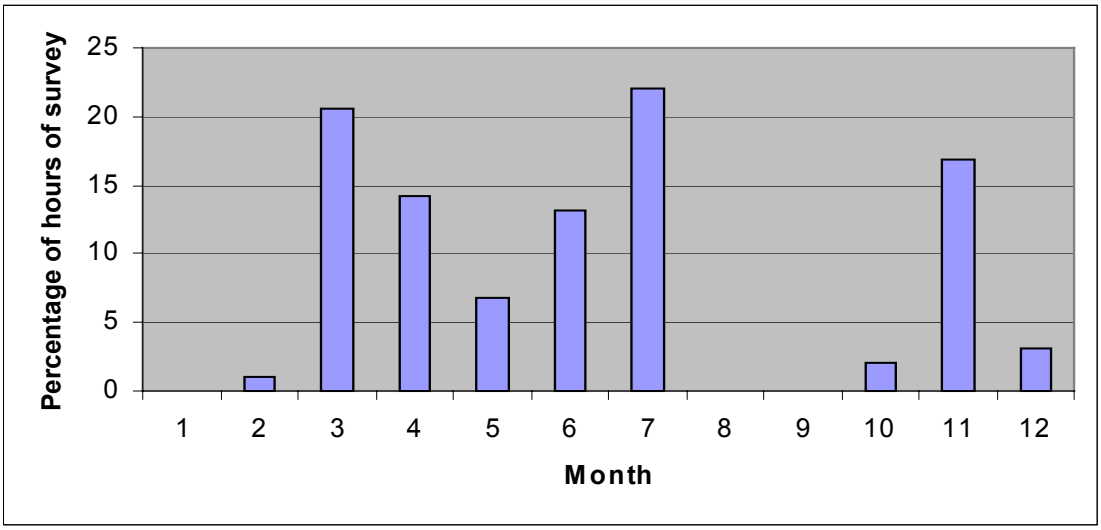


Figure 29. Average percentage of surveys hours relating to shorebirds for survey block 8.

Although inland wetlands were reasonably important, there were two main areas for shorebirds in this survey block. These were Castlereagh and Boucaut Bays, and they have some of the largest flocks of shorebirds in the Top End.

The highest single count for the coast and adjacent saline wetlands of the Castlereagh Bay area was in excess of 30 500 in mid December 1998. The second highest count was in excess of 28 500 in late March 1992. Both counts were recorded in aerial surveys covering more than 75% but less than 100% of the potential habitat. This bay easily qualifies for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts. It would also qualify on the basis of several single species counts in excess of the 1% criteria (see below) and counts of in excess of 5 000 during the over-wintering season. This site is discussed in greater detail in Chatto (2000a).

The highest single count for Boucaut Bay was in excess of 26 000 in mid December 1998 and the second highest was 19 500 in late March 1992. Both counts were recorded in aerial surveys covering more than 75% but less than 100% of the potential habitat. A ground count of only four sites within this Boucaut Bay area in late March 1999 recorded in excess of 17 000 shorebirds. With no other part of the bay counted in this survey the count would have only represented 25% to 50% of the potential habitat, suggesting numbers well above the two aerial counts mentioned above for this bay. Parts of the bay were also flown in November 2000. Although a count of the bay was not done, it appeared that there were many more birds present this time than in any of the above counts. This bay also easily qualifies for listing under the East Asian-Australasian Shorebird Site Network on the basis of these counts. It would also qualify under the criteria of having several single species counts in excess of the 1% criteria (see below) and counts of in excess of 5 000 during the over-wintering season. This site is discussed in greater detail in Chatto (2000a).

Twenty-five species of shorebirds (22 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

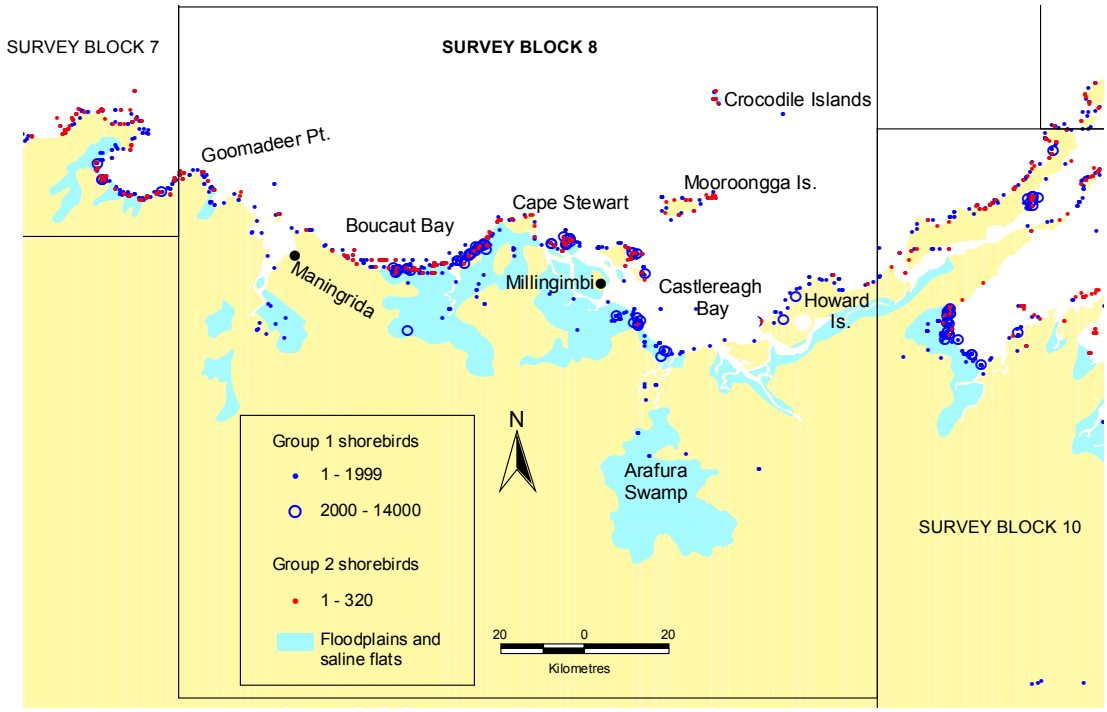


Figure 30. Distribution of shorebird records for survey block 8.

Group 1 Species. Group 1 species were observed along most of the coast and some of the inland wetlands of this survey block, with many significant roosts (greater than 2 000 birds) being present in both Boucaut and Castlereagh Bays (Figure 30).

The most extensive single coastal survey for this block was done in December 1998. This survey recorded around 56 000 group 1 shorebirds. Another count of the small section of coast that was not covered in this December survey recorded 3 000 birds. This was done in February when there was likely to be less birds present than December. Counts of the offshore islands and inland wetlands during the month of November recorded around 1 500 and 5 500 shorebirds respectively. Combining the counts of each of these separately assessed areas suggests a conservative estimate of at least 66 000 group 1 shorebirds.

Four comparable fixed wing surveys were done along the coast between the western end of Boucaut Bay and the eastern end of Castlereagh Bay. These were March 1992 (33 000 birds), April 1993 (11 000), June 1996 (20 000) and October 1993 (26 000). These suggest that the largest numbers of group 1 shorebirds are present in March, just prior to their northward migration. However, the previously mentioned December 1998 counts of Boucaut and Castlereagh Bays totalled 56 500 shorebirds. Although these counts included all shorebirds, most were group 1 species. This total could not be included in the above monthly count comparisons because it included adjacent saline wetlands as well as the coast. This suggests that there could be more group 1 shorebirds present at this time of the year compared to March, or that large numbers also use the adjacent coastal wetlands.

Even more interesting is the large number or birds in the area during June, despite an apparent drop in numbers in April. Perhaps many of the 'local' area migratory birds have left by April, but then there is an influx of migrants moving into the area from the south. Some of these may choose to remain there and not continue their further northward migration. Further possible evidence to this theory can be seen by looking at four high-tide ground counts done at the same roost but at different time of the year. The counts, on one of the outer islands off Millingimbi, were in March, June, November and December and all had between 12 600 and 14 000 group 1 shorebirds. This is something that needs to be considered in future surveys.

Plate 9. The shoreline of Boucaut Bay, on which many thousands of shorebirds roost at high tide, after feeding on the extensive mudflats which become exposed as the tide continues to go out, July 1998. Photo R. Chatto.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 31.

The most abundant migratory shorebird recorded in this survey block was the Great Knot. This was nearly three times as abundant as the next species, the Bar-tailed Godwit. The next most abundant species were Greater Sand Plovers, Bar-tailed Godwits, Red-necked Stints and Red Knots.

The species found to be the dominant migratory species in my surveys were similar to those found by Lane (1987) in his surveys of Boucaut Bay and near Millingimbi in October 1986. Ground surveys by Lane in these two areas combined, showed Great Knots easily the most abundant, followed by Bar-tailed Godwits, Black-tailed Godwits and Greater Sand Plovers.

The species recorded on the highest number of separate occasions during ground surveys were both of the knots, both sand plovers and the Common Greenshank. A number of species were not recorded in this survey block.

This survey block had 26 single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 9).

Figure 31. Average percentage abundance of group 1 species in survey block 8.

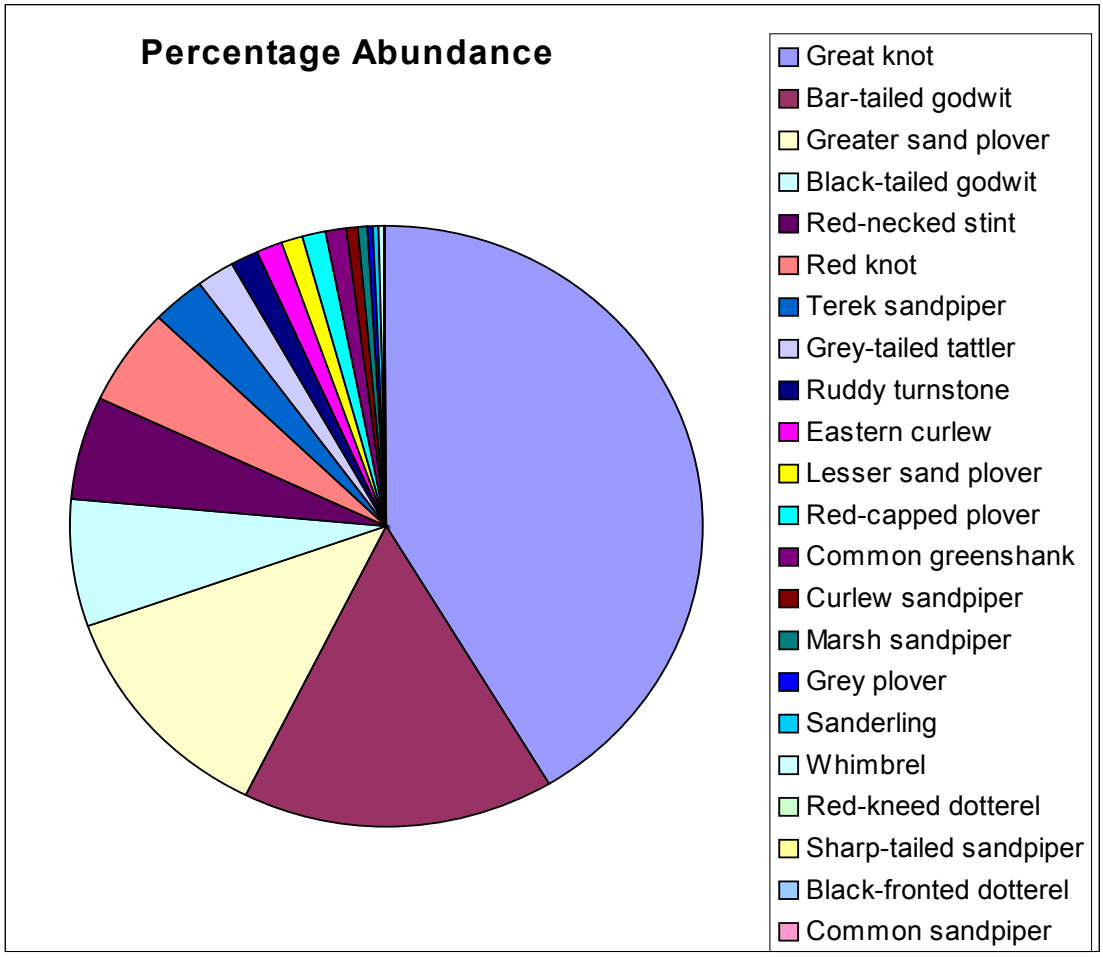


Table 9. Significant single records for survey block 8. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% Internation al Level	Rating for all surveys this project
Black-tailed Godwit	March	2900	✔	✔	4
Black-tailed Godwit	March	2000	✔	✔	=5
Black-tailed Godwit	March	2000	✔	✔	=5

Black-tailed Godwit	March	2000	✔	✔	=5
Bar-tailed Godwit	December	4300	✔	✔	1
Bar-tailed Godwit	March	2000	✔	✘	=3
Whimbrel	July	110	✔	✘	Not in top 5
Eastern Curlew	July	400	✔	✔	4
Eastern Curlew	July	300	✔	✔	=5
Marsh Sandpiper	July	150	✔	✘	Not in top 5
Common Greenshank	July	350	✔	✘	4
Terek Sandpiper	June	500	✔	✔	Not in top 5
Terek Sandpiper	July	445	✔	✔	Not in top 5
Terek Sandpiper	June	300	✔	✘	Not in top 5
Terek Sandpiper	July	300	✔	✘	Not in top 5
Grey-tailed Tattler	July	550	✔	✔	4
Ruddy Turnstone	July	305	✔	✔	1
Ruddy Turnstone	July	150	✔	✘	5
Great Knot	March	4500	✔	✔	Not in top 5
Great Knot	December	3700	✔	✔	Not in top 5
Sanderling	March	200	✔	✔	2
Red-necked Stint	June	850	✘	✘	4
Red-capped Plover	June	300	✘	✘	=3
Lesser Sand Plover	June	200	=	✘	Not in top 5
Greater Sand Plover	June	1000	✔	✔	2
Greater Sand Plover	December	500	✘	✘	5

The number of separate sites involved for species where more than one count is listed in the above table are: Black-tailed Godwit (3), Bar-tailed Godwit (2), Eastern Curlew (2), Terek Sandpiper (2), Ruddy Turnstone (2), Great Knot (2) and Greater Sand Plover (1).

There were also two counts from the one site of mixed sand plovers (2 000 in June and 1 000 in July) that would have been greater than the international 1% level for one or both species.

None of the resident species of group 1 shorebirds were confirmed breeding in this survey blcok.

Group 2 Species. Beach Thick-knees and Sooty Oystercatchers were both reasonably well represented in this survey block, and Pied Oystercatchers were more abundant here than in any other survey block.

Beach Thick-knees were recorded on 17 occasions from the ground and 16 from the air, totalling 56 individuals. The combination of surveys used above to estimate the group 1 total, recorded around 20 Beach Thick-knees but this is undoubtedly an underestimate. Ground counts of several islands in this survey block regularly revealed more birds than aerial counts of the same area prior to landing. The population estimate based on distributional records of pairs located throughout the survey period suggests a population of at least 20 pairs for this block.

Pied Oystercatchers were recorded on 16 occasions from the ground and 77 from the air, totalling 3 234 individuals. The December 1998 coastal survey of this block, mentioned above, recorded 574 Pied Oystercatchers. Counts at around the same time of the year from other areas not covered in this survey totalled 27. Consequently the peak estimate for Pied Oystercatchers in this block was around 600. Most of these birds were counted in roosts on one of the islands off Millingimbi. At this site there were eleven separate counts between 1992 and 1999 that were above the international 1% level. Birds were present in these large numbers at whatever time of the year the area was surveyed, suggesting little movement away from the area. The top five counts here (the largest being 320) were the top five for the Top End in all surveys. Two other counts, from two different sites in this block, were equal to the Australian 1% level.

Sooty Oystercatchers were recorded on 10 occasions from the ground and eight from the air, totalling 90 individuals. The December 1998 survey mentioned above recorded 30 Sooty Oystercatchers. Adding in counts from the islands and the section of the coast that was not covered in this survey increases this total by 22 to 52. Again most of these birds were on the islands off Millingimbi. The largest single flock of Sooty Oystercatchers was 30.

Little evidence of breeding was recorded. A single record was made of Sooty Oystercatchers breeding in mid November 2000, and probable Beach Thick-knee breeding was recorded at three separate locations in July 1998, March 1999 and November 2000.

SURVEY BLOCK 8 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Boucaut Bay	Great Knot	Black-tailed Godwit (3)	Group 1 – 66 000
Millingimbi Islands	Bar-tailed Godwit	Bar-tailed Godwit (2)	
Castlereagh Bay	Greater Sand Plover	Whimbrel (1)	Group 2 – 670
	Black-tailed Godwit	Eastern Curlew (2)	
	Red-necked Stint	Marsh Sandpiper (1)	
		Common Greenshank (1)	
		Terek Sandpiper (2)	
		Grey-tailed Tattler (1)	
		Ruddy Turnstone (2)	
		Great Knot (2)	
		Sanderling (1)	
		Greater Sand Plover (2)	
		Pied Oystercatcher (3)	

Survey Block 9

Location

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 out 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. Survey block 9 is all part of Arnhem Land, and as such, is 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 intertidal-exposed sand areas. 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 surveys during the period of this project. This represented approximately 4.3% 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 32). This was largely due to the amount of seabird breeding work done in this area. February, August and December received no surveying but January and most of the dry season months received at least some surveying, thus covering most of the important time periods in relation to shorebirds. There were 33 separate ground surveys involving 22 different and well-spread sites.

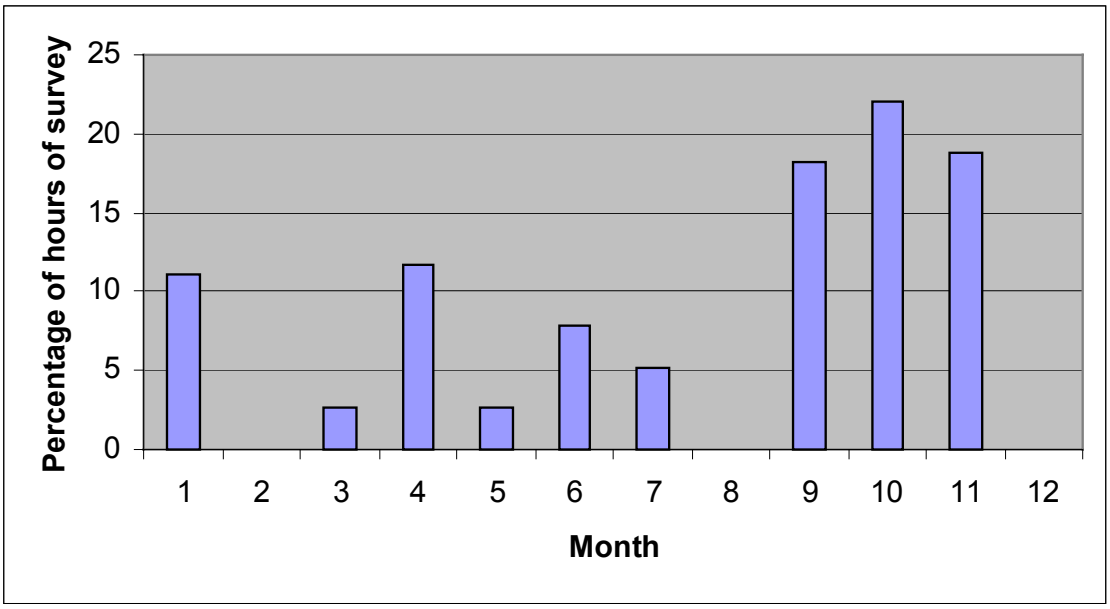


Figure 32. Average percentage of surveys hours relating to shorebirds for survey block 9.

Results and Discussion

Shorebirds were sparsely distributed over most of the survey block, with group 2 species being more widely distributed than group 1 species. Few birds were seen along the coast where the high cliffs fall straight into the ocean along the eastern side of the outer Wessel Islands.

Within this survey block there were 242 separate shorebird records. These totalled over 7 730 birds (Figure 33). The low number of shorebirds in this block, compared to most other blocks, would be expected given the habitat of this block. The records represented 1.9% of the records and <1% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

Twenty species of shorebirds (17 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. Group 1 species were sparsely distributed throughout this survey block, but the majority of the relatively small numbers were in the south west of the survey block. There was only one roost (containing 2000 or more birds) in this survey block. This was the high tide roost of most of the migratory shorebirds that use the south west part of the block.

The only surveys to cover the majority of the survey block were in the October/November time period. The highest count from any single survey was a little over 2 500, however another survey of only a small section of the survey block counted just over 2 200 birds. These two surveys, done at similar times of the year, were used to produce a conservative estimate of at least 3 000 group 1 shorebirds present in this survey block at this time of year.

No seasonal comparisons were attempted for this survey block due to the relatively low number of group 1 shorebirds and the restricted repeat survey coverage.

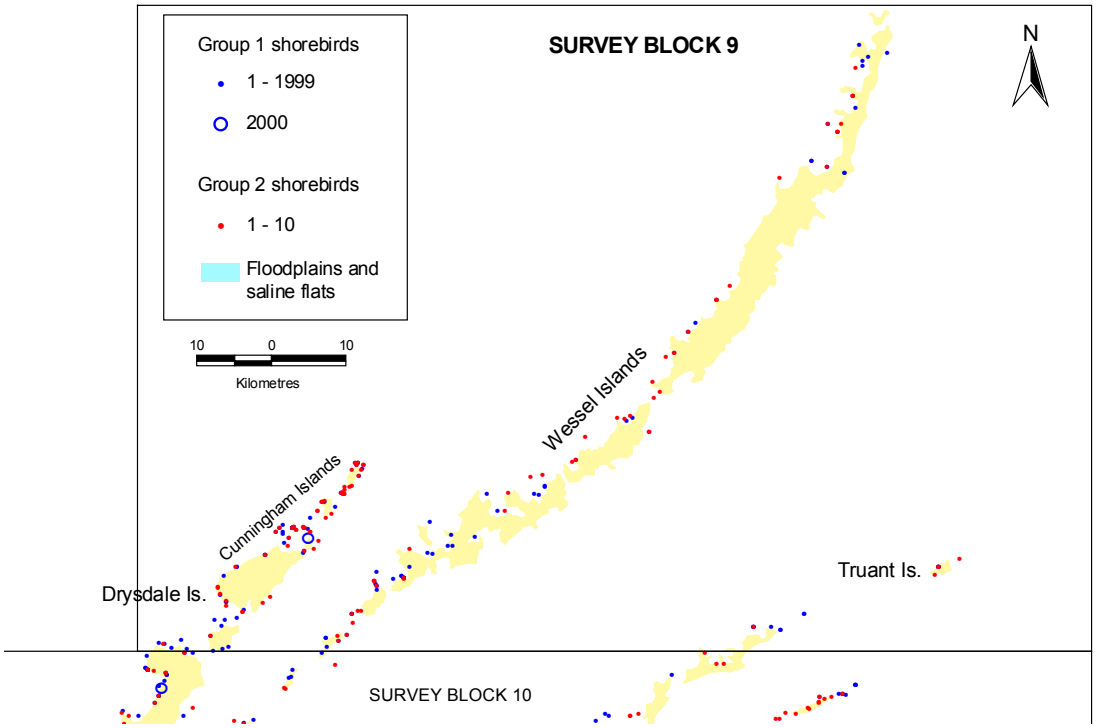


Figure 33. Distribution of shorebird records for survey block 9.

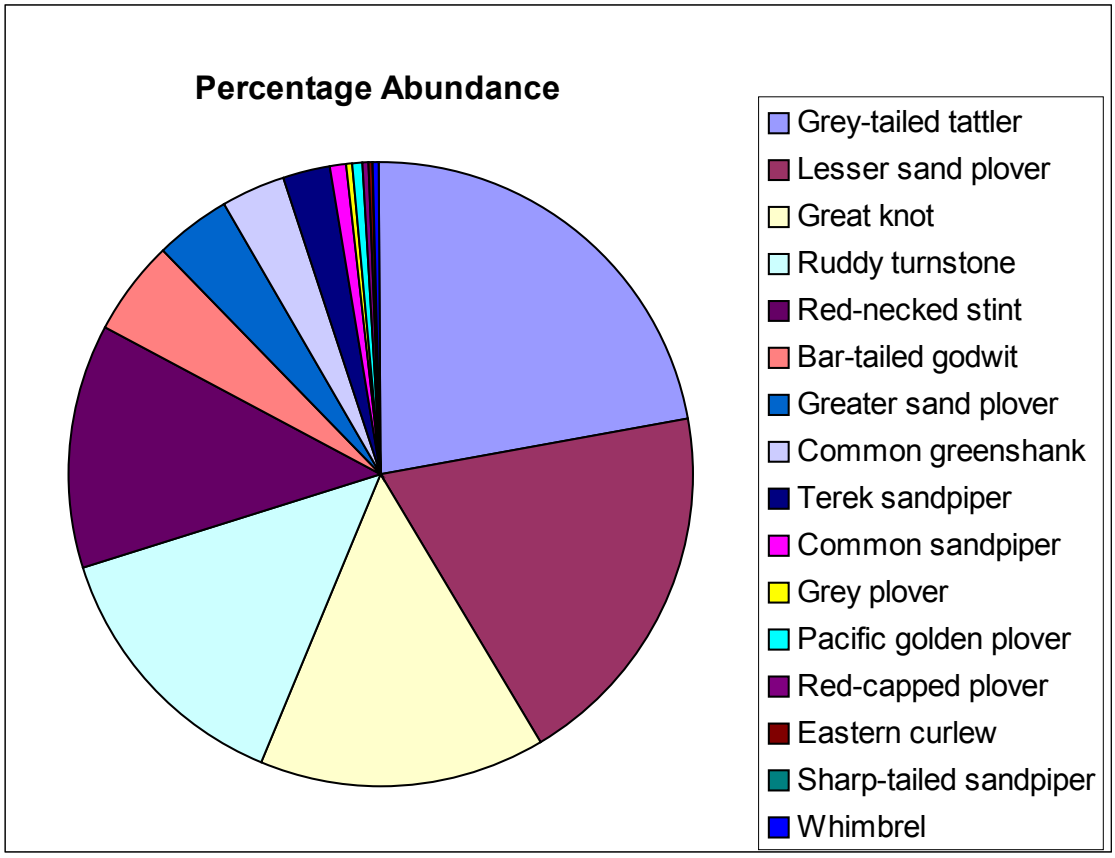


Figure 34. Average percentage abundance of group 1 species in survey block 9.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 34.

The most abundant migratory shorebirds recorded in this survey block were Grey-tailed Tattlers followed by Lesser Sand Plovers, Great Knots, Ruddy Turnstones and Red-necked Stints. Given the relative lack of good migratory wader habitat for most species, there were many species not recorded in this block.

The species recorded on the highest number of separate occasions from ground surveys were Common Sandpipers, Ruddy Turnstones and Great Knots.

This survey block had no significantly high single records and no sites exceeding the Australian or international 1% levels. No resident group 1 species were confirmed breeding.

Group 2 Species. All three species were recorded throughout the survey block. Sooty Oystercatchers were better represented in this survey block than any other block.

Beach Thick-knees were recorded on five occasions from the ground and 30 from the air, totalling 51 individuals. Using a similar combination of surveys to those used above to estimate the group 1 total, the estimated peak number of Beach Thick-knees in this survey block totals around 12. This is undoubtedly an underestimate. Distributional records suggest a population of around 16 pairs for this block.

Pied Oystercatchers were recorded on four occasions from the ground and 18 from the air, totalling 60 individuals. A survey in November, which covered most of the survey block coast, counted nine Pied Oystercatchers. Adding in counts from the islands and the section of the coast that was not covered in

this survey increases this total by nine to 18. Most of these birds were in the southern part of the survey block.

Sooty Oystercatchers were recorded on three occasions from the ground and 43 from the air, totalling 121 individuals. A survey in November, which covered most of the survey block coast, counted 55 Sooty Oystercatchers. Adding in counts from the islands and the section of the coast that was not covered in this survey increases this total by 16 to 71.

Little evidence of breeding was recorded. A single record was made of Sooty Oystercatchers strongly defending in mid December 1992, and probable Beach Thick-knee breeding was recorded at two separate locations in December 1992 and December 1999.

SURVEY BLOCK 9 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Nil	Grey-tailed Tattler Lesser Sand Plover Great Knot Ruddy Turnstone Red-necked Stint	Nil	Group 1 – 3 000 Group 2 – 120

Plate 10. Part of the sand and reef area off the north of Drysdale Island, October 1999. One of few areas of reasonable numbers of shorebirds in this survey block. Photo R. Chatto.

Survey Block 10

Location

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 of the survey block 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 bays, with Buckingham Bay, Arnhem Bay and the northern part of Blue Mud Bay being important for shorebirds.

The entire block is Aboriginal land and there are no pastoral properties within the block. 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 shorebird 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 shorebirds except some of the group 2 species. Islands closer to the coast are often surrounded by turbid water but further offshore the seas become clear.

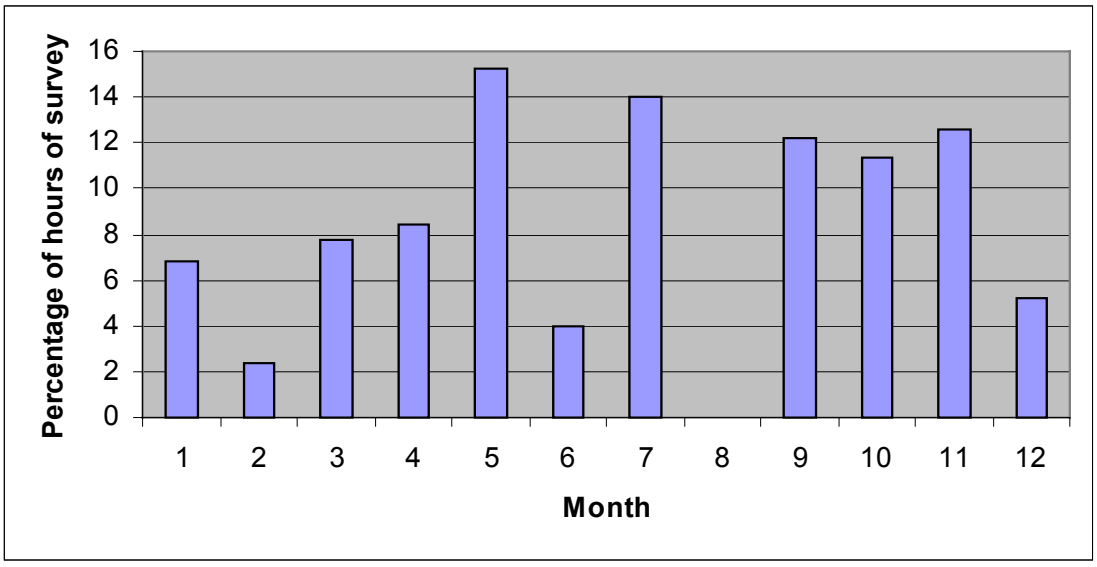


Figure 35. Average percentage of surveys hours relating to shorebirds for survey block 10.

Survey Effort

This survey block received approximately 250 hours of surveys during the period of this project. This represented approximately 13.9% 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 35). There were 174 separate ground surveys involving 128 different and well-spread sites.

Results and Discussion

Shorebirds were distributed all around the coast and near coastal wetlands of this survey block. The largest numbers were in Buckingham and Arnhem Bays, the northern section of the straits between Elcho Island and the mainland, and the smaller bays of the northern section of Blue Mud Bay. The southern section of Blue Mud Bay also has many shorebirds but this is covered in survey block 12. Some wetlands were also important for shorebirds on occasions.

Within this survey block 1 362 separate shorebird records were made totalling over 265 184 birds (Figure 36). Both of these figures are among the highest for all the survey blocks, representing 10.5% of the records and 12.6% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

The most important of the coastal areas was Buckingham Bay. The highest count for a single survey for the site was in excess of 19 000 in late January 1996. The next highest counts were in excess of 15 000 in late March 1992 and again in early April 1994. All counts were recorded in aerial surveys covering more than 75% but less than 100% of the potential habitat. Garnett (1983) reported nearly 31 000 waders in this bay in February 1983. Even though Garnett probably included species such as Black-winged Stilts, Red-necked Avocets, Masked Lapwings and pratincoles (which I am leaving to include in a subsequent report on waterbirds), his count would have likely been considerably more than for any of my survey counts. However, Garnett (1987) averages summer counts of this bay to be just over 20 000. It is also interesting to note that Garnett (1987) averages winter counts in this bay (ie counts between late April to early September) to be only 1 200, yet I recorded just under 9 000 birds in a mid July aerial survey of this bay. My surveys and Garnett's counts would suggest this bay would qualify for listing under the East Asian-Australasian Shorebird Site Network.

Next in importance in terms of the highest number of shorebirds recorded was the northern area of the Cadell Straits. The highest count for this area is based on the high tide roost along the southern side of Elcho Island. Over 20 000 shorebirds were recorded in a few nearby roosts in March 1992 and over 15 000 were recorded in March 1999. A November 1993 count in this area was around 10 000 birds.

The third important shorebird area in this survey block is Arnhem Bay. The highest single survey shorebird count for this Bay was in excess of 8 000 in mid November 1993. The second highest count was in excess of 4 500 in late March 1992. Both counts were recorded in aerial surveys covering more than 75% but less than 100% of the potential habitat. The Arnhem Bay figures from Garnett (1987) were around 1 300 for summer and 350 for winter. Thus the summer figures during my surveys were considerably higher, and with around 2 000 birds counted in one of my July surveys, so are my winter figures.

There are no counts from surveys during this project confirming that Arnhem Bay would qualify for listing under the East Asian-Australasian Shorebird Site Network, but it is possible that more complete coverage of this area would record sufficient numbers for listing.

The highest count for the forth area mentioned above, Blue Mud Bay, was nearly 11 500. This is a fairly extensive and complex area and no single survey covered anywhere near all of the area. This highest count was taken from only two ground surveys and little other aerial work in late September 1996. These surveys would have counted less 25% of the potential shorebird area. The second highest count was just under 11 500 from an aerial survey. Again this did not cover anywhere near the entire

area of potential habitat. Full coverage of this area would almost certainly see it record sufficient numbers in both the breeding and over-wintering seasons to qualify for listing under the East Asian-Australasian Shorebird Site Network

Twenty-eight species of shorebirds (25 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

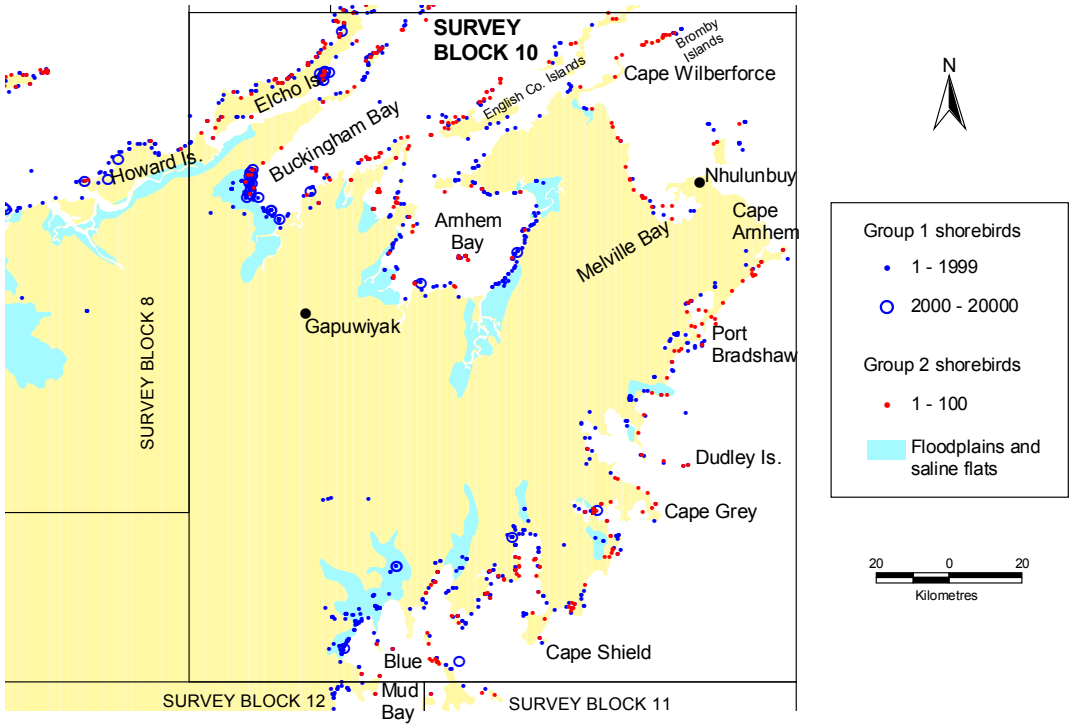


Figure 36. Distribution of shorebird records for survey block 10.

Group 1 Species. Group 1 shorebirds were located around most of the coast and coastal wetlands of this survey block, though in lower densities in the more ocean beach type habitats of the north east of the block. There were many single flock records of greater than 2 000 birds, however apart from three in Blue Mud Bay, all were in the three areas mentioned above in the north west of the block. The largest numbers by far were in the bottom of Buckingham Bay and the roosting area along the north east shore of Elcho Island.

This was another extremely complex survey block in terms of survey geography and habitats. Attempting to combine surveys of a number of separate sections to derive the highest total of group 1 shorebirds for this block is complex. However, there was one fairly extensive survey, in November 1993, that covered most of the coast and immediately adjacent wetlands. On this survey Buckingham Bay was not well covered because of having to dodge large storms. Because this is such a significant migratory shorebird area, a more complete survey the following January is used as the count for this section of the block. Although these two surveys may not have captured all the significant sites in the one total it is much less likely to suffer from the problem of potential movements of waders between areas if more surveys are used. With these surveys a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 67 500. This figure will not include birds that may have been on the wetlands further inland, such as south of Buckingham and Arnhem Bays. However, based on random flights over some of these areas on other occasions, these numbers are not likely to be high at this time of year.

For the reasons mentioned in the above paragraph, comparing surveys at different times of the year is also difficult for this survey block. There were some roughly comparable aerial surveys done in

Buckingham and Melville Bays and as these are two of the main group 1 shorebird areas in this survey block they will give a fairly representative view of the shorebirds in the northern part of this block. A similar approach can be taken with the northern part of Blue Mud Bay in the south of this survey block.

For Buckingham and Melville Bays there were roughly comparable aerial surveys done in January 1999 (21 600 birds), March 1992 (20 300), April 1993 (6 100), July 1996 (11 500) and November 1993 (16 000). This latter count is likely to be fairly well below the true number because of the weather diversions mentioned above. These figures suggest (as was the case for the adjacent survey block 8) a relatively high number of birds remain over the breeding season. Assuming the November count should be higher, it also appears that numbers remain relatively constant over the non-breeding period, and that there are no obviously large increases in numbers in the arrival season compared to the departure season.

For the northern Blue Mud Bay area there were three roughly comparable aerial surveys done. These included late March 1994 (5 000 birds), mid July 1996 (2 600) and mid November 1993 (9 200). These figures do not really suggest anything out of the ordinary. The highest numbers are in November, the lowest in July and by late March many of the birds have gone.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 37.

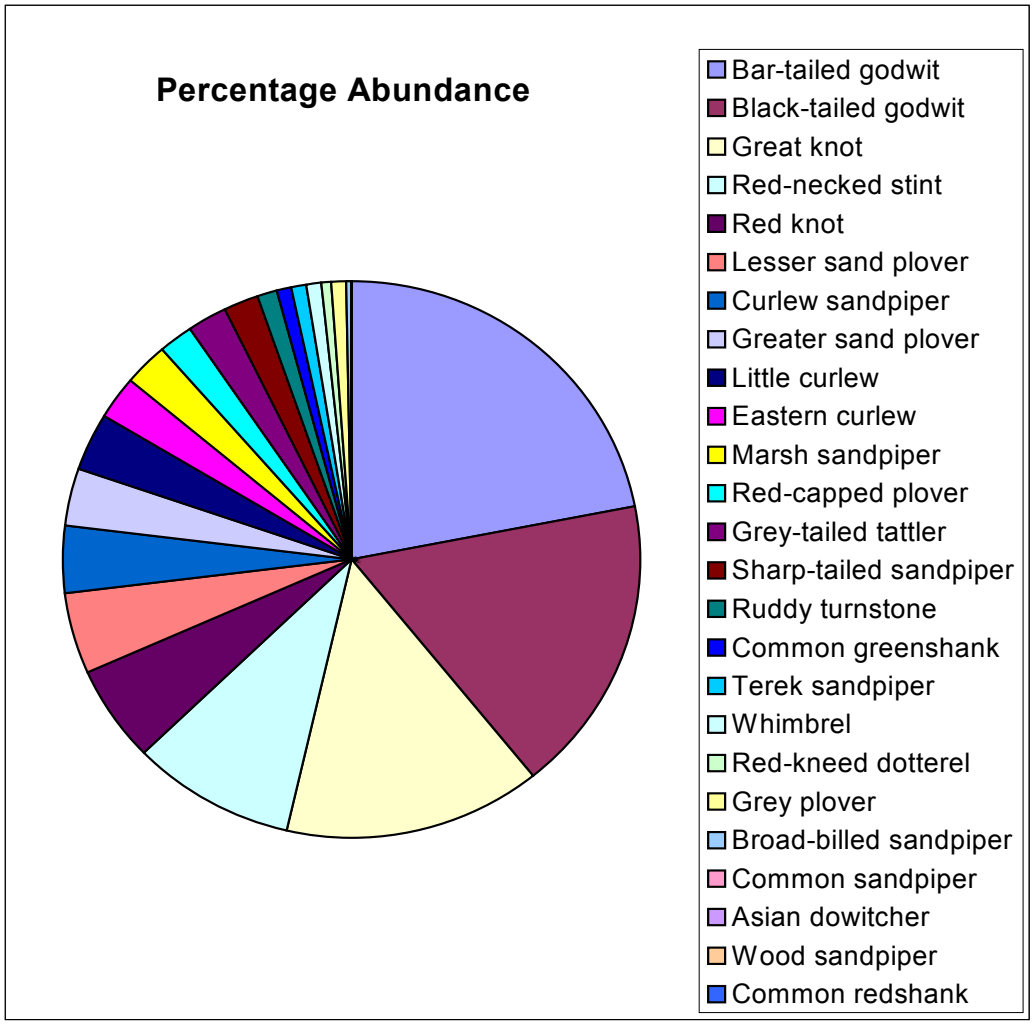


Figure 37. Average percentage abundance of group 1 species in survey block 10.

Table 10. Significant single records for survey block 10. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Black-tailed Godwit	March	5000	✔	✔	1
Black-tailed Godwit	September	4000	✔	✔	2
Black-tailed Godwit	March	3500	✔	✔	3
Bar-tailed Godwit	March	4300	✔	✔	=1
Whimbrel	June	100	=	✘	Not in top 5
Eastern Curlew	July	500	✔	✔	=1
Eastern Curlew	June	500	✔	✔	=1
Eastern Curlew	June	200	✔	✘	Not in top 5
Marsh Sandpiper	July	450	✔	✘	Not in top 5
Marsh Sandpiper	September	200	✔	✘	Not in top 5
Terek Sandpiper	November	210	✔	✘	Not in top 5
Grey-tailed Tattler	November	600	✔	✔	3
Ruddy Turnstone	November	210	✔	✘	Not in top 5
Great Knot	March	5000	✔	✔	=1
Red-necked Stint	July	1200	✘	✘	2
Curlew Sandpiper	July	800	✘	✘	2
Broad-billed Sandpiper	July	100	✔	✘	=3
Red-capped Plover	April	400	✘	✘	2
Lesser Sand Plover	November	750	✔	✔	1
Lesser Sand Plover	July	400	✔	✔	Not in top 5
Lesser Sand Plover	October	250	✔	✘	Not in top 5
Red-kneed Dotterel	July	200	✘	✘	1

The most abundant migratory shorebirds recorded in this survey block were Bar-tailed and Black-tailed Godwits, and Great Knots. These three species alone made up over 53% of the group 1 shorebirds. Most of the other group 1 shorebirds were represented on this block but in lower numbers.

The species most frequently recorded during ground surveys were Great Knots, while a number of other species were also fairly frequently recorded. Eastern Curlews, Whimbrels and the two godwits were also recorded quite frequently from the air.

This survey block had 22 single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 10). The number of separate sites involved for species where more than one count is listed in this table are: Black-tailed Godwit (2), Eastern Curlew (2), Marsh Sandpiper (2) and Lesser Sand Plover (3).

Eggs or young were confirmed for Red-capped Plover at two sites, one in April and one in May.

Group 2 Species. These species were recorded in reasonable numbers throughout the survey block, although Beach Thick-knees and Sooty Oystercatchers tended not be found in the mangrove lined bays that were very prominent in this survey block.

Beach Thick-knees were recorded on 28 occasions from the ground and 112 from the air, totalling 194 individuals. Using a similar combination of surveys to those used above to estimate the group 1 total, the estimated peak number of Beach Thick-knees in this survey block totals around 20. This is undoubtedly very much an underestimate. Distributional records suggest a population of around 72 pairs.

Pied Oystercatchers were recorded on 19 occasions from the ground and 109 from the air, totalling 990 individuals. The above-mentioned survey in November 1993, which covered most of the survey block coast, counted 214 Pied Oystercatchers. Using other surveys to account for the aerial diversions in Buckingham Bay that were mentioned above, recorded two counts of 100 in March/April and one

count of 75 in September. These indicated that there is usually a good number of Pied Oystercatchers here that were not accounted for with the November survey. Consequently an adjusted figure for the highest number of Pied Oystercatchers recorded in this block during this project would be at least 300.

Four counts of Pied Oystercatchers (all 100) from two sites were all equal to the Australian 1% level but not in the top five counts for these surveys.

Sooty Oystercatchers were recorded on 14 occasions from the ground and 26 from the air, totalling 112 individuals. The survey in November 1993, which covered most of the survey block coast, counted 18 Sooty Oystercatchers. Other surveys recorded larger numbers of Sooty Oystercatchers at some of the individual sites but they did not have an overall higher survey total because they did not cover the whole area in one survey. Consequently 18 is likely to be an underestimate for the total number of Sooty Oystercatchers in this survey block.

Little evidence of confirmed breeding was recorded in this survey block but there were a number of records of likely breeding, deduced from strongly defending birds. There were six separate instances of the latter for Beach Thick-knees (spread between April and October) and four for Sooty Oystercatchers (between May and November). Eggs or young were confirmed for Sooty Oystercatcher (October) at a different location to the sites referred to above, and Pied Oystercatcher (one site in May).

SURVEY BLOCK 10 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Cadell Straits	Bar-tailed Godwit	Black-tailed Godwit (2)	Group 1 – 67 500
Buckingham Bay	Black-tailed Godwit	Bar-tailed Godwit (1)	
Arnhem Bay	Great Knot	Whimbrel (1)	Group 2 – 468
Blue Mud Bay	Red-necked Stint	Eastern Curlew (2)	
	Red Knot	Marsh Sandpiper (2)	
		Grey-tailed Tattler (1)	
		Ruddy Turnstone (1)	
		Great Knot (1)	
		Broad-billed Sandpiper (1)	
		Lesser Sand Plover (3)	
		Pied Oystercatcher (2)	

Survey Block 11

Location

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. 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 mostly of sparsely vegetated sandstone or granite islands (some quite high) or low sand and coral islands.

Survey Effort

This survey block received approximately 100 hours of surveys during the period of this project. This represented approximately 5.3% 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, thus covering most of the important time periods in relation to shorebirds (Figure 38). Increased survey effort in this block between September and December was again largely due to the amount of seabird breeding work done in this area, from which it is hard to separate out shorebird work. There were 77 separate ground surveys involving 59 different and well-spread sites.

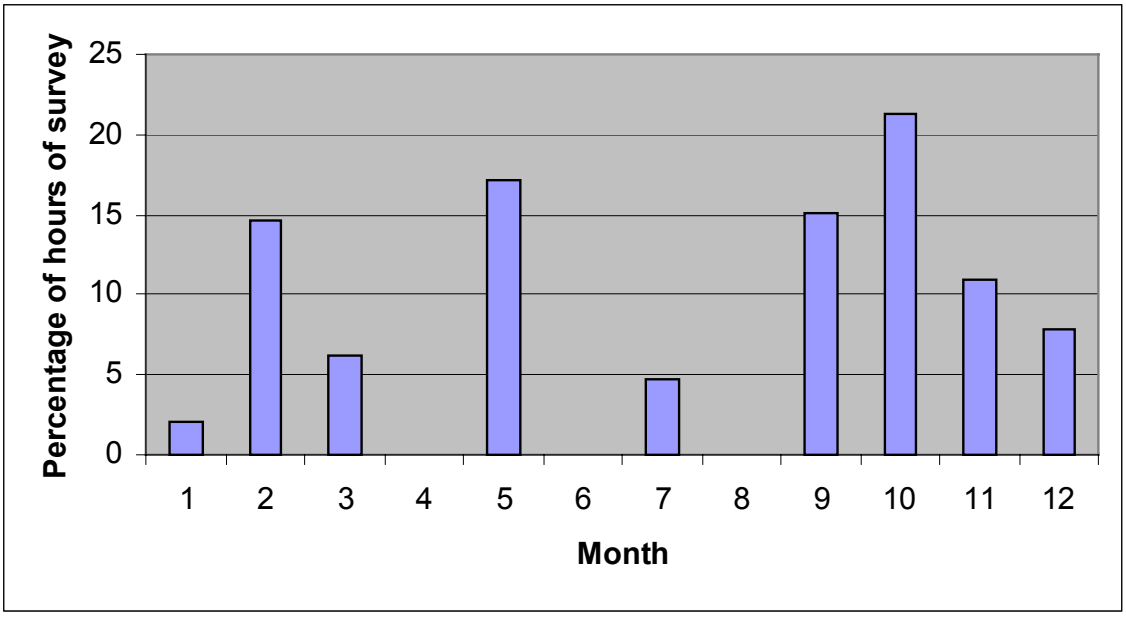


Figure 38. Average percentage of surveys hours relating to shorebirds for survey block 11.

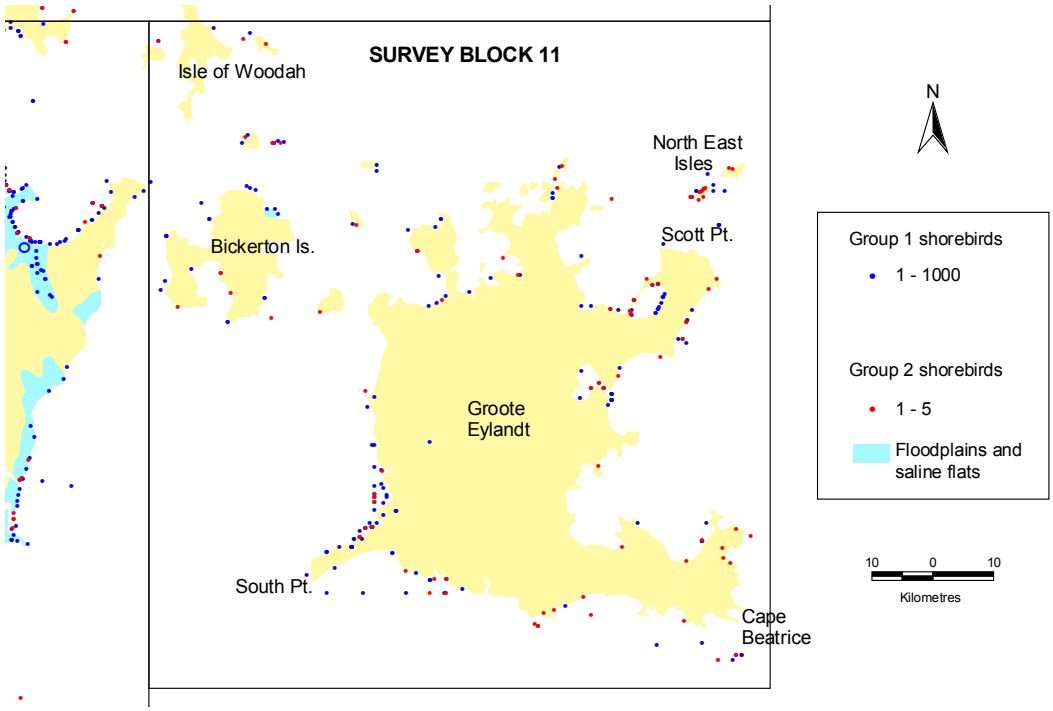


Figure 39. Distribution of shorebird records for survey block 11.

Results and Discussion

Migratory shorebirds were few in number compared to other survey blocks but resident species such as Beach Thick-knee and Pied Oystercatcher were comparable with most other survey blocks. Most species of shorebird were only sparsely distributed throughout this survey block, with the majority of the larger groups being in the south west of Groote Eylandt.

Within this survey block there were 273 separate shorebird records totalling over 4 900 birds (Figure 39). These represented 2.1% of the records and <1% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

Nineteen species of shorebirds (16 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. There were no significant roosts (containing 2 000 or more birds) in this survey block but there was one aerial record of 1 000 birds roosting on one of the small islands off the south east of Groote in December 1993.

A fixed wing survey in November 1993 was quite extensive and covered most of this survey block. This recorded 1 100 group 1 shorebirds. With other surveys not suggesting many more birds present in other parts in this block, a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 2 000. A similar aerial survey in July 1996 counted only 310 birds, indicating the majority had left, and this survey block was not one to have an increase in numbers from over wintering birds.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 40.

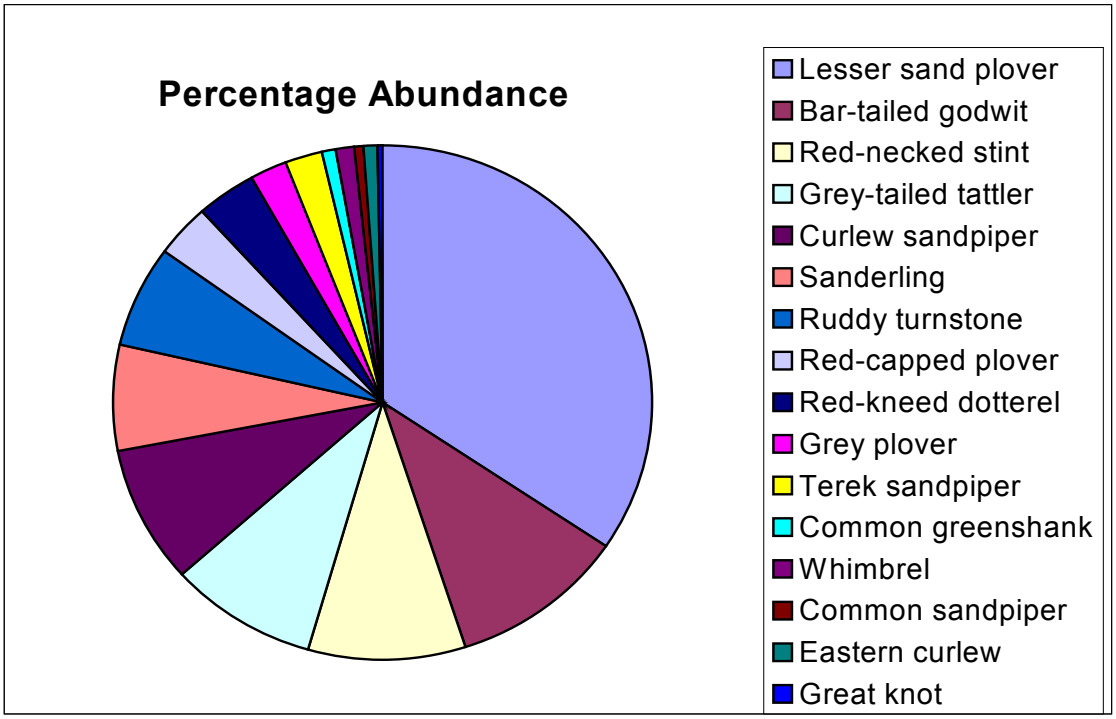


Figure 40. Average percentage abundance of group 1 species in survey block 11.

Easily the most abundant migratory shorebird recorded in this survey block was the Lesser Sand Plover, which was recorded at more than three times the abundance of the next highest species, the Bar-tailed Godwit. It should be kept in mind that the relatively small number of ground surveys can possibly lead to single counts in suitable areas for certain species having a large effect on their average percentage abundance. Given the relative lack of good migratory shorebird habitat and small number of sites ground-surveyed, a lot of species were not confirmed in this block. No species were recorded on more than five separate occasions.

This survey block had no significantly high single records and no sites exceeding the Australian or international 1% levels. No group 1 species were confirmed breeding in this survey block.

Group 2 Species. Beach Thick-knees and Pied Oystercatchers were reasonably abundant but Sooty Oystercatchers were infrequently recorded.

Beach Thick-knees were recorded on six occasions from the ground and 34 from the air, totalling 58 individuals. Using a similar combination of surveys to those used above to estimate the group 1 total, the estimated peak number of Beach Thick-knees in this survey block totals around 40. This is likely an underestimate and distributional records suggest a population of around 26 pairs.

Pied Oystercatchers were recorded on two occasions from the ground and 34 from the air, totalling 64 individuals. Surveys in November 1993, which covered most of the survey block coast, recorded 29 Pied Oystercatchers. There were no other large groups detected in other surveys to suggest that this figure should be increased greatly.

Sooty Oystercatchers were recorded on one occasion from the ground and four from the air, totalling nine individuals. The survey in November 1993, which covered most of the survey block coast, counted three Sooty Oystercatchers. There were no other large groups detected in other surveys to suggest that this figure should be increased greatly.

Little evidence of breeding was recorded. A single record of Beach Thick-knee on an egg was made in late September 1996 and two defending birds in late July 1996 in another area could have also been breeding. A defending pair with a full grown juvenile at a third site also suggested recent breeding in that area. A pair of strongly defending Pied Oystercatchers in September 1996 and Sooty Oystercatchers in October 1994 at different locations also strongly suggested breeding in their respective areas.

SURVEY BLOCK 11 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Nil	Lesser Sand Plover	Nil	Group 1 – 2 000
	Bar-tailed Godwit		
	Red-necked Stint		Group 2 – 86
	Grey-tailed Tattler		
	Curlew Sandpiper		

Plate 11. Coastline typical of south east Groote Eylandt and not highly suitable to shorebirds, March 1994. Photo R. Chatto.

Survey Block 12

Location

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 main 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 in from the coast they are mostly open and saline. There is not much freshwater wetland in this survey 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 one of the lesser amounts of survey effort with approximately 60 hours of surveys during the period of this project. This represented approximately 3.2% 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 spread over only 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 41). There were 16 separate ground surveys involving 14 different and well-spread sites.

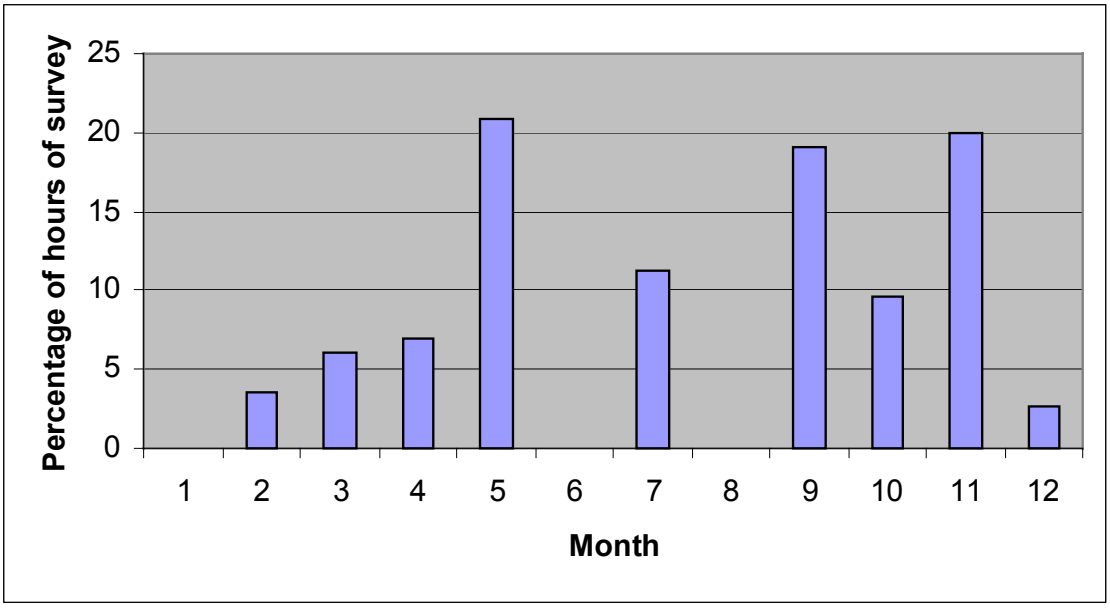


Figure 41. Average percentage of surveys hours relating to shorebirds for survey block 12.

Results and Discussion

Most shorebirds were distributed in the northern and southern coastal sections of this survey block. The only inland freshwater areas to have reasonable numbers of shorebirds were those running in to the southern part of Blue Mud Bay. The forest backed narrow sandy beaches along the central part of the coast in this block only had a scattering of a small number of species.

There were 411 separate shorebird records made for this survey block totalling over 29 769 birds (Figure 42). These records represented only 3.2% of the records and 1.4% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

Twenty species of shorebirds (17 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. There were only three sites recorded with single flocks of over 2 000 shorebirds. Two were in the northern part of the survey block (in the southern part of Blue Mud Bay) and the third was in the southern part of the block.

A fixed wing survey of the coast in November 1993 recorded just over 12 000 group 1 shorebirds. Ground counts from helicopter surveys of a sample of sites a little in from the coast and not covered by the 1993 aerial surveys recorded just over 4 200 shorebirds in October 1996. Combined, the two surveys still do not cover all areas, but there would have to be at least 20 000 group 1 shorebirds in the block around this time of year.

Fixed wing surveys similar to those done in November 1993 were also done in late March 1994 (just over 6 400 birds) and mid July 1996 (just over 2 100). These suggest many birds have started to leave by late March and most are gone by mid July, with there being no clear indication of an over-wintering influx of birds in this survey block.

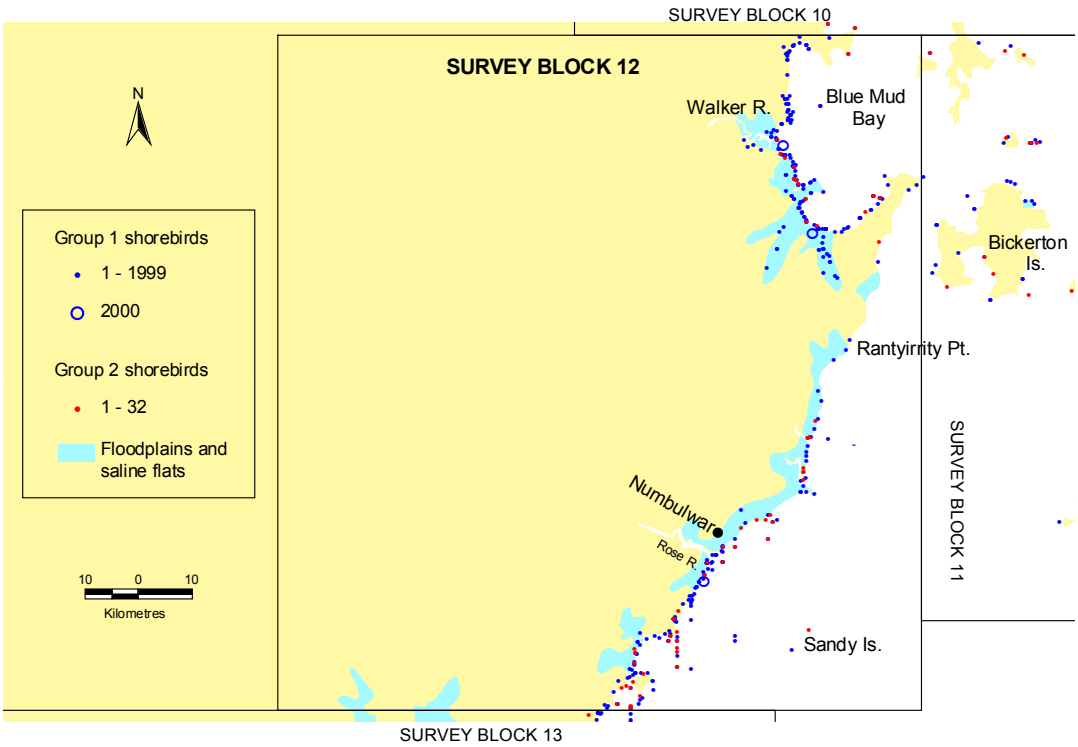


Figure 42. Distribution of shorebird records for survey block 12.

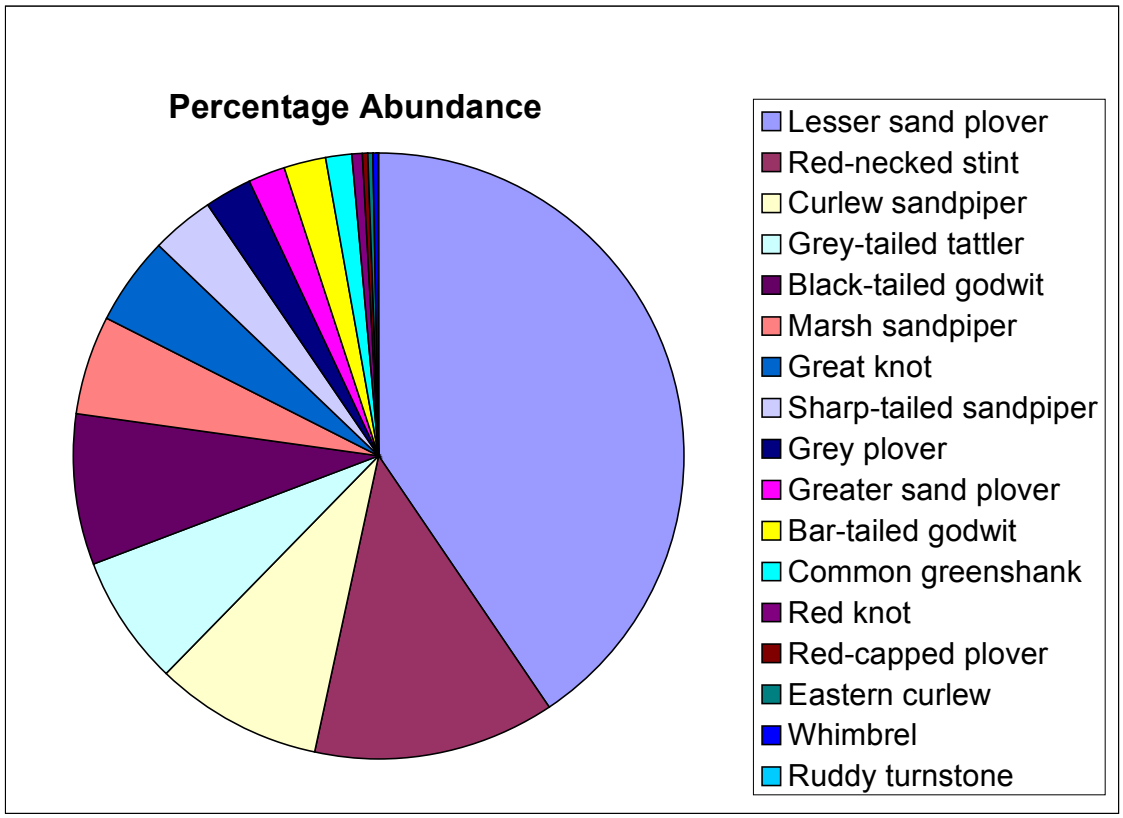


Figure 43. Average percentage abundance of group 1 species in survey block 12.

No counts were done in September so any Red Knots temporarily passing through, as reported by Garnett (1986), may have been missed. However, the relatively low percentage abundance of Great Knots may mean that the area is not particularly suitable for knots.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 43.

The most abundant group 1 shorebird recorded in ground surveys for this survey block was clearly the Lesser Sand Plover, but again there was only a relatively small number of ground surveys in this block. The next most abundant species were Red-necked Stints, Curlew Sandpipers and Grey-tailed Tattlers. It is possible that Black-tailed Godwits which were frequently recorded in aerial counts, especially in Blue Mud Bay in the north of the block, may be considerably under-represented in these figures because very few ground counts were done in areas of likely higher numbers of this species. There were a number of species at the lower end of the abundance scale and also a number of species not recorded at all in the block. These latter include Terek Sandpipers. This is the only block for which this species was not recorded, although it is certainly less common in the south east of the Top End, as the individual species section will discuss further.

The most frequently recorded species were the sand plovers but neither were recorded on more than four separate times. No group 1 species were confirmed breeding in this survey block.

This survey block had significant single records relating to only two species. Three counts of Lesser Sand Plover (between 400 and 600) at three different sites were all above the international 1% level. The highest count in this block was the second highest single flock record for all blocks. A single count of 200 Marsh Sandpipers was greater than the Australian 1% level but well down on high counts in other blocks.

Group 2 Species. All three group 2 species were recorded in this survey block but none were highly abundant.

Beach Thick-knees were recorded on one occasion from the ground and 11 from the air, totalling 15 individuals. The highest number of Beach Thick-knees recorded in a single survey in this survey block was only four, in a July 1996 survey. This is likely an underestimate and distributional records suggest a population of around five pairs.

Pied Oystercatchers were recorded on two occasions from the ground and 38 from the air, totalling 183 individuals. Fixed wing surveys in March 1994, which covered most of the survey block coast, recorded 67 Pied Oystercatchers. This was the highest count of the three full-coast fixed wing surveys and there were no other large groups detected in other surveys to suggest that this figure should be increased greatly.

Sooty Oystercatchers were recorded on one occasion from the ground and two from the air, totalling six individuals. The highest number of Sooty Oystercatchers recorded in a single survey in this survey block was only four, in an October 1996 survey. This is likely a fair estimate of the number of Sooty Oystercatchers in this survey block as they were always only recorded in the one area.

SURVEY BLOCK 12 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Blue Mud Bay	Lesser Sand Plover	Lesser Sand Plover (3)	Group 1 – 20 000
	Red-necked Stint		
	Curlew Sandpiper		Group 2 – 82
	Grey-tailed Tattler		
	Black-tailed Godwit		

Survey Block 13

Location

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 much in the way of shorebirds). 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 extensive and intensive along this part of the coast.

The survey block has a relative short 165 kilometres of coastline, but extensive (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 saline wetland in behind the coast, but in other areas the intertidal zone just merges in with open saline mudflats which extend many kilometres inland in some places. Mangroves dominate the banks of the rivers and 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 this survey block are saline. 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 surveys during the period of this project. This represented approximately 2.3% 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 only 20 separate days. There were no surveys in January or August, and apart from July, no months received many hours of shorebird dominated surveys (Figure 44).

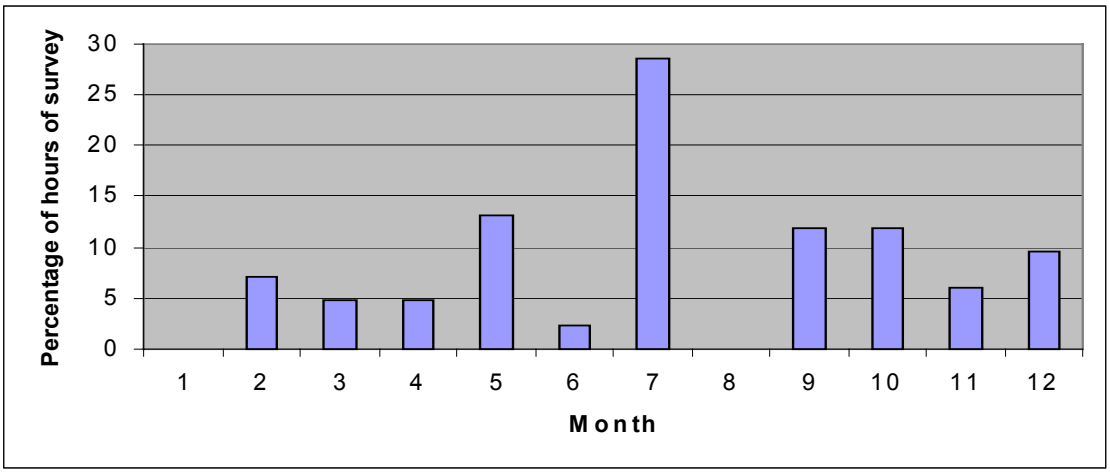


Figure 44. Average percentage of surveys hours relating to shorebirds for survey block 13.

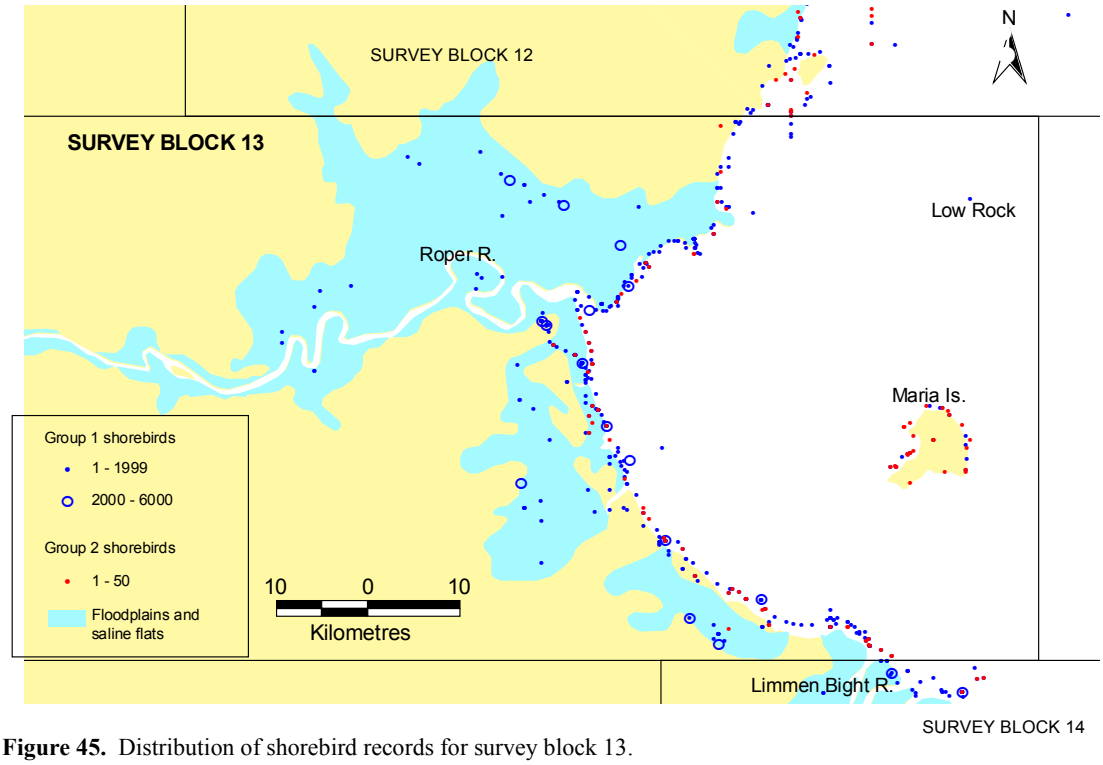


Figure 45. Distribution of shorebird records for survey block 13.

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 under-surveyed part of the coast.

Results and Discussion

Shorebirds were distributed throughout this small survey block, with coast and wetlands both well represented. There were 465 separate shorebird records made for this survey block totalling over 85 622 birds (Figure 45). These records represented only 3.6% of the records and 4.1% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project. The full extent of the Roper River upstream wetlands are not included in Figure 45 as there were no shorebirds recorded during the single survey of this area.

No specific areas were selected from this survey block to individually discuss in this section because the small size of the block means that any such areas are little different to discussions below on the total area.

Twenty-two species of shorebirds (20 group 1 and 2 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. Group 1 shorebirds were located all along the coast of this survey block and over a lot of the inland wetlands. There were numerous, well spread sites with single flocks of over 2 000 shorebirds recorded.

The November 1993 surveys, which have given good coverage of the survey blocks to the north of here, were not of great value in this block because here the tides were low for the whole survey. (In this area tides can be out all day). This means shorebirds are very dispersed over a lot of exposed mud flat and are difficult to properly survey. The best count, in terms of covering the whole survey block in one survey, was done in late March 1994. This was a helicopter survey which included ground and aerial counts done along the coast when flying south, then of inland wetlands when coming back northwards. This revealed just over 38 000 group 1 shorebirds. Most were along the coast and saline wetlands just in from the coast, but the extensive downstream wetlands of the Roper River also had

quite good numbers. Unfortunately this count was done at a time when a number of the migratory shorebirds would have departed, so probably is an under-estimation of minimum peak numbers for this survey block.

In terms of comparing different times of year, similar surveys were done in February (1996), March (1994) and September (1993). These were not full block surveys but covered approximately the same sections of the block and were all done in a fixed wing. These recorded just under 8 000, just over 13 000 and just over 11 000 respectively. One possible conclusion from these figures, in very general terms, is that there is an increase in numbers of the migratory species just before the departure. The latter count (September) may also have been prior to the arrival of some species, particularly Red Knots, which may only remain for a short period before continuing their migration further south.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 46.

The most abundant migratory shorebird recorded in this survey block was the Red Knot, which made up over 25% of the group 1 shorebirds. However, it needs to be taken into account that within this survey block there were not many ground counts done for shorebirds and all were done in July and October of 1996. This would have had an influence on the percentage abundances of the individual species because of differences in arrival and departure times. A large count of Red Knots, which arrive and stay only for a short time before moving on, at least in their southward migration, may have influenced their high percentage in this survey block.

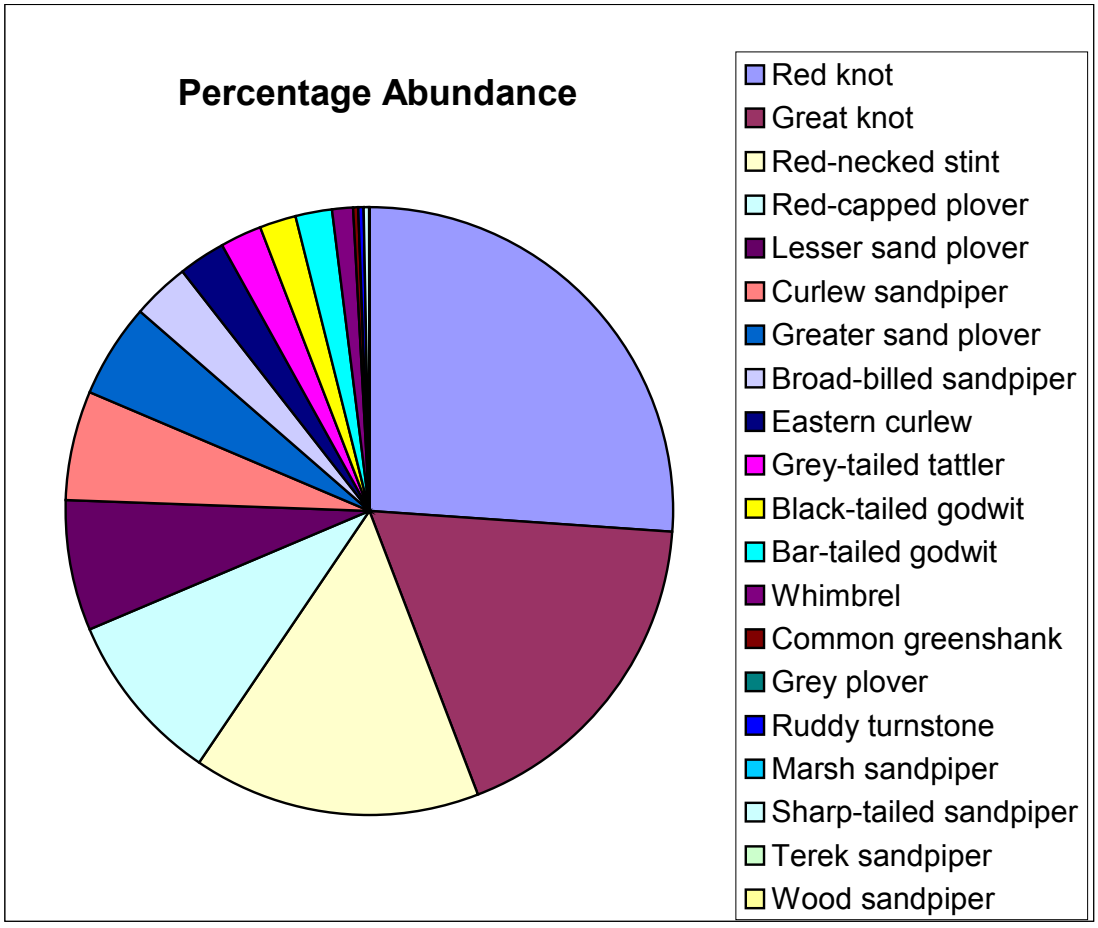


Figure 46. Average percentage abundance of group 1 species in survey block 13.

The next most abundant species were Great Knots, Red-necked Stints, Red-capped Plovers and Lesser Sand Plovers. This is the only survey block in which Red-capped Plovers were in the top five. The number of Red-capped Plovers is quite significant and they are probably even more abundant than these results suggest because they spread throughout the saline wetlands of the survey block and these were not always covered. Of those species confirmed in the block, Wood, Terek, Sharp-tailed and Marsh Sandpipers were the least abundantly recorded.

In surveys near the mouth of the Roper River in late March 1990 Garnett and Taplin (1990) also recorded knots as the most abundant species. Although much fewer in number, they reported Black-tailed Godwits as the next most abundant species. Garnett and Carruthers (1982b) stated that surveys done along the coast south of the Roper River in February 1982 were dominated by Black-tailed Godwits. Black-tailed Godwits, a species easy to see from the air, were not a dominant species in my surveys of this coast, which included February and March aerial surveys, and surveys spread over many years. Although Black-tailed Godwits are a species that is subject to seasonal variation, perhaps the migratory shorebird species breakdown of this part of the Top End coast may have changed since the early 1980's. This comment would also relate to survey block 14.

The species recorded on the greatest number of individual occasions from ground surveys were Lesser Sand Plovers, but this species was only recorded on seven occasions. Both species of godwit, Whimbrels and Grey Plovers were also recognised from the air on a number of additional occasions. There were a number of other species recorded five and six times, but ten species were not recorded at all in this survey block. It is likely that the limited number of ground surveys would mean that some of these species could have been present in the survey block but not at the ground sites that were surveyed.

This survey block had a five single records that were in the highest five for all surveys in this project, and/or were above the international or Australian 1% levels (Table 11). There were two sites involved with the high Red-capped Plover counts listed in this table.

A pair of Red-capped Plovers was recorded on a single egg in May 1999. This was the only confirmed breeding record for a group 1 shorebird in this block.

Group 2 Species. All three group 2 species were recorded in this survey block but only Pied Oystercatchers were reasonably abundant.

Beach Thick-knees were not recorded from the ground and were recorded 12 times from the air, totalling 24 individuals. The highest number of Beach Thick-knees recorded in a single survey in this survey block was eight, in a December 1993 survey. This did not include any area north of the Roper River, which does have Beach Thick-knees. Distributional records suggest a population of around 10 pairs.

Pied Oystercatchers were recorded on five occasions from the ground and 50 from the air, totalling 393 individuals. The highest number of Pied Oystercatchers recorded in a single survey in this survey block was 61, in a December 1998 survey. This did not include any area north of the Roper River which, in another survey (September), had 15 birds recorded. Thus a minimum peak number estimate for Pied Oystercatchers in this survey block would be around 76 birds.

Table 11. Significant single records for survey block 13. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Red Knot	October	1500	✘	✘	2
Broad-billed Sandpiper	July	200	✔	✔	=1
Red-capped Plover	July	300	✘	✘	=3
Red capped Plover	July	300	✘	✘	=3
Lesser Sand Plover	October	280	✔	✔	Not in top 5

Sooty Oystercatchers were recorded on one occasion from the ground and 12 from the air, totalling 21 individuals. The highest number of Sooty Oystercatchers recorded in a single survey in this survey block was 12, in a March 1994 survey. This is likely a fair estimate of the number of Sooty Oystercatchers in this survey block. All, apart from a couple of sites on the mainland coast, were around Maria Island.

A pair of Sooty Oystercatchers was recorded as probably breeding in October 1996.

SURVEY BLOCK 13 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Most of coast and adjacent saline wetlands between the Roper and Limmen Bight Rivers.	Red Knot Great Knot Red-necked Stint Red-capped Dotterel Lesser Sand Plover	Broad-billed Sandpiper (1) Lesser Sand Plover (1)	Group 1 – 38 000 Group 2 – 118

Plate 12. Typical habitat along the coast between the Roper and Limmen Bight Rivers, showing the band of saline wetland in behind the coast, December 1998. Photo R. Chatto.

Survey Block 14

Location

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, however, there are no towns, property residences 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 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. However, this is simply because this is a small survey block. Like the previous survey block, virtually the entire coast of 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 along here. In other areas there is virtually no real definable coast as it just merges in with open saline mudflats which extend many kilometres inland in some places. There are a small number of freshwater wetlands associated with the Limmen Bight River, but most of the wetlands in this survey block are saline.

Survey Effort

This survey block also received one of the lesser amounts of survey effort with approximately 40 hours of surveys during the period of this project. This represented approximately 2.3% of the hours of survey in all survey blocks combined. Again the relatively low number of hours is partly due to the small size of the block. These surveys were spread over only 19 separate days. There were no surveys in January, June or August, and apart from May, July and September, no months received many hours of shorebird dominated surveys (Figure 47). There were eight separate ground surveys involving six different and well-spread sites.

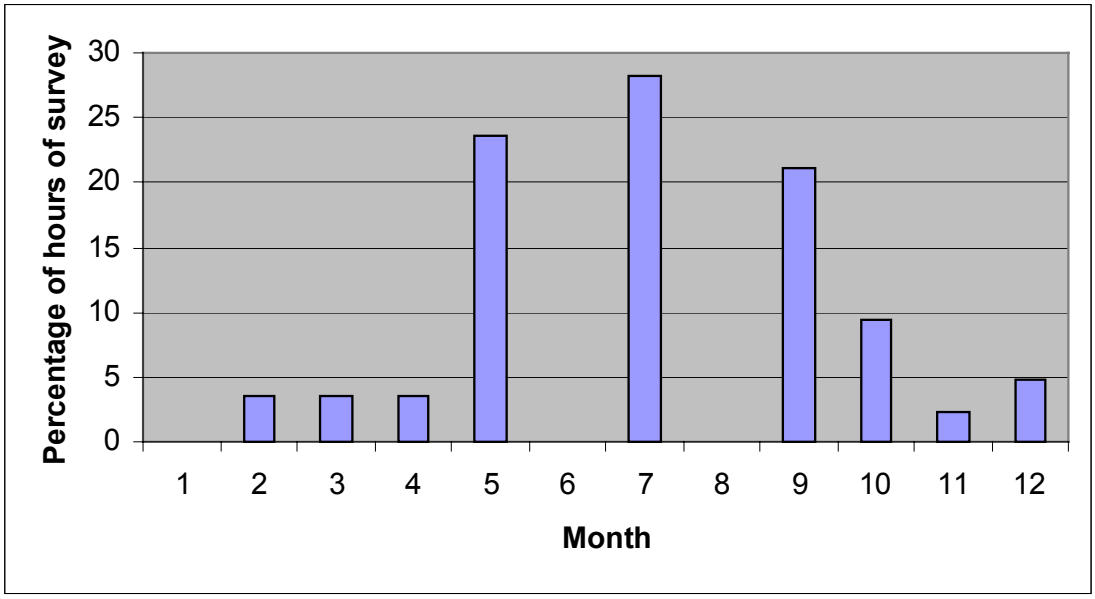


Figure 47. Average percentage of surveys hours relating to shorebirds for survey block 14.

Results and Discussion

Shorebirds were distributed all along the coast and adjacent saline wetlands of this survey block. Unlike the Roper River wetlands those associated with the Limmen Bight River had few shorebirds recorded on them, however the delta system associated with the Limmen Bight River was dominated by mangroves rather than open wetlands.

Within this survey block 416 separate shorebird records were made totalling over 43 291 birds (Figure 48). These records represented only 3.2% of the records and 2.1% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

No specific areas are selected from this survey block to individually discuss in this section because the small size of the block means that any such areas are little different to discussions below on the total area.

Twenty species of shorebirds (19 group 1 and 1 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. Group 1 shorebirds were recorded along the entire coastline of this block. They were also recorded on the saline flats just in from the coast but densities were not as high. All but one of the five single flocks of over 2 000 shorebirds were on the coast in the vicinity of the Limmen Bight River (Figure 48).

This survey block had similar surveys to the previous block. Differences in numbers recorded in surveys of these two blocks at the same time of the year suggest birds may begin leaving before, and arriving after, from the more southern part of the Gulf of Carpentaria compared to sites further to the north. This was also suspected on the western side of the Top End although neither can be confidently stated in light of this small amount of data.

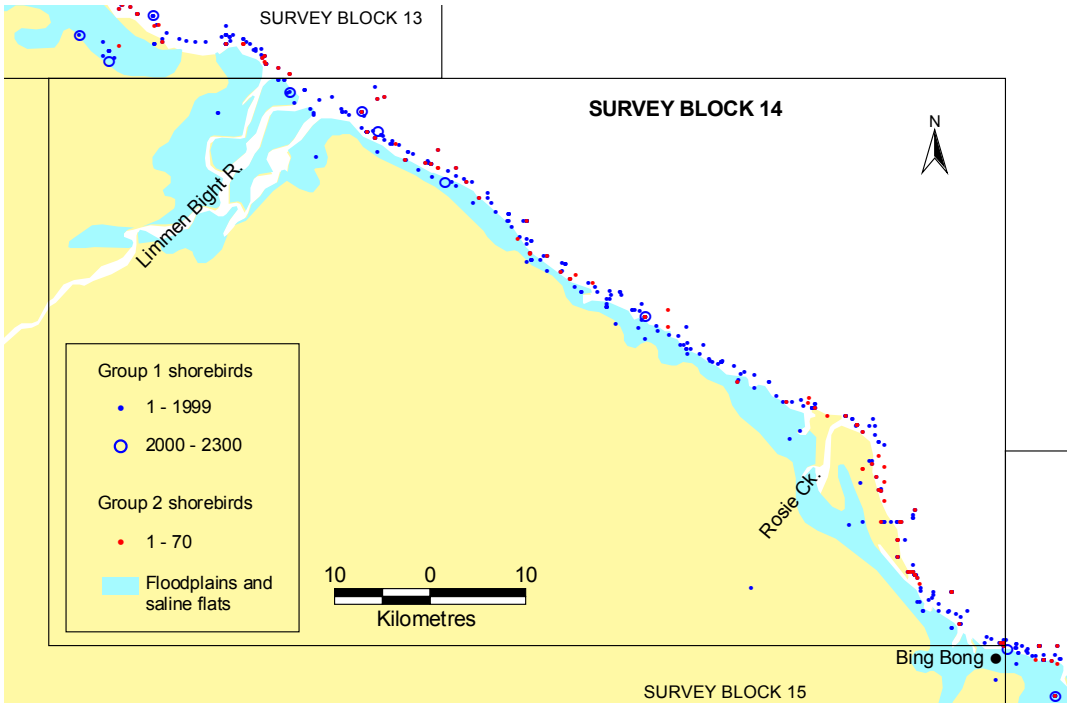


Figure 48. Distribution of shorebird records for survey block 14.

The highest count in a single survey for this block was in September 1993, but it did not include the surveying of inland wetlands. This recorded just over 11 000 group 1 shorebirds. No other partial counts suggested this figure should be much higher so this remains the estimate for the highest number of group 1 shorebirds for this survey block during these surveys.

Aerial surveys that were comparable to this September 1993 count were done along the coast in February 1996 (a little under 8 000 birds), July 1996 (just over 3 000 birds) and December 1998 (just over 6 000 birds). These show that the September 1993 count was the highest of these four time periods. It may also suggest that there is a loss of migratory species after September (eg continued passage migrants). The counts also suggest numbers start building up prior to migration in February and that most birds have left the area in July. Of course more survey work and analysis of the data is needed before such suggestions could be more confidently stated.

The average percentage abundance, largest single record (with month of record), and number of separate ground and aerial counts for each group 1 species, from all surveys for this block, are detailed in Appendix A. The average percentage abundance is also diagrammatically shown in Figure 49.

The most abundant group 1 shorebirds recorded in this survey block were Great Knots (which was recorded at more than three times the abundance of the next most abundant species), Grey-tailed Tattlers, Red-necked Stints and both of the sand plover species. Of those species confirmed in the survey block Broad-billed Sandpipers, Terek Sandpipers and Whimbrels were least abundantly recorded in ground surveys.

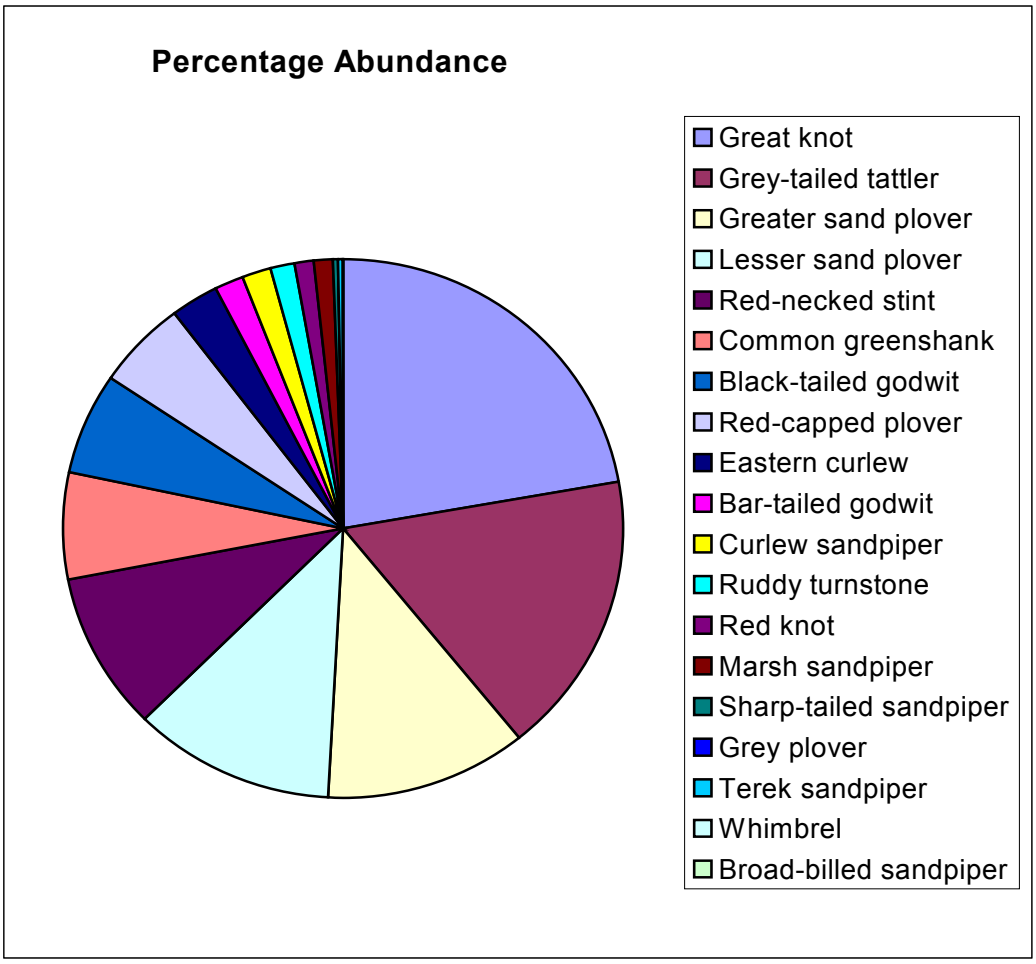


Figure 49. Average percentage abundance of group 1 species in survey block 14.

The species recorded on the highest number of separate ground counts were Common Greenshanks but they were only recorded on eight occasions. There were a number of species recorded six and seven times but 11 species were not recorded at all in the survey block. It is likely that the limited number of ground surveys would mean that some of these species could have been present in the block but not the ground survey sites.

This survey block had only one significant single flock count of any of the group 1 species. This was a single record of 500 Grey-tailed Tattlers. Although greater than the international 1% level the count was not among the highest counts for this species over all survey blocks in these surveys.

There was a single confirmed record of one pair of Red-capped Plovers breeding along the coast in May 1999.

Group 2 Species. All three group 2 species were recorded in this survey block but only Pied Oystercatchers were reasonably abundant.

Beach Thick-knees were not recorded from the ground but were recorded 18 times from the air, totalling 26 individuals. The highest number of Beach Thick-knees recorded in a single survey in this survey block was eight, in a July 1998 survey. Distributional records suggest a population of around seven pairs.

Pied Oystercatchers were recorded on eight occasions from the ground and 40 from the air, totalling 470 individuals. The highest number of Pied Oystercatchers recorded in a single survey in this survey block was 142 in a May 1999 survey. There were no other surveys that suggested this number should be increased.

Sooty Oystercatchers were not recorded from the ground and were recorded only once from the air, totalling four individuals. It is unlikely that the peak population of Sooty Oystercatchers would be much higher than this number.

There were three separate confirmed records of Pied Oystercatchers breeding, two in September 1994 and one in October 1996.

SURVEY BLOCK 14 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Limmen Bight R. mouth	Great Knot Grey-tailed Tattler Greater Sand Plover Lesser Sand Plover Red-necked Stint	Grey-tailed Tattler (1)	Group 1 – 11 000 Group 2 – 160

Survey Block 15

Location

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 Islands. These islands have a wide range of habitats. Closer to the coast 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 they have a few outstations and tourist camps on them. Fishing/tourist camp usage has 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 of 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 of this block. The McArthur River mine shipping dock is on the coast in the western part of this block.

This survey block has a very diverse range of shorebird habitats. It has a fairly long coastline of approximately 900 kilometres and substantial wetland 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 islands to the coast adjacent to the eastern end of the Pellews. 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 into the sea. Most of the block has extensive wetlands adjacent to the coast. In some areas these wetlands extend in for large distances (such as the Port McArthur area) but in other areas they do not extend very far inland (such as much of the coast near the Queensland border). The majority of the huge expanses of wetland are open, bare, saline flats. They are among the most extensive coastal saline flats around the Northern Territory coast.

Survey Effort

This survey block received approximately 140 hours of 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 31 separate days. There was little or no surveying done in January, April or August (Figure 50). All other months had a reasonable amount, with May receiving the most. September, October and November were also well represented. There were 101 separate ground surveys involving 72 different and well-spread sites.

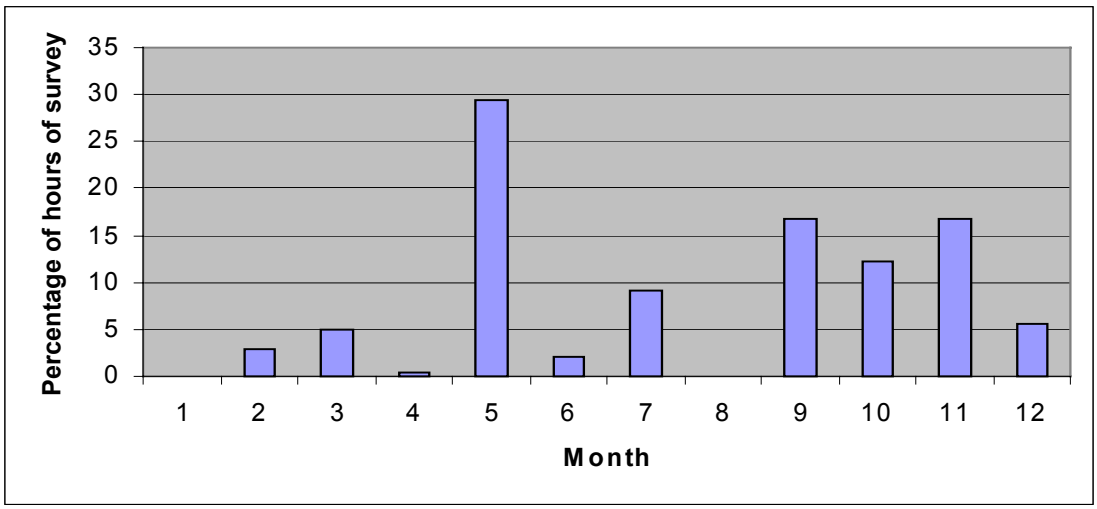


Figure 50. Average percentage of surveys hours relating to shorebirds for survey block 15.

Results and Discussion

Shorebirds were distributed all around the coast, the wetlands near the coast and the islands of this survey block. The largest numbers of group 1 shorebirds were along the coast and adjacent wetlands in the western half of the survey block, while the group 2 species were spread relatively evenly along the coast and adjacent islands. The extensive inland wetlands around the McArthur and Wearyan Rivers, which were mainly open, saline flats, were not observed to have large numbers of shorebirds. Those that were present were dominated by species, such as Red-capped Plovers. Most shorebirds were observed around the coast and the immediately adjacent saline wetlands.

Within this survey block 905 separate shorebird records were made totalling over 93 823 birds (Figure 51). They represented 7% of the records and 4.5% of the total numbers of shorebirds recorded in the fifteen survey blocks of this project.

One area, Port McArthur, had counts that would qualify it for listing under the East Asian-Australasian Shorebird Site Network. The coast and the immediately adjacent saline wetlands of this area had a highest single survey shorebird count of nearly 27 500 in mid October 1996. This total involved ground counts at 11 different sites and a little aerial counting between sites. As such it would have covered around 50% to 75% of the potential shorebird habitat along the coast and immediately adjacent wetlands. The second highest count was in excess of 25 500 in mid September 1993. This count was made during aerial surveys covering more than 75% but less than 100%of the potential habitat. This site is discussed in greater detail in Chatto (2000a).

Garnett (1987) reports an average of 530 (summer) and 240 (winter) shorebirds in this area. This is a lot less than my counts. I did surveys of this area on many occasions and, although usually recording many thousands of shorebirds in this area, there was the occasional survey that recorded numbers that were only in the hundreds. This is not because of a great change in the numbers but due to the difficulty of finding all birds in such an area. The Port McArthur area is a particularly complex area, with many mangrove islands, channels and open saline flats. Sometimes the survey route, which cannot cover the whole area without a large amount of flying time, does not fly over some of the large roosts that can vary in location in different weather conditions and tide heights.

Twenty-six species of shorebirds (23 group 1 and 3 group 2) were recorded throughout the project in this survey block (Appendix A).

Group 1 Species. Group 1 shorebirds were located all along the coast and coastal wetlands of this survey block. They were also quite commonly recorded around the islands of the Sir Edward Pellews. The western mainland coast had the highest densities of group 1 shorebirds and there were numerous roosts of more than 2 000 birds in this area but few elsewhere (Figure 51).

In order to estimate the largest number of group 1 species in this complex block, surveys from four separate sections are used. All but one of these were in the September/October period. Unfortunately there were no surveys at this time for the eastern section of the block and a late March survey was used to provide an estimate of the number of birds in that section. As many of the migratory birds had departed the number counted at this time would probably be less than the September/October period used for the other sections. Also the count from most of the Port McArthur area, which has the highest densities of group 1 shorebirds, only involved totalling a series of ground survey sites. This was done by helicopter, which because of the cost, had to fly a direct route between sites and consequently miss other areas with birds present. With all this in mind, a conservative estimate of the largest number of group 1 shorebirds to have been present in this survey block during the project would be at least 43 000. However, this is likely to be well under the true peak number.

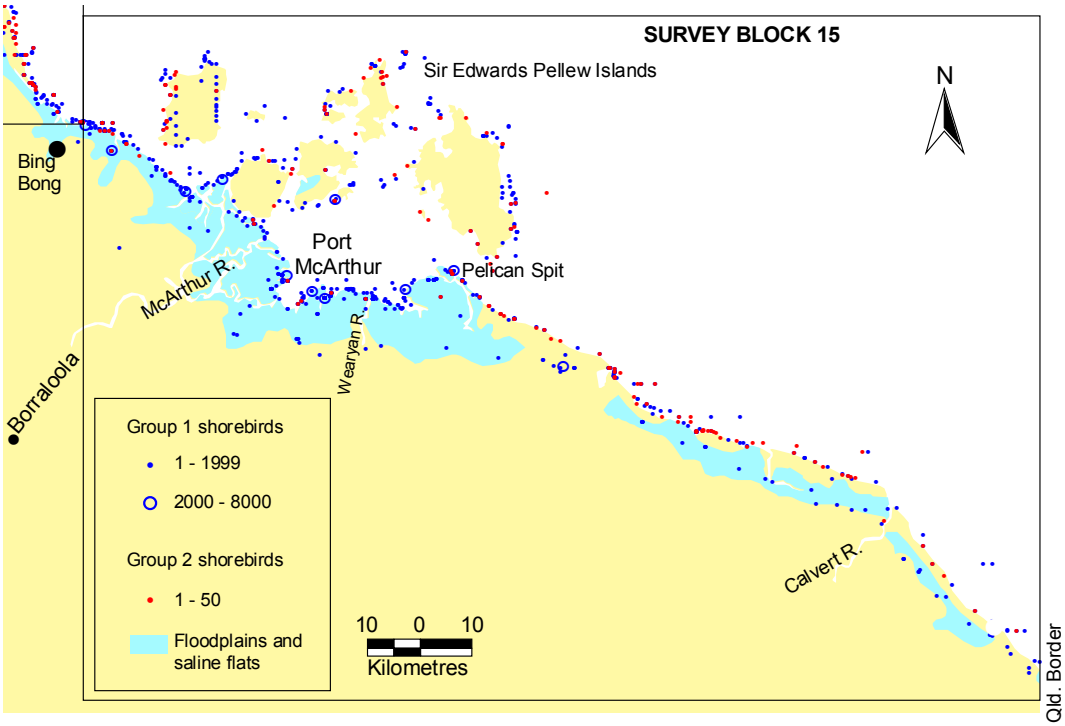


Figure 51. Distribution of shorebird records for survey block 15.

Plate 13. A small portion of the extensive saline flats in behind the coast in the Port McArthur area, September 1996. Photo R. Chatto.

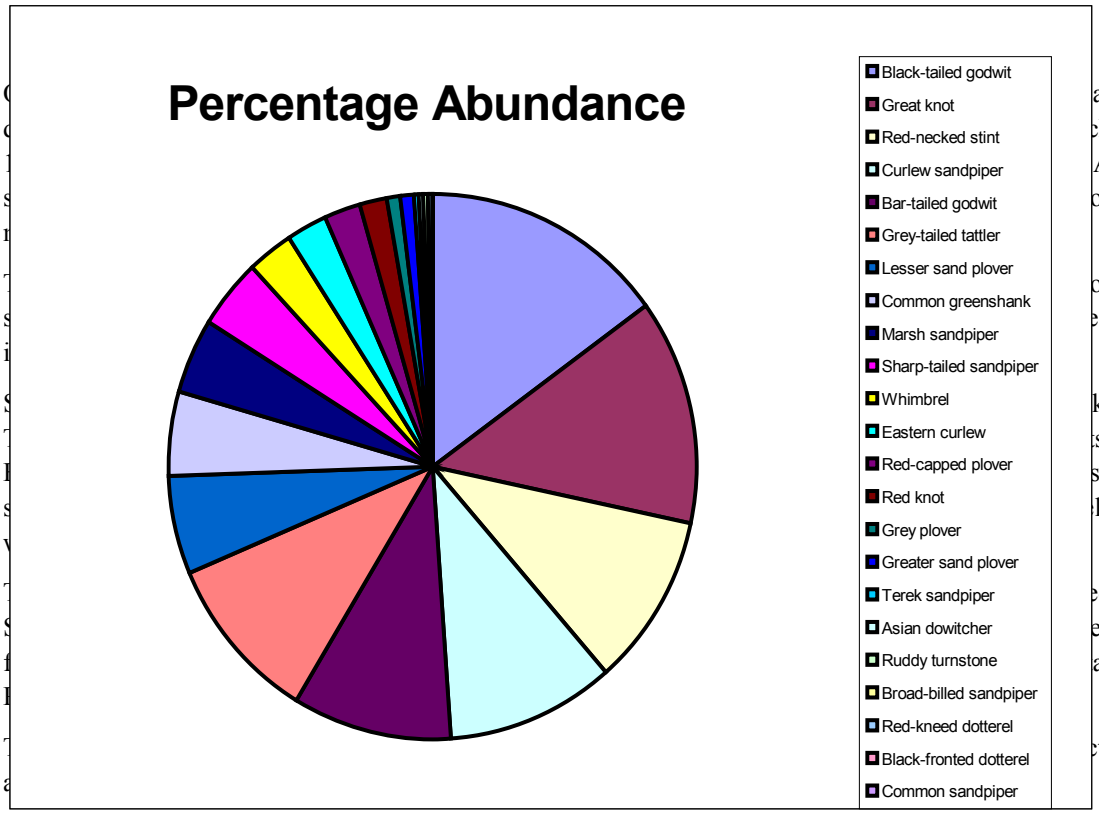


Figure 52. Average percentage abundance of group 1 species in survey block 15.

Table 12. Significant single records for survey block 15. (✔ = greater than and ✘ = less than).

Species	Month	Single flock count	>1% Aust. Level	>1% International Level	Rating for all surveys this project
Black-tailed Godwit	October	1730	✔	✔	Not in top 5
Black-tailed Godwit	October	1600	✔	✔	Not in top 5
Black-tailed Godwit	October	1000	✔	✔	Not in top 5
Bar-tailed Godwit	October	2400	✔	✘	3
Whimbrel	October	350	✔	✘	2
Whimbrel	October	200	✔	✘	=4
Whimbrel	July	200	✔	✘	=4
Whimbrel	May	150	✔	✘	Not in top 5
Eastern Curlew	July	300	✔	✔	=5
Marsh Sandpiper	October	640	✔	✘	3
Marsh Sandpiper	October	400	✔	✘	Not in top 5
Marsh Sandpiper	May	260	✔	✘	Not in top 5
Common Greenshank	October	500	✔	✔	1
Common Greenshank	October	400	✔	=	3
Common Greenshank	July	270	✔	✘	Not in top 5
Grey-tailed Tattler	October	1000	✔	✔	1
Grey-tailed Tattler	September	660	✔	✔	2
Grey-tailed Tattler	October	520	✔	✔	5
Grey-tailed Tattler	July	400	✔	✘	Not in top 5
Ruddy Turnstone	September	150	✔	✘	5
Asian Dowitcher	July	70	?	?	1
Asian Dowitcher	October	20	?	?	2
Red-necked Stint	July	1000	✘	✘	3
Curlew Sandpiper	September	750	✘	✘	1
Lesser Sand Plover	October	550	✔	✔	Not in top 5
Lesser Sand Plover	October	300	✔	✔	Not in top 5
Lesser Sand Plover	October	250	✔	✘	Not in top 5

The number of separate sites involved for species where more than one count is listed in the above table are: Black-tailed Godwit (2), Whimbrel (2), Marsh Sandpiper (3), Common Greenshank (2), Grey-tailed Tattler (3), Asian Dowitcher (1) and Lesser Sand Plover (2).

There were four separate instances between May and October of single pairs of Red-capped Plovers breeding. (In one instance a single egg was laid on a dried 'cow-pat' on the beach).

Group 2 Species. All three group 2 species were recorded in this survey block but Sooty Oystercatchers were not very abundant.

Beach Thick-knees were recorded on nine occasions from the ground and 37 from the air, totalling 72 individuals. Because of the complication of comparing individual surveys to obtain survey block totals of Beach Thick-knees, the distributional records only were used to estimate the survey block total population. This suggests a population of around 24 pairs.

Pied Oystercatchers were recorded on 13 occasions from the ground and 70 from the air, totalling 363 individuals. The highest number of Pied Oystercatchers recorded in a single survey in this survey block was 98 in a late March 1994 survey. There were no other surveys that suggested this number should be increased.

Sooty Oystercatchers were recorded on four occasions from the ground and eight from the air, totalling 27 individuals. The highest number of Sooty Oystercatchers recorded in a single survey in this survey block was six in a late March 1994 survey. There were no other surveys that suggested this number should be increased.

There were three separate instances of confirmed or strongly suspected breeding of Sooty Oystercatchers (around September/October) and two of Pied Oystercatcher (June and October).

SURVEY BLOCK 15 SUMMARY

IMPORTANT AREAS	MOST ABUNDANT SPECIES (Top Five)	SPECIES WITH NUMBERS > 1% OF AUST. POPULATION AT A SINGLE SITE (No. of different sites)	MINIMUM ESTIMATE OF PEAK SURVEY BLOCK POPULATION
Port McArthur	Black-tailed Godwit	Black-tailed Godwit (2)	Group 1 – 43 000
	Great Knot	Bar-tailed Godwit (1)	
	Red-necked Stint	Whimbrel (2)	Group 2 – 142
	Curlew Sandpiper	Eastern Curlew (1)	
	Bar-tailed Godwit	Marsh Sandpiper (3)	
		Common Greenshank (2)	
		Grey-tailed Tattler (3)	
		Ruddy Turnstone (1)	
		Lesser Sand Plover (2)	

Plate 14. Saline splash just in from the coast (just west of the Wearyan River) and used by thousands of shorebirds, October 1996. Photo R. Chatto.

SHOREBIRDS – BY SPECIES
GROUP 1 SPECIES

Snipe spp.

Geographic Distribution

The species of snipe recorded in these surveys is unknown. Based on other confirmed identifications in the Top End, most are likely to be Swinhoe's Snipe *Gillinago megala*. However, Niven McCrie (*pers. comm*.) suggests that records from the eastern Top End and records prior to October may be Latham's Snipe *Gillinago hardwickii*. In terms of this report my few records are referred to as *Snipe spp.*

Within this project *Snipe spp.* were only recorded on three occasions (Figure 53). These were from a wetland adjacent Joseph Bonaparte Gulf in mid March 1999, a wetland in Darwin in mid November 1990 and one on the outer Wessel Islands in mid November 1993. These surveys suggest that *Snipe spp.* are not widespread in the Top End. However, the surveys were clearly not designed or suited to locating the more secretive and cryptic species. They were only recorded by chance. There is a large amount of potential *Snipe spp.* habitat in the Top End so they could be more widespread than my records suggest.

Higgins and Davies (1996) show the Northern Territory distribution of Swinhoe's Snipe to be restricted to the north west of the Top End. This, along with McCrie's statement from above, suggests that the single record from the Wessel Islands may be a Latham's Snipe.

Numbers

There were three ground records totalling approximately 10 individual *Snipe spp*. These equate to <1% of all the group 1 species records from ground surveys and <1% of numbers. Thus *Snipe spp*. were one of the least frequently recorded and least abundant of the shorebirds recorded during these surveys.

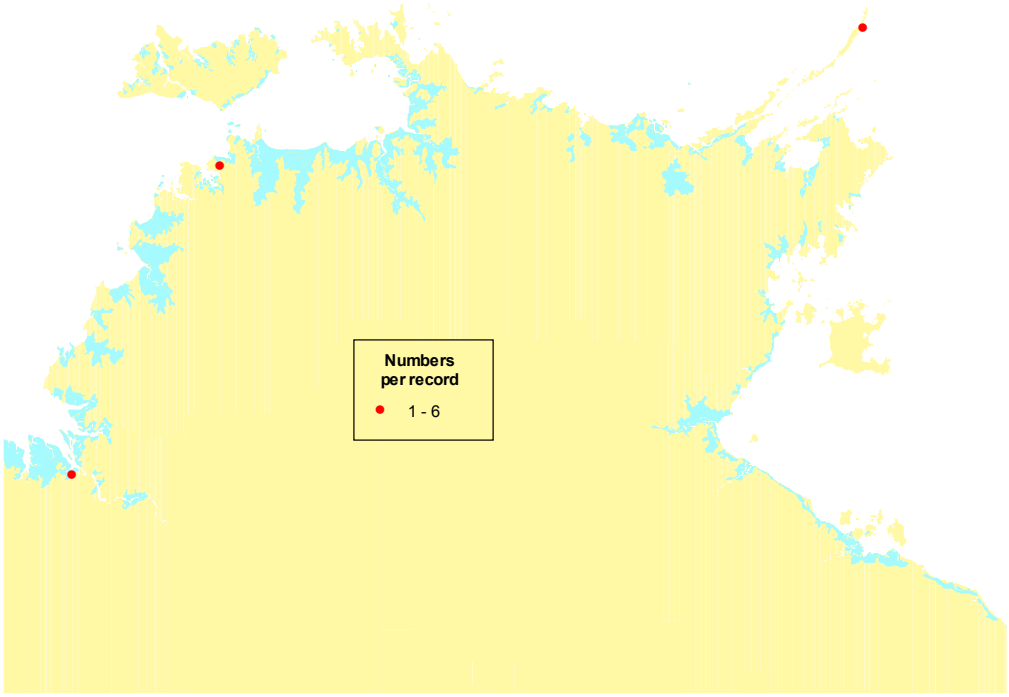


Figure 53. Distribution of all *Snipe spp.* records.

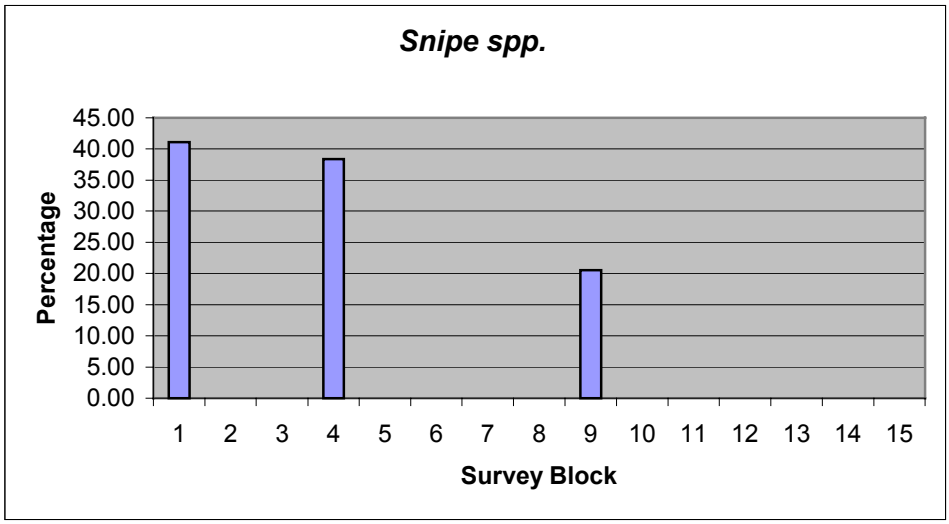


Figure 54. Percentage of *Snipe spp.* numbers by survey block.

Snipe spp. was recorded in survey blocks 1, 4 and 9 (Figure 54). Further details, by survey block, can be found in Table B1, Appendix B.

As well as suggesting that *Snipe spp.* are not widespread in the Top End these surveys also suggest that they are not abundant. Even though McCrie (*pers. comm.*) suggests that they are not uncommon around Darwin (up to 30 at one swamp), this may not be the case in other areas. Roger Jaensch (*pers. comm.*) failed to find any *Snipe spp.* in suitable habitat on Lake Finniss (near Darwin) in surveys on 1 September and 1 October 1993. Both Morton *et al* (1991) and Bamford (1990) rarely recorded them in surveys of the freshwater wetlands in Kakadu in the early 1980's and late 1980's respectively. G. Brennan lived on Groote Eylandt for 17 years and only reported the very occasional bird in that area (Noske and Brennan, 2002).

The calculated minimum estimate for the peak number of *Snipe spp.*, likely to have been present in the Top End during these surveys, is at least 20 birds. With single flocks of 30 reported, and this being a cryptic bird not well covered in my surveys, this estimate is obviously under the true figure.

Seasonality

There were insufficient records in these surveys to make any comment on *Snipe spp.* seasonality other than birds were recorded in March and November. Crawford (1997) recorded *Snipe spp.* at a swamp near Darwin on only two (December and February) of 12 consecutive monthly surveys in 1970/71. G. Brennan's observations of *Snipe spp.* on Groote Eylandt were in the months of November and December (Noske and Brennan, 2002). McCrie also says they are present in Darwin in November and December.

Breeding Plumage

No comment is possible in this regard for this species.

SNIPE SPP. SUMMARY

Top End Distribution	Habitat	Status (See Page 13 for codes)	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	20	November to March at least.
	Islands	✔		
	Wetlands	✔		

Black-tailed Godwit

Geographic Distribution

Black-tailed Godwits were recorded from around most of the Northern Territory coast, particularly where there were extensive areas of mangroves and intertidal mudflats (Figure 55). Consequently, they were more common in larger bays around the coast. These included Fog and Anson Bay on the west coast, Chambers Bay east of Darwin, Boucaut, Castlereagh and Buckingham Bays in the north east, Blue Mud Bay on the east coast and the coast in the vicinity of the Roper River and the Port McArthur areas. Black-tailed Godwits were also recorded on inland swamps, though less frequently than on the coast.

Black-tailed Godwits were much less frequently recorded in the far south west, along the northern Tiwi Islands and Cobourg Peninsula coasts, and in the far north east of Arnhem Land. They were also uncommon on most of the islands around the Northern Territory, even the larger islands such as Groote Eylandt that were adjacent to mainland areas with good numbers of Black-tailed Godwits. As this species is one of the easiest migratory shorebirds to recognise from the air, it is unlikely that there would be many significant Black-tailed Godwit sites around the Northern Territory that would not have been observed in these surveys. The inclusion of G*odwit spp.* records does not increase the distributional range of Black-tailed Godwits (Figure 55).

It is also possible that this species may either arrive directly onto the southern part of the west coast (ie survey block 2) before the northern part (ie survey block 3) or move north along the coast after they have arrived. In survey block 3, eight out of the ten largest single counts for this species were in November or December, while for survey block 2 the top three were in August and September.

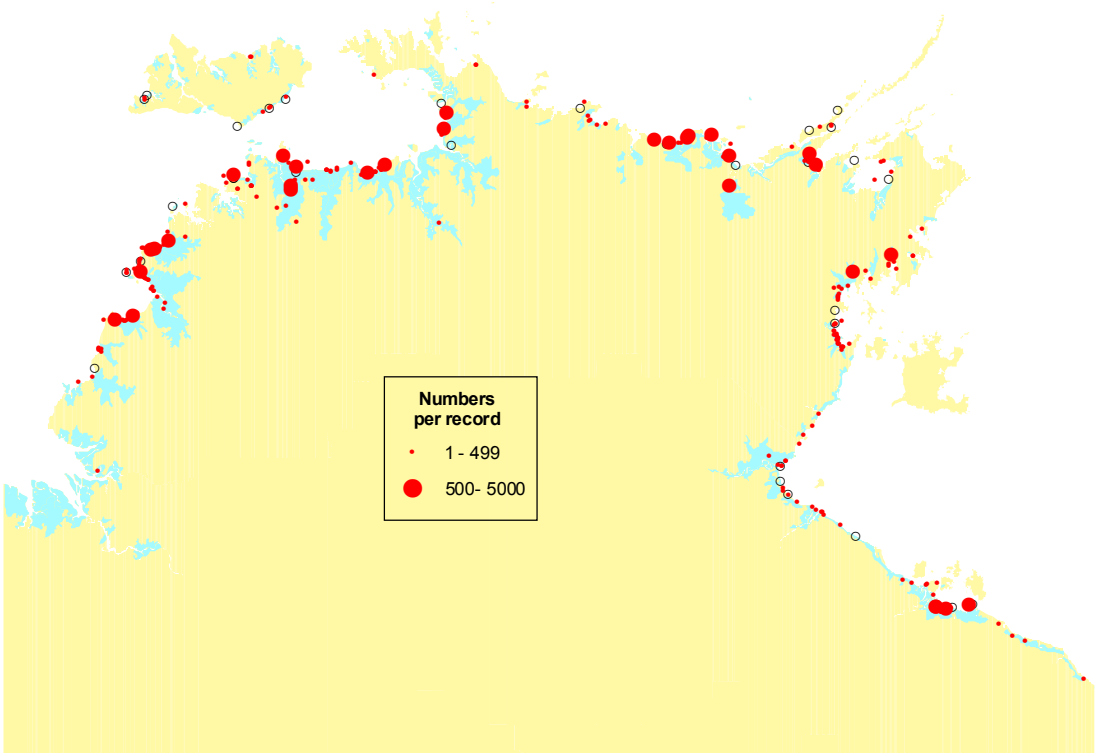


Figure 55. Distribution of all Black-tailed Godwit records. (Hollow black circles are *Godwit spp*. records).

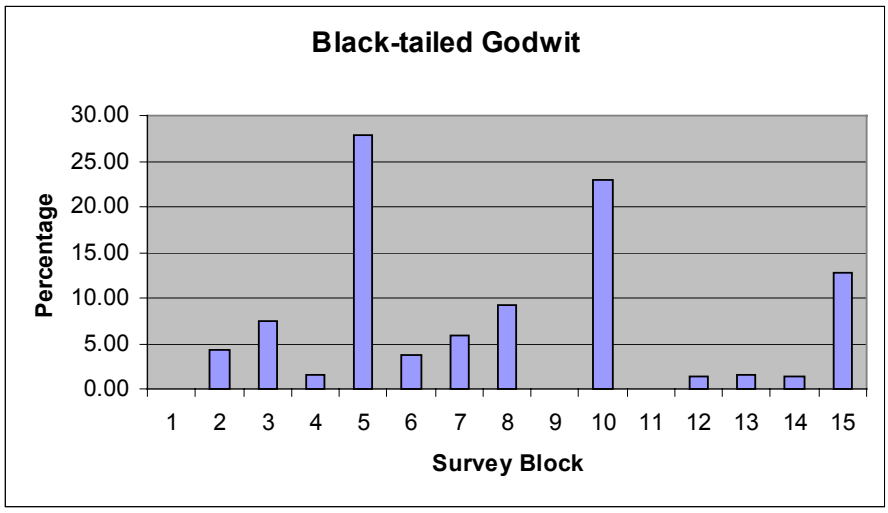


Figure 56. Percentage of Black-tailed Godwit numbers by survey block.

Numbers

Black-tailed Godwits were one of the more frequently recorded and most abundant of the shorebirds in these surveys. There were 130 ground records totalling approximately 35 000 birds. These equate to approximately 4% of all group 1 species ground records and 9% of numbers. Being more easily identifiable from the air there were also many (170) aerial records.

The highest numbers of Black-tailed Godwits were recorded in survey blocks 5, 10 and 15, while the lowest numbers were in survey blocks 1, 12, 13 and 14 (Figure 56). This species was not recorded in survey blocks 9 and 11. Further details, by survey block, can be found in Table B2, Appendix B.

Roosting flocks of Black-tailed Godwits were consistently in the high hundreds or low thousands. The species had eight single flock counts of over 1 000 with the largest single group being 5 000. This latter count was recorded during an aerial survey in Buckingham Bay (survey block 10) in late March 1992. Adding the appropriate Black-tailed Godwit percentage of the '*wader spp*.' records on that day suggests there were at least 6 000 Black-tailed Godwits in this area at this time. Other important area counts include over 5 000 in Boucaut Bay (survey block 8) in late March 1999, and over 4 000 on a freshwater swamp in the northern part of Blue Mud Bay (survey block 10) in September 1996. There were also two single flock counts in excess of 2 000 birds on swamps about 20 kilometres inland from the coast on the Adelaide River floodplain (survey block 5). These latter two counts were on 16 July and 10 May, both of which are periods when most Black-tailed Godwits should be in the Northern Hemisphere.

The calculated minimum estimate of the peak number of Black-tailed Godwits, likely to have been present in the Top End during these surveys, is at least 44 000 birds.

Seasonality

There were no months of exceptionally large numbers of Black-tailed Godwits per record, but there were higher peaks in March and September (Figure C1, Appendix C). This may be due to a build up in average flock size prior to departing and then again on return from migration. After September the numbers per record remained high through to December, suggesting birds remain in the Top End. There was also a higher peak in July, further suggesting that good numbers of Black-tailed Godwits remain around the Top End coast during the Northern Hemisphere breeding season.

The number of Black-tailed Godwits as a percentage of the combined group 1 species numbers showed a peak in May (Figure C2, Appendix C). On the surface this is also hard to explain but a look at the individual May ground counts showed they were numerically dominated by a large count at an inland

site in survey block 5, which most species of group 1 shorebirds do not use. This is further compounded by a major exodus of shorebirds from along the coast prior to this survey.

The proportion of Black-tailed Godwits records of all species of group 1 shorebirds combined remained relatively constant throughout the year (Figure C3). This suggests that there were no major sudden changes in the frequency with which Black-tailed Godwits were recorded. It further suggests that there were no major changes in the overall distribution of Black-tailed Godwits during the year, regardless of the numbers of birds present. (The reasoning behind this is explained in the methods section).

Although masked by Red Knot movements Garnett (1986) found Black-tailed Godwits to be more abundant in the south-east Gulf of Carpentaria after September 1983, but suggested a possible protracted arrival. He also suspected departure was likely to have been rapid following 15 April, because his final count included many fat and vivid godwits on the verge of migration.

Although probably not directly comparable to the Top End, Minton (1995) reports Black-tailed Godwits departing from the Broome area of Western Australia in mid April. He also says they start arriving in the last two weeks of August, but most arrive in September. Lane (1987) reports they first arrive in the north west Western Australia in late August, but then numbers fall from September to mid November.

Breeding Plumage

Little data was collected on breeding plumage during these surveys but a few comments are drawn from general field notes. There were three references to large percentages of the birds being in full or near full breeding plumage in late March and late April, and three references there being little breeding plumage (but a few in near full) in mid July. As these references are so few in number little can be said other than the obvious: many departing birds are in full or near full breeding plumage before they depart, and that some birds remaining over winter still go into breeding plumage.

BLACK-TAILED GODWIT SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔✔	44 000	Many birds present all year, highest numbers between September and May
	Islands	✔		
	Wetlands	✔		

Bar-tailed Godwit

Geographic Distribution

Bar-tailed Godwits were recorded all around the Northern Territory coast and on most large islands and some smaller islands (Figure 57). Some of the more significant Bar-tailed Godwit areas had some overlap with significant Black-tailed Godwit areas. These included the coastal areas in the vicinity of Fog and Anson Bay on the west coast, Boucaut, Castlereagh and Buckingham Bays along the eastern part of the north coast, and the Port McArthur area in the south east. Bar-tailed Godwits were also recorded in significant numbers in some areas where the Black-tailed Godwits were not so numerous. These include the south east coast of the Tiwi Islands and the Cadell Straits south of Elcho Island.

Unlike Black-tailed Godwits, there were few sightings of Bar-tailed Godwit made in wetlands that were not close to the coast. Also unlike Black-tailed Godwits, there were no extensive areas of coast where Bar-tailed Godwits were not recorded. The inclusion of G*odwit spp.* records does not increase their distribution.

Numbers

Bar-tailed Godwits were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys. There were 211 ground records totalling approximately 42 000 individual birds. These equate to approximately 6% of all group 1 species ground records and 11% of their numbers. There were also 163 aerial records of Bar-tailed Godwits.

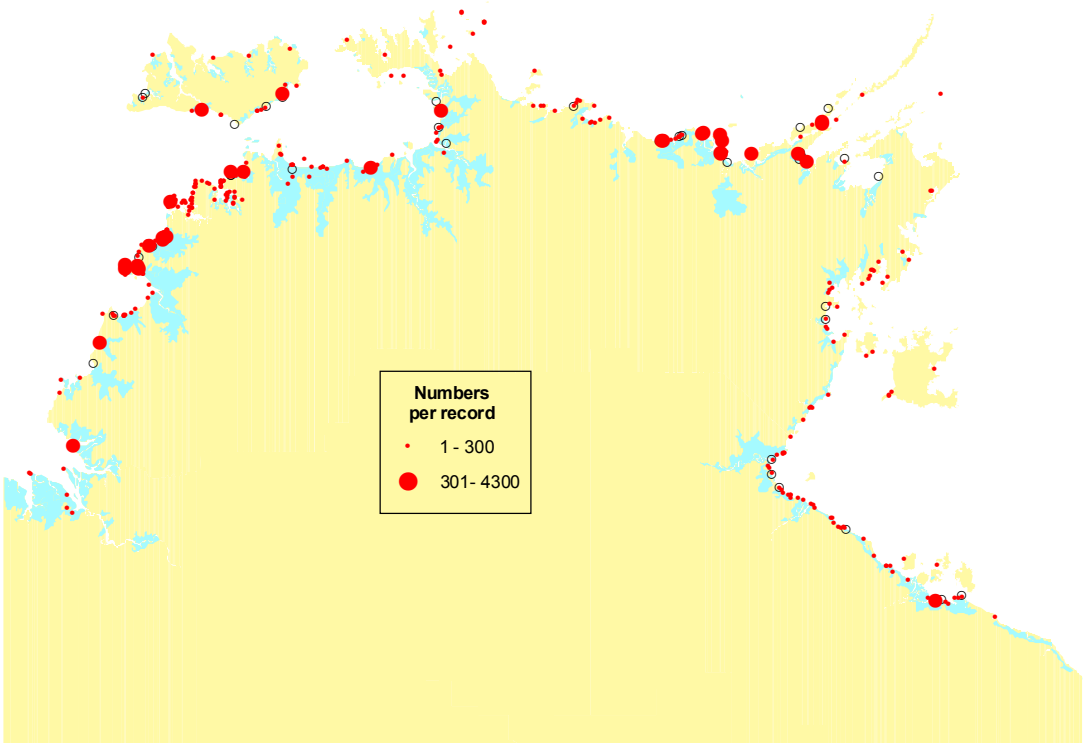


Figure 57. Distribution of all Bar-tailed Godwit records (Hollow black circles are *Godwit spp*. records).

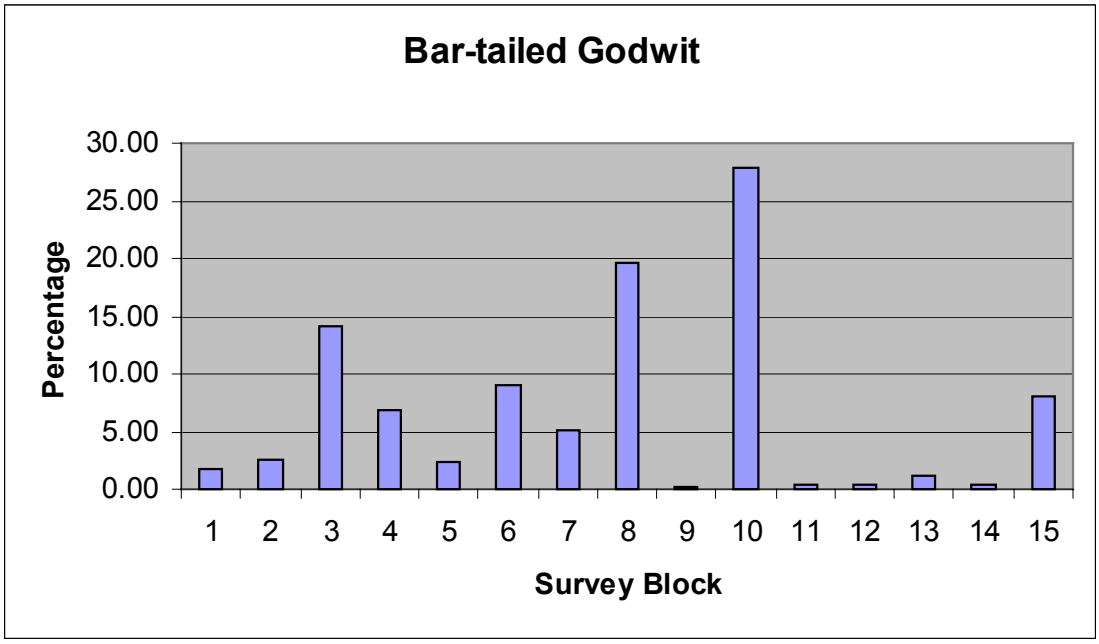


Figure 58. Percentage of Bar-tailed Godwit numbers by survey block.

The highest numbers of Bar-tailed Godwits were recorded in survey blocks 3, 8 and 10, while the lowest numbers were in survey blocks 9, 11, 12 and 14 (Figure 58). There were no survey blocks that did not have this species recorded. Further details, by survey block, can be found in Table B3, Appendix B.

Roosting flocks of Bar-tailed Godwits were also consistently in the high hundreds or low thousands. The species had 14 single flock counts of over 1 000 with the largest single roost being 4 300. This was recorded during a ground count on one of the islands off Millingimbi (survey block 8) on the central north coast in mid December 1998. There were a further 1 350 on a nearby island. Adding the appropriate Bar-tailed Godwit percentage from the '*wader spp.*' calls for that area shows there were at least 7 000 Bar-tailed Godwits in the area at the time. Other important area counts include over 5 000 roosting on the southern side of Elcho Island (survey block 10) and over 3 000 in Boucaut Bay (survey block 10). Both were in late March 1999. A count of over 2 500 was made in mid August 1992 in Fog Bay (survey block 3).

The calculated minimum estimate of the peak number of Bar-tailed Godwits, likely to have been present in the Top End during these surveys, is at least 53 000 birds.

Seasonality

The number of birds per record showed a distinct higher peak in March for Bar-tailed Godwits (Figure C4). This may be as a result of grouping up prior to migrating. During the remainder of the months this calculation proved to be a little erratic, although slightly higher from August to December. The numbers of Bar-tailed Godwits as a percentage of all group 1 species were highest from December through to March (Figure C5). Neither of these histograms indicated a peak around the expected arrival period.

The number of Bar-tailed Godwit records as a percentage of all group 1 species showed a similar story to the Black-tailed Godwits, in that there was no large changes during the year (Figure C6). Again this only refers to separate records, not the actual number of birds, but it does suggest that there is no large, regional, short-term influxes as is the case for Little Curlew (see below). It also indicates a relatively similar distribution of Bar-tailed Godwits throughout the Top End during both breeding and non-breeding seasons. (See methods section for explanation of this conclusion).

Minton (1995) reports Bar-tailed Godwits to be the main species departing from the Broome area of Western Australia in the first two weeks of April. He also says they start arriving in the last two weeks of August, but most arrive in September.

Lane (1987) reports they first arrive in north west Western Australia in late August with numbers increasing until mid November while at the other end of the season flocks form in late February and March, stay a while, then depart out to sea.

Breeding Plumage

Little data was collected on breeding plumage during these surveys but a few comments are drawn from general field notes. There were four references to large percentages of the birds being in breeding plumage (many in full or near full) in late March, late April and mid September. There are also five references of little breeding plumage among flocks at times between mid May and mid August. Again, there were the odd birds in near full breeding plumage during these times showing that some over-wintering birds do go into breeding plumage.

BAR-TAILED GODWIT SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔✔	53 000	Many birds present all year, highest numbers between August and April
	Islands	✔✔		
	Wetlands	R		

Plate 15. Part of the large and regular roost which included over 4 000 Bar-tailed Godwits along the side of Elcho Island, March 1999. Photo R. Chatto.

Little Curlew

Geographic Distribution

Little Curlews were most frequently recorded in the wetlands to the east of Darwin, where they were always seen in the freshwater wetlands rather than the inter-tidal zone or adjacent saline wetlands (Figure 59). They also frequent parks, golf courses etc. around Darwin. The only other areas where this species was recorded were the wetlands near the mouth of the Daly River on the mid west coast and from wetlands in behind Buckingham, Melville and Blue Mud Bays in the north east of the Top End. Garnett (1986) recorded Little Curlew on the grass plains inland from the coast in the south east Gulf of Carpentaria during his December surveys. None were recorded here during my surveys, but at that time of the year my surveys in this area were primarily coastal.

The full Top End distribution of Little Curlews may not have been determined during these surveys. These birds can form large flocks on the wetlands when they first arrive in the north, but only remain as such for a short period. As these surveys could not cover all of the large floodplains of the Top End at this time, some of these large flocks could have been missed. While still present in the Top End but not in these large flocks Little Curlews often spread out in low-density numbers over dry and/or burnt floodplains. Here they are also often difficult to detect or confirm (hence some being recorded as *wader spp.*) from the air against this background. Such low density, low diversity areas from which birds were harder to detect from the air were infrequently surveyed in light of the cost of the aircraft.

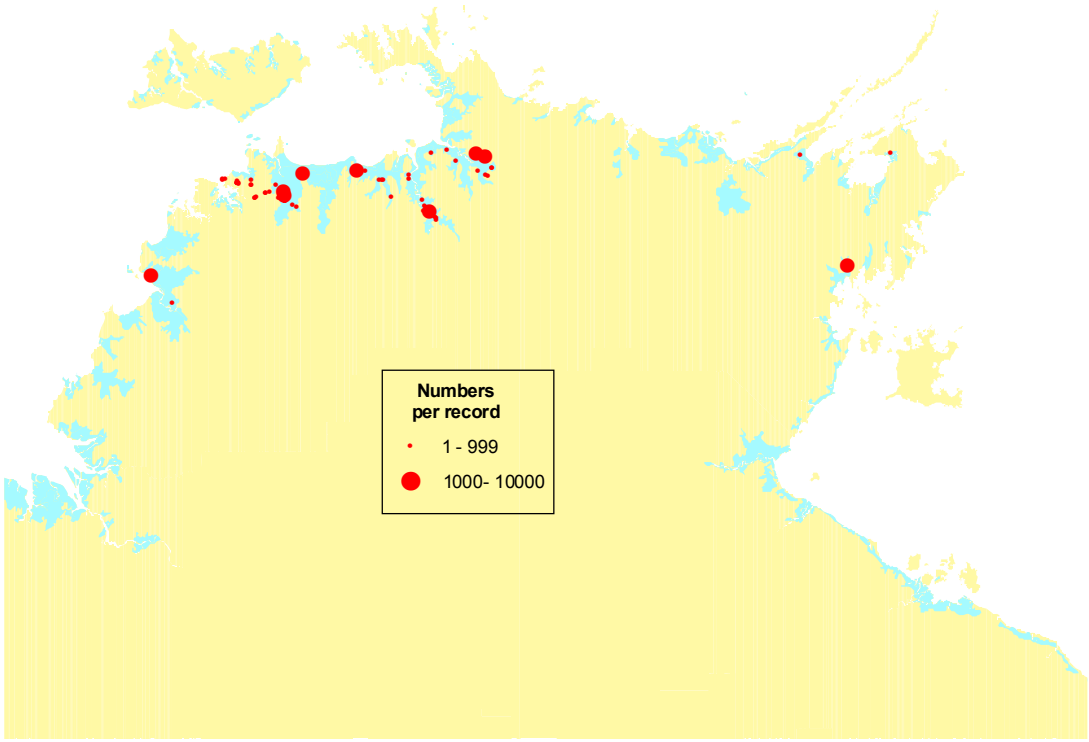


Figure 59. Distribution of all Little Curlew records.

Numbers

Of the areas in the north east, only the Blue Mud Bay site (survey block 10) had a reasonably significant flock (1 000) recorded, the other two having counts of less than 50 birds.

Throughout all surveys there were 38 ground records totalling approximately 16 000 Little Curlews. These equate to approximately 1% of all group 1 species ground records and 4% of numbers. There were also 39 aerial records of Little Curlews. The vast majority of these aerial records were from the one survey in the wetlands to the east of Darwin during the short period of time after the birds had arrived and were still in large flocks before moving on or dispersing. Nevertheless these results still suggest Little Curlews to be one of the less frequently recorded but more abundant of the shorebirds recorded during these surveys.

The largest numbers of Little Curlews were clearly in survey block 5 (Figure 60). The only other survey blocks in which they were recorded were 3, 4 and 10. Further details, by survey block, can be found in Table B4, Appendix B.

The largest single flock recorded during this survey period was 10 000 birds on Lake Finniss (survey block 5) in early October. This is possibly among the most important sites in the Northern Territory during their southward migration (Jaensch, 1995), however, there were several records in the low thousands in other areas a little further to the east of this lake. Over ten percent of records, either ground or aerial, were of flocks of 1 000 birds or more. Little Curlews were mostly recorded when the birds grouped together in the wetlands.

Surveys by other authors prior to this project also report large flocks of Little Curlew. Garnett (1986) counted 6 400 Little Curlews on the grass plains inland from the coast in the south east Gulf of Carpentaria during his December surveys. Deignan (1964) reported that a single flock of 100 in late September 1948 had built up to tens, maybe hundreds of thousands by mid October in the Oenpelli area of the East Alligator floodplains. Also Smith (1971) reported 250 000 Little Curlew flew over the Fogg Dam area on 22/23 October 1966, but this may be an overestimate according to Higgins and Davies (1996).

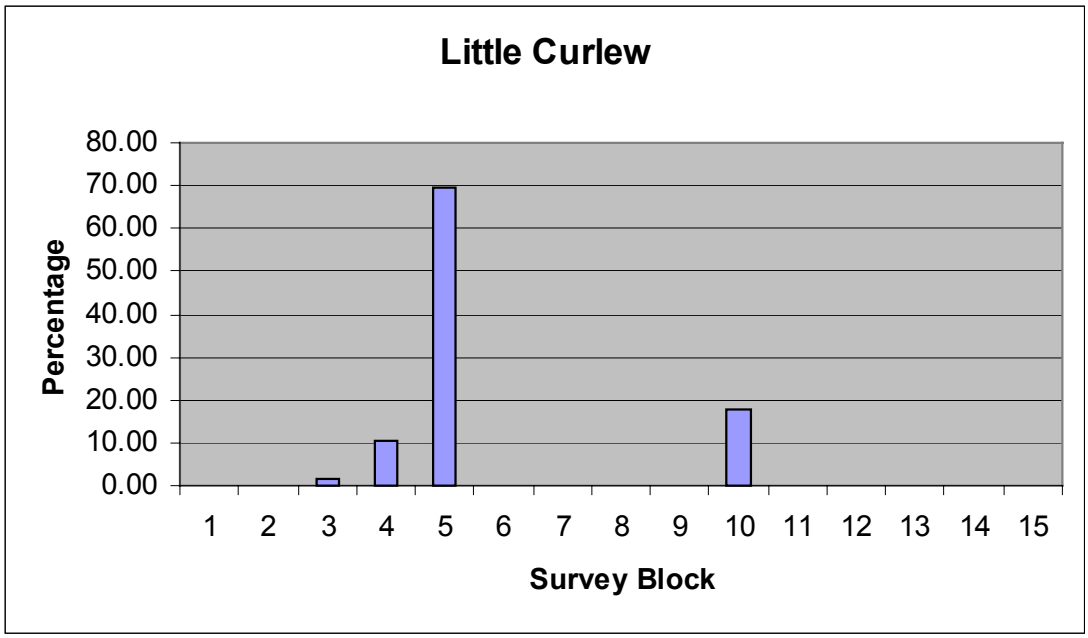


Figure 60. Percentage of Little Curlew numbers by survey block.

The calculated minimum estimate of the peak number of Little Curlews, likely to have been present in the Top End during these surveys, is at least 12 500 birds. Considering some of the observed single flocks in my surveys and the numbers reported by other authors, this estimate is obviously well under the true figure.

Seasonality

All but three of the records of Little Curlew from these surveys were made between the period of late September and late November. (The remaining three records were in late December). Even though this species may have been under-represented in these surveys, these results strongly suggest few birds remain anywhere in the Top End coastal wetlands or grass plains after migrating in from their northern breeding grounds. They arrive in during the later part of September, remain here for a month or two, and then move further south.

Garnett and Minton (1985) reported up to 50 000 Little Curlews at Roebuck Plains (north west Western Australia) during March and April of 1985, showing that they do move back through that area on their northern migration. No Little Curlews were recorded during my Top End surveys at that time of the year, and it is unlikely that such large numbers would have been missed. Further, Garnett and Taplin (1990) failed to find any in specific searches of grass plains near the McArthur River in late March 1990. Consequently, it appears Little Curlews generally do not pass back through the Top End, or at least do not stop en masse, on their northward migration. McCrie (*pers. comm.*) reports a few pass through Darwin on their northward migration but not every year. (Just as this report was going to print small flocks were seen in late January 2003 on the new golf course in Palmerston near Darwin. This area had not been visited since mid December 2002, by which time they had left after arriving during September, so it is not known when they arrived back).

The three histograms of Little Curlews (Figures C7-9) all show October to have the highest numbers per count and percentages of records or numbers of the other combined group 1 species.

Minton (*pers. comm*.) reports Little Curlew to depart the Broome area of Western Australia around the last week of March. In terms of arriving into the area the main groups come in during the middle part of September, while there is also a continued slow build up through October and November. Collins and Jessop (2001) reported departure from Broome in Western Australia commenced during the last week in March and recorded the latest flock to leave on 15 April. They also reported the first arrivals into the area on 4 September with most birds arriving in the third week of September. McKean *et al* (1986) reported Little Curlew arrive in Darwin in September (usually mid September) and depart in December, with their occurrence in other months being exceptional. They also reported that the birds do not normally stop on the Darwin coastal plains on their return migration.

Breeding Plumage

No comments were made during the surveys with respect to breeding plumages for this species.

LITTLE CURLEW SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	12 500	Birds occasionally present in small numbers during northward migration, but most birds only present between September and November (sometimes to December).
	Islands	R		
	Wetlands	✔✔		

Whimbrel

Geographic Distribution

Whimbrels were recorded all around the Northern Territory coast and on many of the offshore islands (Figure 61). Coastal areas with mangroves were preferred and they were also widely distributed, both as feeding and roosting flocks, along the edges of creeks and channels running inland through the mangroves. Although they were not in high densities along these banks, there are many thousands of kilometres of such watercourses in the Top End and not all were covered in my surveys. The lack of coverage of all these channels will lead to not all birds being counted in the area but would not greatly effect their general distribution on the scale shown in Figure 61. Garnett (1986) also found the riverbanks in the south east Gulf of Carpentaria held relatively high numbers of Eastern Curlew, Whimbrel, Common Sandpipers and Terek Sandpipers compared to the adjacent coast. Whimbrels were rarely recorded on freshwater wetlands or saline wetlands too far in from the coast.

One of the most important areas for Whimbrels was the coast and adjacent wetlands between the Daly and the East Alligator Rivers in the north west of the Top End. Other important areas included Buckingham Bay and the coast near Millingimbi in the central north, and the mouths of the Roper and McArthur Rivers in the south east. Larger inlets such as Darwin and Bynoe Harbours, that have long mangrove-lined sections of coast, were also significant in terms of the distribution of Whimbrels. Areas of least importance to Whimbrels were the more sandy and rocky coastlines along some sections of the Top End coast and many of the islands. Such areas included the coast east of Cobourg Peninsula, north east Arnhem Land and it's associated island chains, the coast immediately south of Blue Mud Bay and many of the islands in the Gulf of Carpentaria.

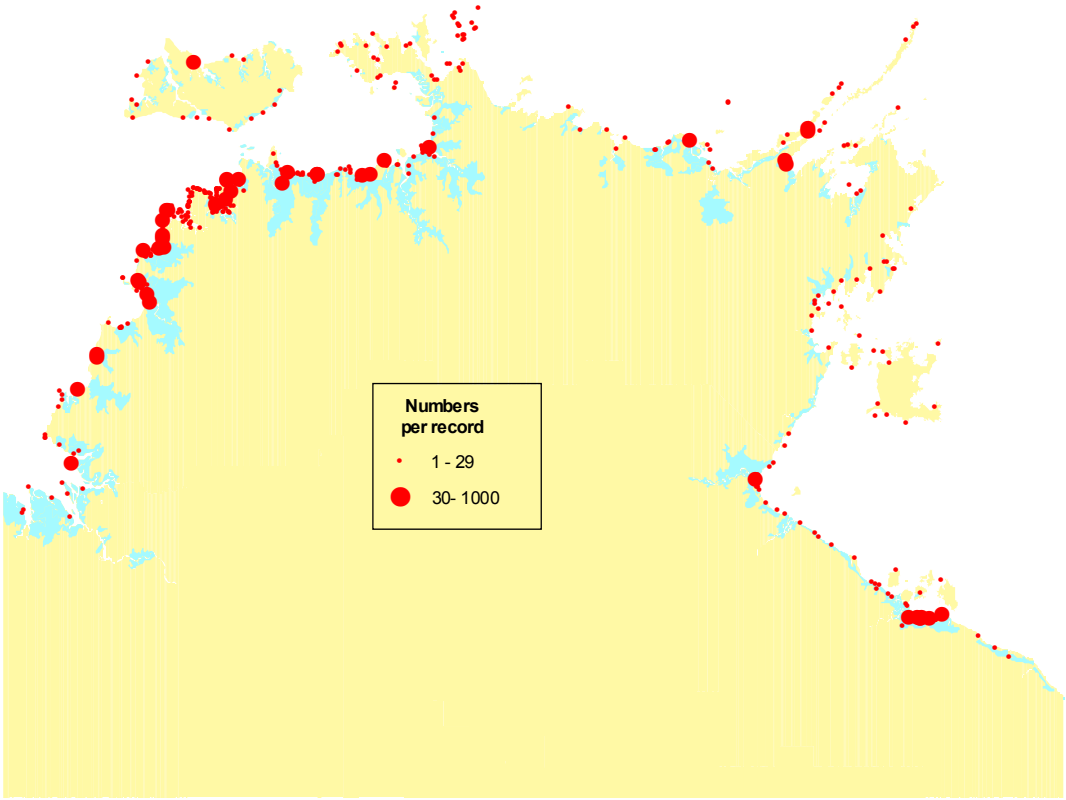

Numbers
per record
1 - 29
30- 1000

Figure 61. Distribution of all Whimbrel records.

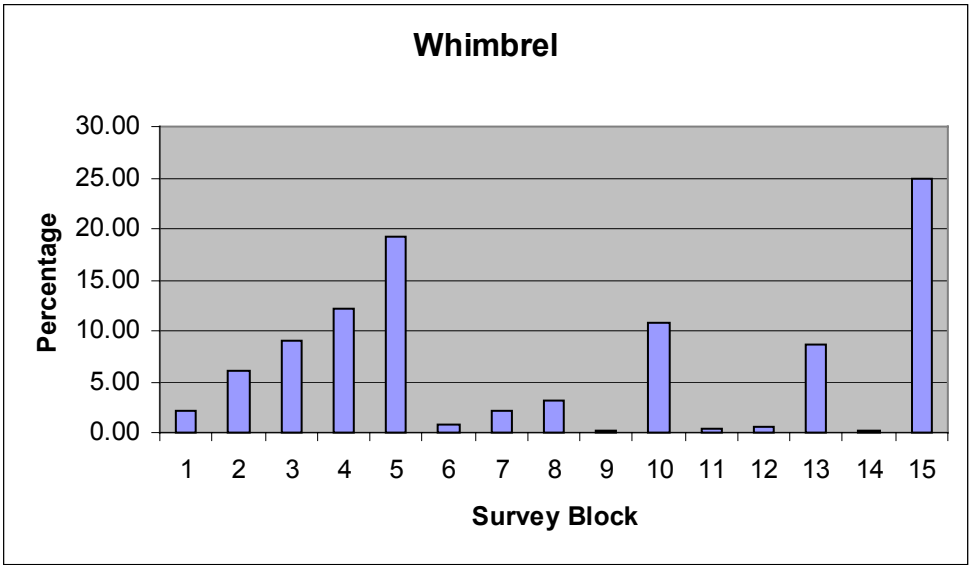


Figure 62. Percentage of Whimbrel numbers by survey block.

Numbers

Throughout all surveys there were 157 ground records totalling approximately 4 600 Whimbrels. These equate to approximately 5% of the ground records of all group 1 species combined and 1% of their numbers. There were also 273 aerial records of Whimbrels. These figures suggest Whimbrels were one of the more frequently recorded but less abundant of the shorebirds recorded during these surveys. However, as many Whimbrels were spread in low-density numbers along the many thousands of kilometres of uncounted creeks and channels, it could mean that their percentage abundance is an under-estimate.

The highest numbers of Whimbrel were recorded in survey blocks 5 and 15, while lowest numbers were in blocks 6, 9 11, 12 and 14 (Figure 62). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B5, Appendix B.

Unlike most of the other more abundant group 1 species, Whimbrels were not often recorded in large flocks. Consequently there were not many high single flock counts of Whimbrels. The largest single flock was 1 000 birds, recorded in early September at a single roost in Chambers Bay east of Darwin (survey block 5). There were a further 430 Whimbrels, recorded as groups of 30 or more, along this bay in the same survey. With limited coverage of the many mangrove lined creeks and channels it is likely that this bay alone supported over 1 500 Whimbrels at this time of year. The next largest single flock was 350 and then there were a number of flocks between 350 and 100 birds. These were in the areas mentioned above. Most of these larger flocks were between late August and early October.

The calculated minimum estimate of the peak number of Whimbrels, likely to have been present in the Top End during these surveys, is at least 5 100 birds. With at least 1 500 Whimbrels present in a single bay, and with the many kilometres of creeks and channels not surveyed, this estimate is obviously well under the true figure.

Seasonality

As mentioned, most of the larger flocks were recorded between late August and early October. This could be due to birds arriving after breeding. The monthly breakdown of the number of Whimbrels per record (Figure C10) and their numbers as a percentage of all group 1 species combined (Figure C11) also suggest an increase in numbers at this time. These two histograms then show a drop through November and December; possibly suggesting Whimbrels spread out more after their arrival. A similar large increase is not apparent around the expected departure time so perhaps they do not

concentrate as much when departing. There is, however, a small rise from April to May then a drop from May to June, suggesting a departure during this period.

The number of Whimbrel records as a percentage of all group 1 species combined was relatively consistent throughout the year (Figure C12). This suggests that there is no large change in the number of times they were recorded even though Figures C10 and C11 suggest changes in numbers. Hence the overall distribution around the coast is likely to remain relatively consistent throughout the year, despite such number changes.

Minton (1995) reports Whimbrels departing from the Broome area of Western Australia in mid April. Lane (1987) says they move south through this area in August and September.

Breeding Plumage

No comments were made during the surveys with respect to breeding plumages for this species.

WHIMBREL SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of peak Top End Population	Seasonality
Widespread, especially NW mainland.	Coast Islands Wetlands	✔✔✔ ✔ R	5 100	Birds present all year, with highest numbers between August and May. Larger flocks during arrival time between August and October.

Plate 16. The southern Fog Bay area which, among other species, has large numbers of Whimbrels, February 1996. Photo R. Chatto.

Eastern Curlew

Geographic Distribution

Eastern Curlews had a similar distribution to Whimbrels in that they were found all around the Northern Territory coast and many of the offshore islands, particularly mangrove areas (Figure 63). Like Whimbrels, they also spread in low densities along the many kilometres of creeks and channels running through the mangroves. They were not recorded on inland wetlands.

The more important areas for Eastern Curlews were along the coast either side of Darwin, the Millingimbi to Buckingham Bay area in the eastern part of the northern coast, and the Roper and Limmen Bight River mouths and the Port McArthur area of the Gulf of Carpentaria. Lower density areas included the south west Top End coast, most of the Tiwi Islands, Cobourg Peninsula and the coast to its east, and much of the Gulf of Carpentaria coast north of the Roper River.

Numbers

Throughout all surveys there were 128 ground records totalling approximately 5 000 Eastern Curlews. These equate to approximately 4% of the group 1 records and 1% of their numbers. There were also 220 aerial records. Eastern Curlews were one of the more frequently recorded but less abundant of the shorebirds recorded during these surveys.

The highest numbers of Eastern Curlews were recorded in survey blocks 5, 8, 10, 13 and 15, while lowest numbers were in blocks 1, 6, 7, 9, 11 and 12 (Figure 64). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B6, Appendix B.

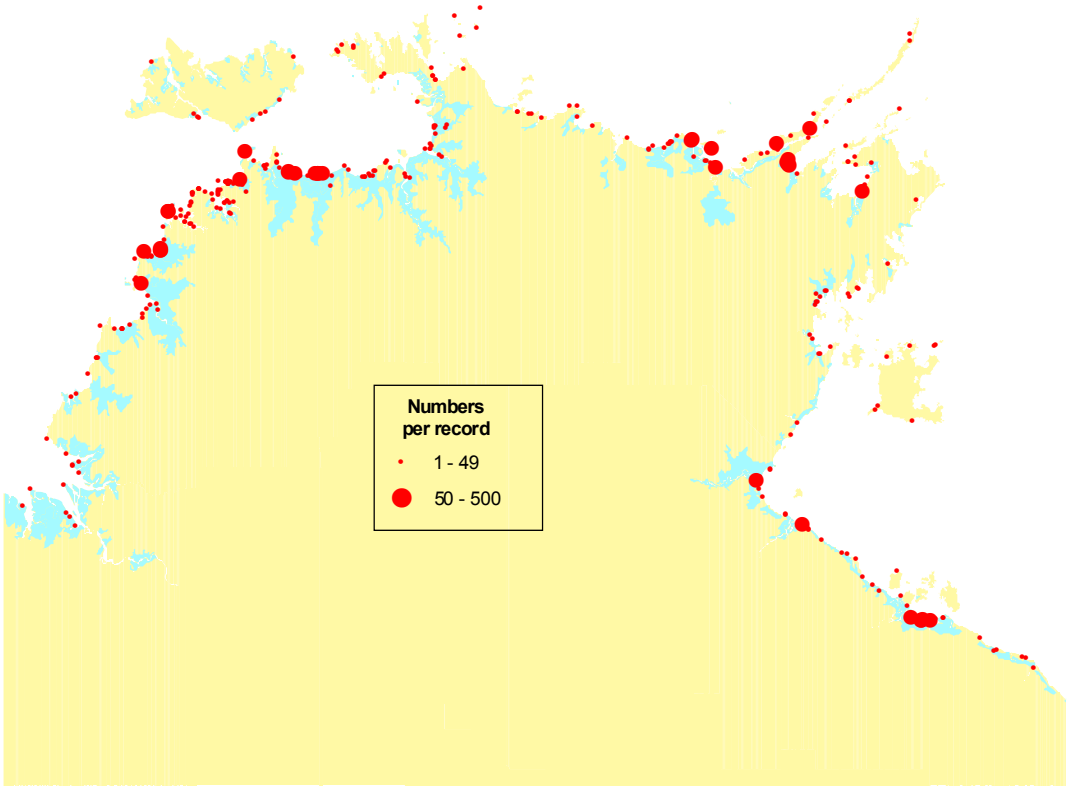


Figure 63. Distribution of all Eastern Curlew records.

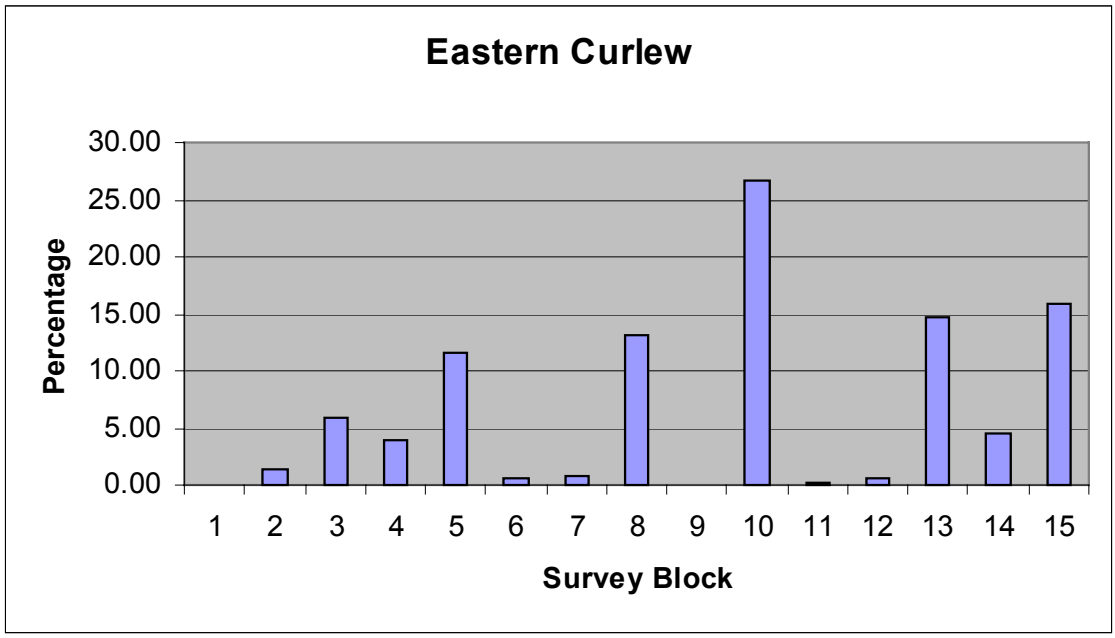


Figure 64. Percentage of Eastern Curlew numbers by survey block.

The largest single flock of Eastern Curlew was 500. Flocks of this size were recorded on three occasions, all in high tide roosts along the coast. One record was from Chambers Bay, east of Darwin (survey block 5) in mid September 1993 and the other two were from Buckingham Bay (survey block 10), in mid July 1996 and in late June 1999. A further 180 were recorded in Chambers Bay on the same survey indicating at least 700 present at this time in this bay. Similarly, in July 1996 there were a further 200 Whimbrels within a two kilometres of the 500 bird roost, suggesting at least 700 in Buckingham Bay at the time. It is further likely that there would have been additional smaller roosts in the many kilometres of mangrove-lined creeks and channels in these areas that were not surveyed at this time.

The calculated minimum estimate of the peak number of Eastern Curlews, likely to have been present in the Top End during these surveys, is at least 6 800 birds.

Seasonality

Interpretation of data relating to the seasonality of Eastern Curlews suggests differences to most other species of migratory shorebirds discussed in this report. Six of the eight largest single flock counts were between June 23 and July 30. All eight groups were in excess of 200 birds. Of the other two counts, one was in late August and one was in mid September. Further, the histograms depicting the number of Eastern Curlews per record (Figure C13) and that depicting the number of Eastern Curlews as a percentage of all group 1 species combined (Figure C14) both show higher peaks from May through July, particularly in June and July. This all suggests higher numbers of Eastern Curlew around the Top End coast during the Northern Hemisphere breeding season than during the rest of the year. This seems unlikely, but perhaps the partial migration of birds that arrive on the Northern Territory coast from the south and then do not continue their migration is higher than was realised. Part of the high July figures could also include the first of the birds arriving back from the north after breeding – birds perhaps arriving in the Top End (being further north) before they are known to arrive in north west Western Australia. A small increase shown in these histograms in September may be due to birds arriving later.

Some surveys in this June to August period show a little bias towards better Eastern Curlew areas compared to the rest of the year. However, there were still several sites around the coast where ground counts were higher during this June to August period compared to other times of the year at the same

site. Further, surveys in mid November 2000 of the coast and swamps in behind Junction Bay (survey block 7) and through to Castlereagh Bay (survey block 8) revealed very large numbers of waders compared to surveys of the same area in July 1998. Despite this there were considerably fewer Eastern Curlew (and Red Knot) in the November surveys compared to the July surveys.

As well as clearly showing higher peaks during the over-wintering period, all three histograms also show low figures from January to April. There are few birds per record, few birds as a percentage of all group 1 birds and few records as a similar percentage. The numbers per record and percentage numbers histograms actually show this right through from October to April. As Eastern Curlews are predominantly coastal birds, and not therefore subject to moving into flooded inland wetlands, and they are one of the easier shorebirds to identify, one conclusion from this is that there are simply less Eastern Curlew in the Top End at this time. It is clear that there is more work needed on Eastern Curlew movements, as there is no obvious reason why these surveys should produce such different results for one species.

Minton (1995) reports Eastern Curlews to be among the first migrants to depart from the Broome area of Western Australia, commencing around early March. He also says Eastern Curlews, along with Greater Sand Plovers, are among the first to arrive back into the area. They begin to arrive in late July and early August but most arrive from mid August into September. Lane (1987) reports they first arrive in north west Western Australia as early as July.

Crawford (1997) did 19 consecutive monthly shorebird counts between July 1970 and January 1972 at five coastal sites near Darwin and 10 similar counts between October 1970 and July 1971 at Leanyer Swamp, in Darwin. Most of these counts were of relatively small numbers of birds so it is possible that local movement to areas that were not counted could have a substantial effect on results. Nevertheless, some species had quite significant changes that are likely to be seasonally influenced. Counts of Eastern Curlew at the coastal sites did not show large changes but the third highest count (22 birds) and the fourth highest count (21 birds) for all months, were recorded in the June/July period.

Breeding Plumage

Only one reference was made to breeding plumage. This was made of birds seen in late March.

EASTERN CURLEW SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, especially NW, NE and SE mainland.	Coast Islands Wetlands	✔✔✔ ✔ R	6 800	Difficult to say, most birds recorded between June and October and most individual records between May and December. Situation possibly being significantly effected by birds moving into Top End from the south, but not continuing migration.

Common Redshank

Geographic Distribution

Common Redshanks were only recorded on six occasions, from three areas (Figure 65). There was only one area where counts of more than a single bird were recorded. This happened on three occasions and was on the saline wetlands just in behind the coast on the western end of Chambers Bay to the east of Darwin. N. McCrie (*pers. comm.*) reports they are occasionally seen around Darwin.

Little effort was put into searching flocks for the odd vagrant and/or rare species. Although this species may be more widely distributed than these records show it is clearly not a widespread and/or abundant species in the Top End.

Numbers

Throughout all surveys there were six ground records totalling 82 individual Common Redshanks. These equate to <1% of all group 1 species ground records and <1% of numbers. Thus Common Redshanks were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

Common Redshanks were only recorded in survey blocks 3, 5 and 10, with most in survey block 5 (Figure 66). Further details, by survey block, can be found in Table B7, Appendix B.

The calculated minimum estimate of the peak number of Common Redshanks, likely to have been present in the Top End during these surveys, is at least 80 birds.

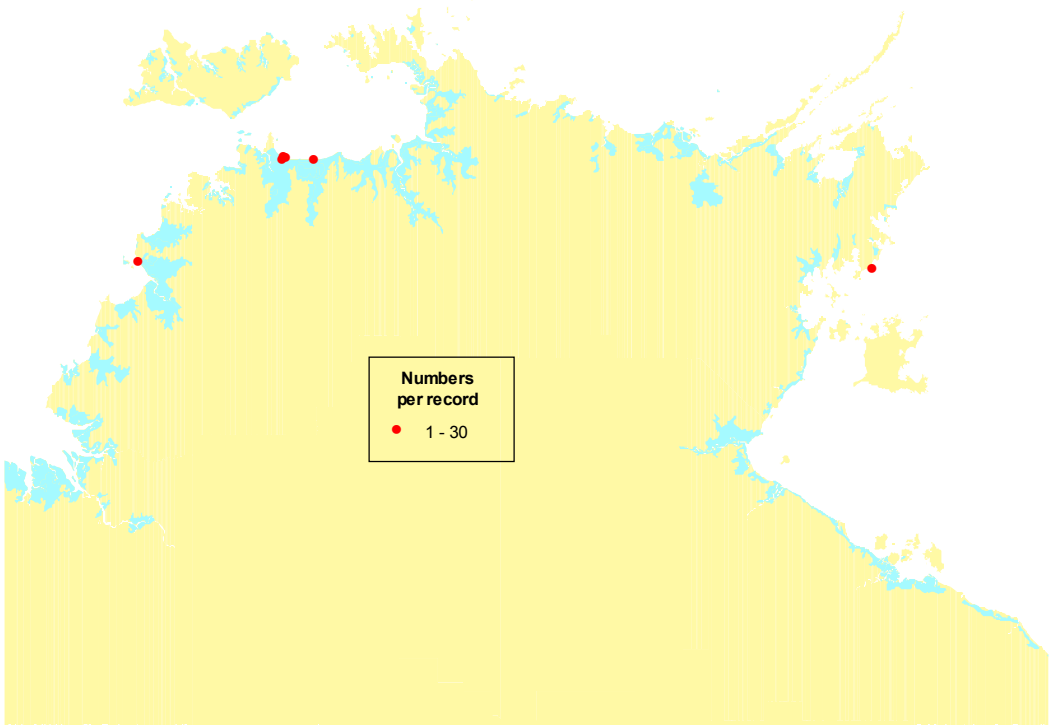


Figure 65. Distribution of all Common Redshank records.

Seasonality

All Common Redshanks were recorded between the months of September and April but with so few records little else can be said about seasonality. Lane (1987) reports Australian arrival from August with a slow increase through to September and large increases at some sites in October and November. Departure is in March and April.

Breeding Plumage

No notes were taken in regard to breeding plumages of this species.

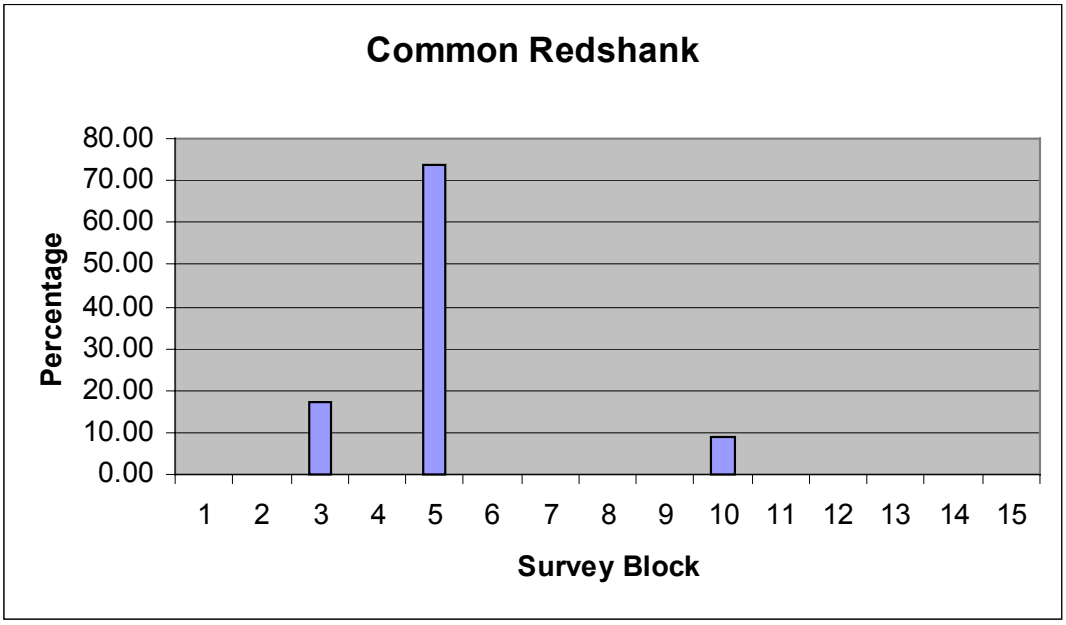


Figure 66. Percentage of Common Redshank numbers by survey block.

COMMON REDSHANK SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	80	Birds recorded between September and April.
	Islands	R		
	Wetlands	✔		

Marsh Sandpiper

Geographic Distribution

The more important areas for Marsh Sandpipers were the wetlands between the Daly River on the west coast and Murgenella Creek in the eastern part of Van Diemen Gulf, and around the Port McArthur area in the south east (Figure 67).

As with many of the group 1 species, the records shown here for Marsh Sandpipers may not represent their full distribution because of the difficulty of identifying them to species level from the air. The addition of Marsh Sandpiper and/or Common Greenshank combined records increases the potential distribution of Marsh Sandpipers, but the type of habitat needs to be considered in terms of which of the two species such records would represent. Of the two species, Common Greenshanks were more frequently found on the coast. Both were recorded on saline wetlands, while Marsh Sandpipers occurred more frequently on freshwater wetlands. With this in mind, many of the combined species records around the coast are likely to be Common Greenshanks.

Additional possible species separation can be achieved from the distribution of confirmed records for each species. In Joseph Bonaparte Gulf, for example, all confirmed records were of Common Greenshanks. Thus, it is likely that most of the combined species records in this area would represent Common Greenshanks. On the other hand the upstream parts of the South Alligator River wetlands are likely to be the opposite. This latter example is also supported by Bamford (1990), who reported Marsh Sandpipers to be more abundant than Common Greenshanks in this area. Areas where neither Marsh Sandpipers or Common Greenshanks were frequently recorded include the northern coast of the Tiwi Islands and Cobourg Peninsula.

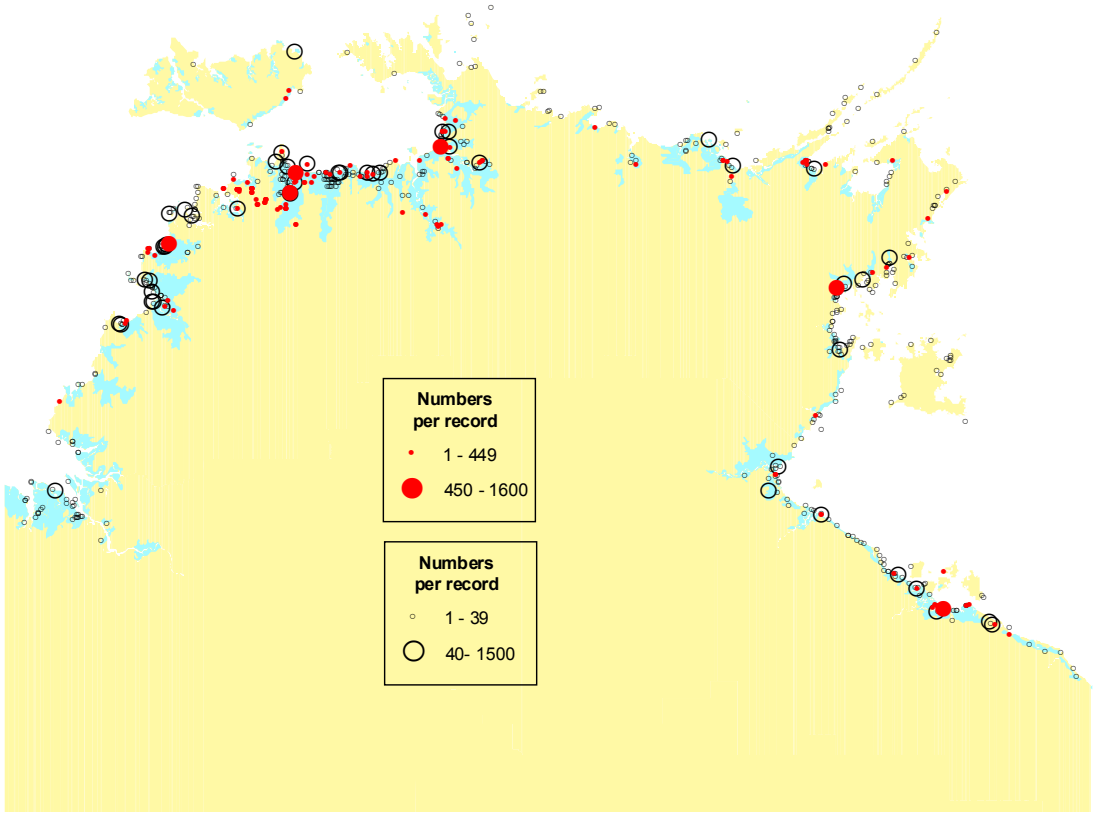


Figure 67. Distribution of all Marsh Sandpiper records. (Hollow black circles represent Marsh Sandpiper and/or Common Greenshank records).

Numbers

Throughout all surveys there were 149 ground records totalling approximately 12 900 Marsh Sandpipers. These equate to approximately 4% of the records and 3% of the numbers of all group 1 species. There were also 16 aerial records of Marsh Sandpipers. Thus Marsh Sandpipers were one of the more frequently recorded and abundant of the shorebirds seen during these surveys.

The highest numbers of Marsh Sandpipers were recorded in survey blocks 3, 5, 10 and 15, while lowest numbers were in blocks 2, 13 and 14 (Figure 68). This species was not recorded in survey blocks 1, 9 and 11, however, there were combined Marsh Sandpiper and/or Common Greenshank records made in these blocks so this species may have been present there in small numbers. Further details, by survey block, can be found in Table B8, Appendix B.

The largest single count of Marsh Sandpiper was 1 600. This count was drawn from a single sample count and subsequent extrapolation of a large group of waders. It was on a large but uniform wetland, and even if other parts of the site had a different species composition it was still clear that Marsh Sandpipers (along with Sharp-tailed Sandpipers) dominated the wetland. It was done on 24 April 1992 near the mouth of the East Alligator River (survey block 5). There were also another 750 Marsh Sandpipers counted directly from another four nearby sites in the same survey, so there were clearly a lot in the area, even if the 1 600 count was an over-estimate for that one site. These large flocks may have been a pre-migration build up.

Other exceptionally large counts of single flocks of this species were made directly of the birds present rather than expanding sample counts. These included 800 near the mouth of the Finniss River (survey block 3) in December 1992, 640 in the Port McArthur area (survey block 10) in October 1996, 500 at two sites near the Adelaide River (survey block 5) in May 1993 and July 1998 and 450 near the northern part of Blue Mud Bay (survey block 10) in July 1998. With the May 1993 count there was also another 350 birds counted at a nearby ground site and with the October 1996 count another 400 at a nearby site.

The calculated minimum estimate of the peak number of Marsh Sandpipers, likely to have been present in the Top End during these surveys, is at least 12 100 birds.

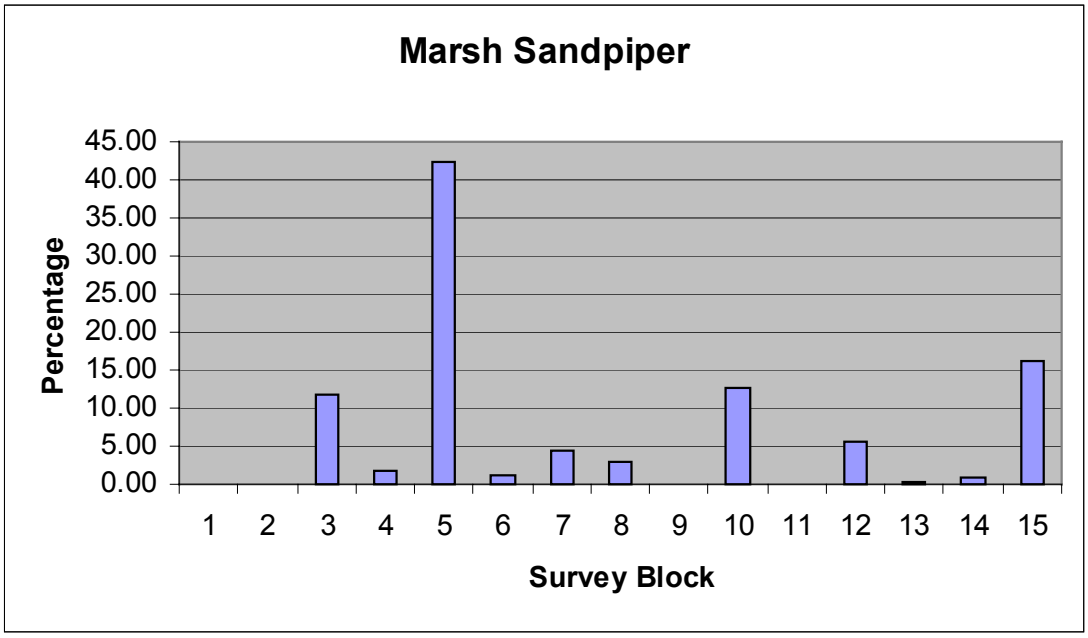


Figure 68. Percentage of Marsh Sandpiper numbers by survey block.

Mention should also be made of significant counts of mixed Marsh Sandpiper and/or Common Greenshank, which are likely to have had significant numbers of one or both species. There were five such counts of 300 or more birds in a single flock. Three of these were actually made from the air travelling between the three sites mentioned above in relation to the Adelaide River area, indicating that this area could have had even more Marsh Sandpipers present. The highest mixed species count was of 1 500, recorded on the same survey that recorded the 1 600 Marsh Sandpipers. The highest confirmed ground count for Common Greenshanks in that area during that survey was only 80. Thus it is likely that a high percentage of this mixed flock of 1 500 could have been Marsh Sandpipers, further increasing the huge number of these birds in this area at the time.

Seasonality

The greater variation and less coverage of inland wetlands compared to the coast during this project means that interpreting seasonality from the three histograms of the species with a greater dependence on these wetlands is less reliable. The Marsh Sandpiper histograms depicting numbers per record (Figure C16) and numbers as a percentage of the other combined group 1 species (Figure C17) are a little erratic, but still essentially interpretable. Both of these histograms, along with the one showing the percentage of records of Marsh Sandpipers (Figure C18), have peaks in April and May. This, and the fact that three of the seven highest single flock counts were recorded between late April and mid May suggest a build up of birds prior to northward migration. This may have been influenced by a certain amount of survey bias (particularly in light of the low March peaks) as surveys done in April and May did tend to be in areas of more importance to Marsh Sandpipers compared to the surveys in March and June.

Plate 17. Wetlands in behind the coast near the East Alligator River that had large numbers of Marsh Sandpipers (and Sharp-tailed Sandpipers), April 1992. Photo R. Chatto.

All three histograms also have varying, but smaller peaks around September and October that may suggest arriving birds. This is supported by Roger Jaensch (*pers. comm*.) who noted substantial increases in the numbers of Marsh Sandpipers on Lake Finniss (near Darwin) between surveys done on 1 September and 1 October 1993. The October peak of the histogram relating to records is considerably higher than the October peaks relating to numbers. This suggest small flock sizes and may indicate that arriving birds are less likely to form the large flocks that the histograms suggest for departing birds in April and May. The subsequent drop after October may be due to birds spreading out over wetlands, particularly after the onset of rains.

The July and December peaks in each histogram as more likely to be due to survey bias. A check of the individual July ground counts, for example, showed they were numerically dominated by three large counts. Perhaps, this peak is more a reflection of the appropriate wetlands being counted during July compared to the months either side of July.

Crawford (1997) found counts of Marsh Sandpipers from sites near Darwin showed a continual decrease from October through to March in 1970/71, suggesting movement out to newly inundated freshwater swamps.

Lane (1987) reports Australian arrival of Marsh Sandpiper to be in September and departure in March and April.

Breeding Plumage

No notes were taken in regard to breeding plumages of this species.

MARSH SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, but mostly in the NW.	Coast Islands Wetlands	✔ R ✔✔✔	12 100	Birds present all year, highest numbers and flock sizes around departure time in late April to early May, and to a lesser extent around arrival time in Sept/Oct. Birds disperse after arrival when rains fill wetlands.

Common Greenshank

Geographic Distribution

Common Greenshanks were recorded all around the Top End coast and many of the islands (Figure 69). The distribution of the combined Common Greenshank and/or Marsh Sandpiper records is also included on this map. As Common Greenshanks were more widely recorded, particularly around the coast, these combined records do not increase the recorded distribution of Common Greenshanks, except for the Gulf of Carpentaria area. (See also, comments made on this in the Marsh Sandpiper discussion above).

Confirmed Common Greenshank records were mostly along the coast and wetlands between the Daly River and Murgenella Creek, the mainland between Boucaut Bay and Arnhem Bay and around the Port McArthur area. Looking at combined Common Greenshank and/or Marsh Sandpiper records, it is also possible that the Blue Mud Bay area and the coast between the Roper and Limmen Bight Rivers could be added to these main areas. They were recorded less often or in lower numbers on the Tiwi Islands, Cobourg Peninsula and some of the outer islands.

When recorded on inland wetlands they tended to be more common on the more saline wetlands. On freshwater wetlands Marsh Sandpiper were more common. The major freshwater wetlands from the South Alligator to East Alligator Rivers for example, were found during my surveys, and in Morton's surveys (Morton *et al*, 1991) to contain many more Marsh Sandpipers than Common Greenshanks.

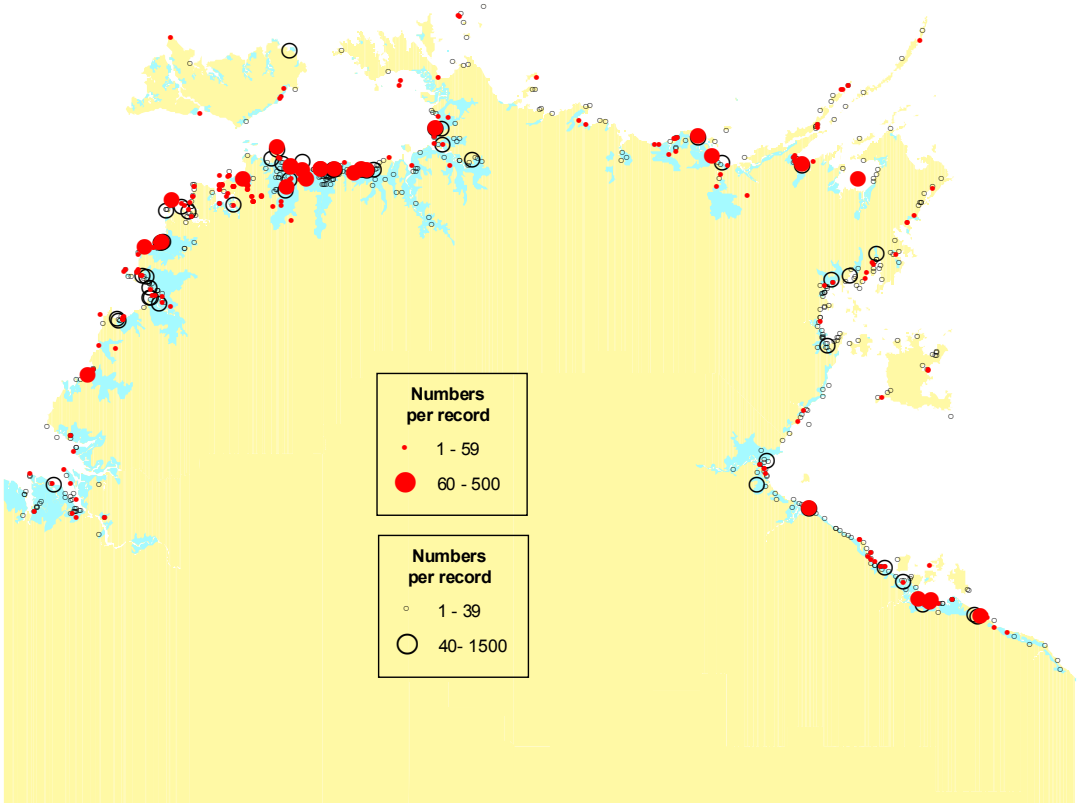


Figure 69. Distribution of all Common Greenshank records. (Hollow black circles represent Marsh Sandpiper and/or Common Greenshank records).

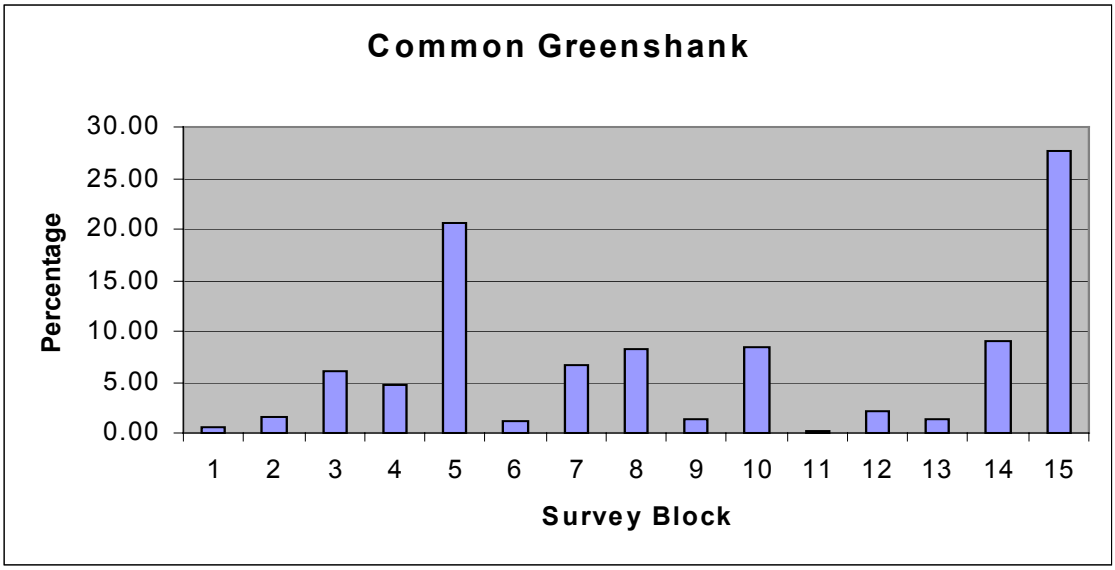


Figure 70. Percentage of Common Greenshank numbers by survey block.

Numbers

Throughout all surveys there were 222 ground records totalling approximately 6 800 Common Greenshanks. These equate to approximately 7% of the records and 2% of the numbers of all group 1 species. There were also 51 aerial records of Common Greenshanks. These figures suggest Common Greenshanks were one of the more frequently recorded but less abundant of the shorebirds seen during these surveys. However, the number of Common Greenshanks among the combined records of Common Greenshank and/or Marsh Sandpipers would almost certainly elevate Common Greenshanks to one of the more abundant shorebirds around the Top End coast.

The highest numbers of Common Greenshanks were recorded in survey blocks 5 and 15, while lowest numbers were in blocks 1and 11 (Figure 70). This species was recorded in all survey blocks even without considering the combined species records. Further details, by survey block, can be found in Table B9, Appendix B.

The highest single flock record for Common Greenshanks was 500. This was recorded in a single ground count near the mouth of the McArthur River (survey block 15) in mid October 1996. There were also another 455 recorded nearby in the same survey. The next highest individual ground count was 450. This was in Chambers Bay (survey block 5) in mid September 1993. Also on this survey there were another 425 counted at four other nearby sites and 250 Common Greenshanks and/or Marsh Sandpipers recorded from the air between theses sites.

The calculated minimum estimate of the peak number of Common Greenshanks, likely to have been present in the Top End during these surveys, is at least 7 600 birds.

Seasonality

As was the case for Marsh Sandpipers, the number of Common Greenshanks per record (Figure C19) and the number of birds as a percentage of all group 1 species (Figure 20) show peaks in April/May, July and September/October. Explanation of this has previously been detailed for Marsh Sandpipers and so will not be repeated again, except to specifically refer to potential survey bias that relates to Common Greenshanks. In this case, the months of May and July had ground surveys done in survey blocks 5 and 15, which were two of the main Common Greenshank areas, while June surveys were done in areas of less importance to Common Greenshanks. Common Greenshanks also had a more consistent build up to the April/May peaks than Marsh Sandpipers. This larger percentage presence of

Common Greenshanks may be due to them being more widely distributed along the coastal zone, which was more frequently surveyed at that time of year.

Minton (*pers. comm.*) reports Common Greenshanks depart from the Broome area of Western Australia in the third and fourth weeks of April. While they start arriving here in the last two weeks of August, most arrive in September. Lane (1987) reports the Australian arrival to be in September and departure in March, but more so April.

Crawford (1997) found counts of Common Greenshanks at sites near Darwin showed a continual decrease from October through to March 1970/71. This also supports the above statements suggested from my surveys.

Breeding Plumage

Limited notes were made on breeding plumage for this species, however it was recorded on birds in March, September and October.

COMMON GREENSHANK SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, particularly the NW and to a lesser extent the NE and SE	Coast Islands Wetlands	✔✔✔ ✔ ✔✔	7 600	Birds present all year, highest numbers and flock sizes around departure time in late April to early May, and around arrival time in Sept/Oct.

Plate 18. The coast and adjacent coastal wetlands in the vicinity of the McArthur River where a single flock of over 500 Greenshanks were recorded, October 1996. Photo R. Chatto.

Wood Sandpiper

Geographic Distribution

Wood Sandpipers were only recorded from wetlands around Darwin, Buckingham Bay and near the Roper River (Figure 71). Records around Darwin would suggest they are more common here than elsewhere in the Top End. Although this maybe so it is more likely a reflection of many more, and longer, surveys being done on small freshwater wetlands that often had very few shorebirds present. Such wetlands were very infrequently surveyed throughout the rest of the survey area because most helicopter landings and counts targeted sites with large numbers of birds present. In such a small number of Wood Sandpipers may not have been detected even if they were present. Although it is possible that their distribution could be greater than recorded in these surveys, they certainly are not common around the Top End. R. Jaensch (*pers. comm.*) suggests this species tends to be more common in the west rather than the east of Australia, with counts of 100+ from the Kimberleys in WA.

Numbers

Throughout all surveys there were 20 ground records totalling approximately 40 individual Wood Sandpipers. These equate to <1% of the records and <1% of the numbers of all group 1 species. Thus Wood Sandpipers were one of the less frequently recorded and less abundant of the shorebirds recorded during these surveys.

Wood Sandpipers were only recorded in survey blocks 4, 5, 10 and 13, with the highest numbers in survey block 4 (Figure 72). Further details, by survey block, can be found in Table B10, Appendix B.

The highest single count of Wood Sandpipers was eight birds near Darwin (survey block 4) in early October 1993. Most records were of single birds.

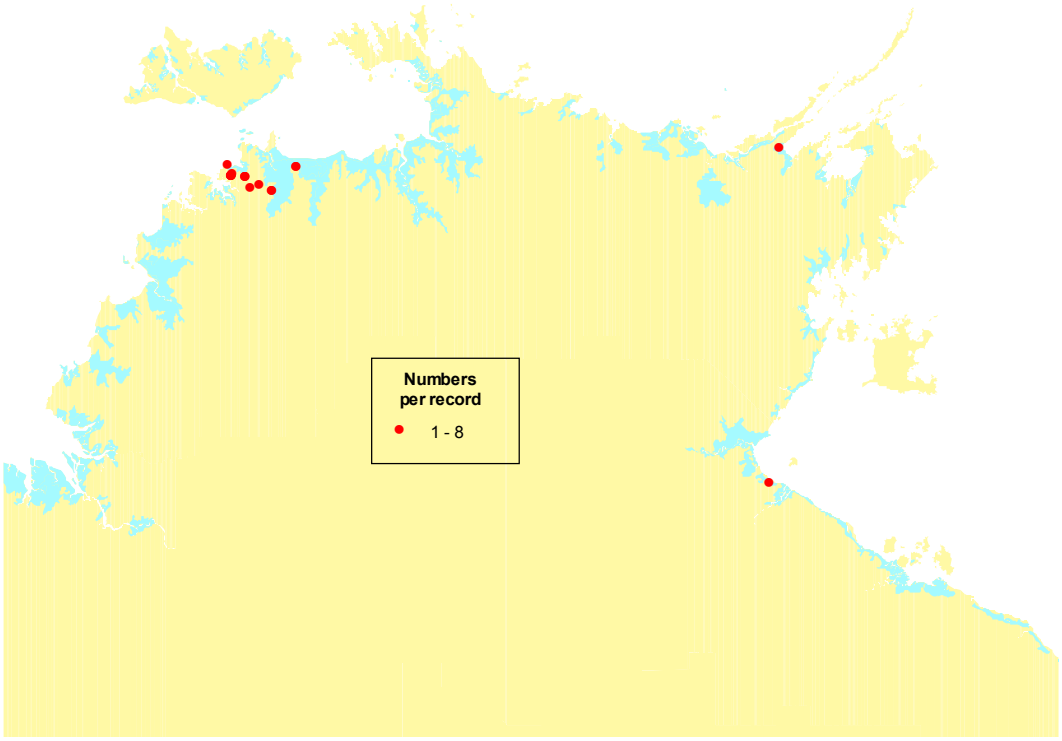


Figure 71. Distribution of all Wood Sandpiper records.

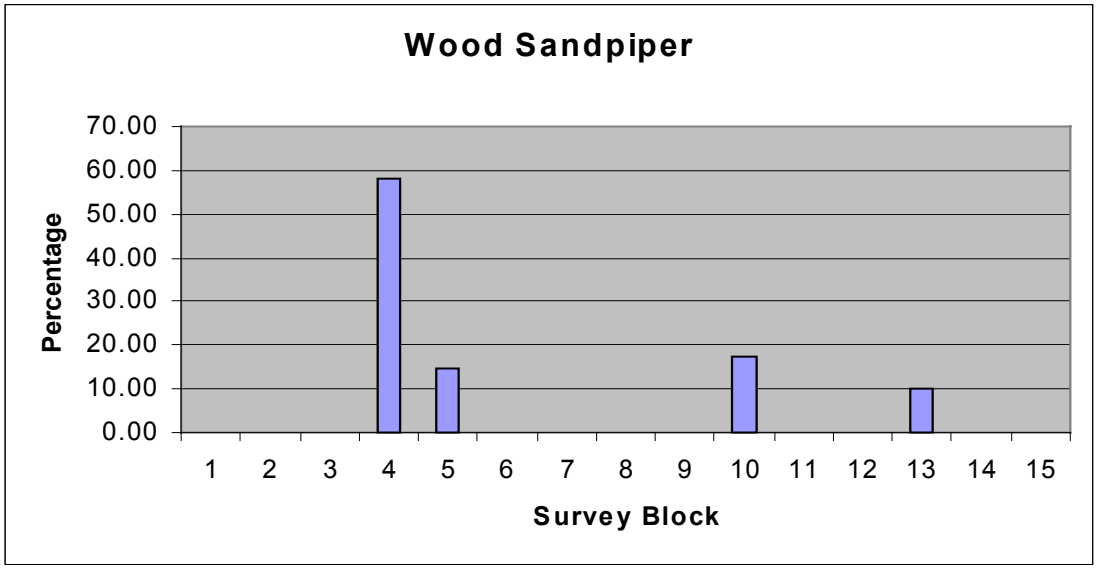


Figure 72. Percentage of Wood Sandpiper numbers by survey block.

The calculated minimum estimate of the peak number of Wood Sandpipers, likely to have been present in the Top End during these surveys, is at least 40 birds. This is likely to be well under the true figure.

Seasonality

There are insufficient records of this species to make any comment other than to say that Wood Sandpipers were recorded from late July to mid December, with most records being in September and the first half of October. McCrie (*pers. comm.*) suggests this species is more common in wetlands around Darwin from August to December. After this water levels rise, reducing the habitat available so their numbers decrease.

Crawford (1972) reports they arrive in Northern Australia in August, and at the other end of the season were not recorded in Darwin after 26 April.

Breeding Plumage

No notes were taken regarding breeding plumage on the few Wood Sandpipers that were recorded during these surveys.

WOOD SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	40	Birds recorded from late July to mid December, with most records being in September and the first half of October.
	Islands	R		
	Wetlands	✔		

Terek Sandpiper

Geographic Distribution

Terek Sandpiper distribution records were considerably less widespread than most of the other migratory shorebirds. Most Terek Sandpipers were recorded in the western half of the Top End. Better areas included Joseph Bonaparte Gulf, from Anson Bay around to the East Alligator River and in the Boucaut and Castlereagh Bay area (Figure 73). There were limited records over the remainder of the Top End coastline, and most of these were of small numbers. Garnett and Taplin (1990) also only recorded small numbers in their late March 1990 surveys from the Roper River to the Queensland border.

Most Terek Sandpipers were recorded along the coast as this species rarely feeds or roosts in wetlands, even on the open saline splashes just in behind the coast. They are however, another of the species that is frequently found, in both feeding and roosting situations, spread thinly along river and channel banks. Consequently, as discussed with Whimbrels, their total distribution may be more extensive than is shown here. This is supported by Garnett (1986) who found Terek Sandpipers, along with Eastern Curlews, Whimbrels and Common Sandpipers, along riverbanks in the south east of the Gulf of Carpentaria during 1984.

Terek Sandpipers are also one of the few species that regularly roosted in smaller groups in the bases of mangroves along coastlines, especially when there were no open ground high tide roosting sites in the immediate area. This also could lead to birds not being detected in sections of aerial surveys that cut across small bays during high tides (usually to save time and/or money) because no exposed area could be seen.

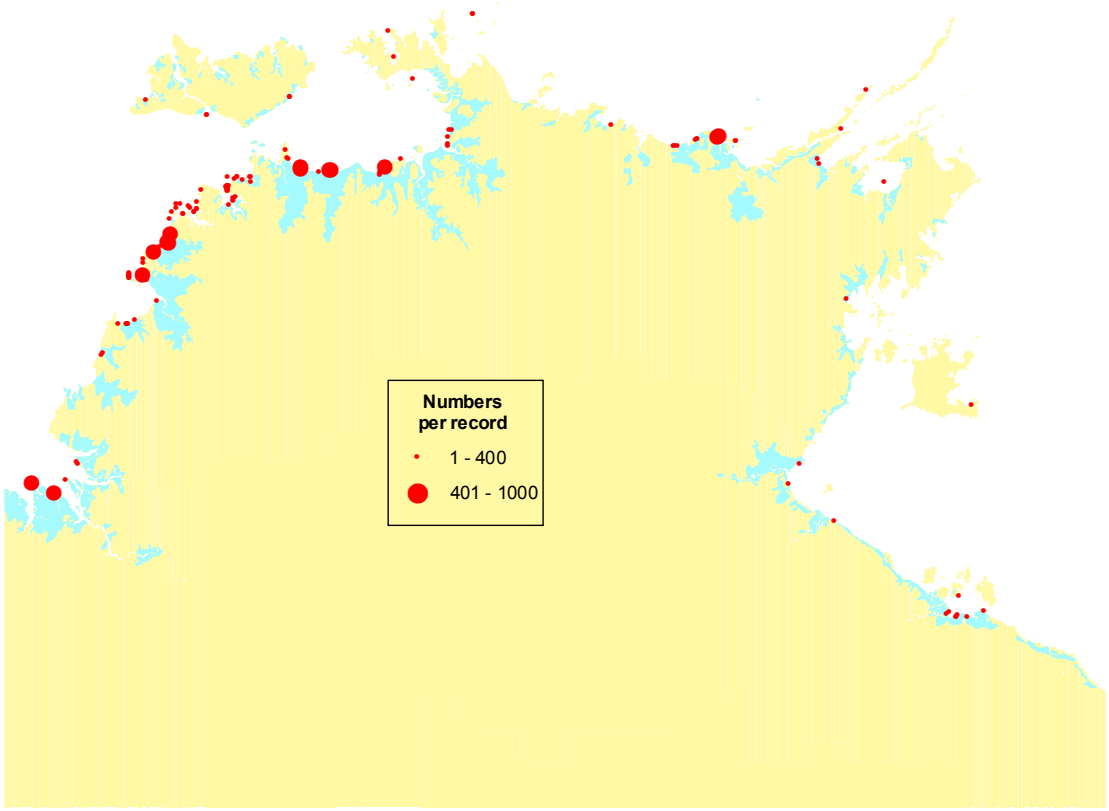


Figure 73. Distribution of all Terek Sandpiper records.

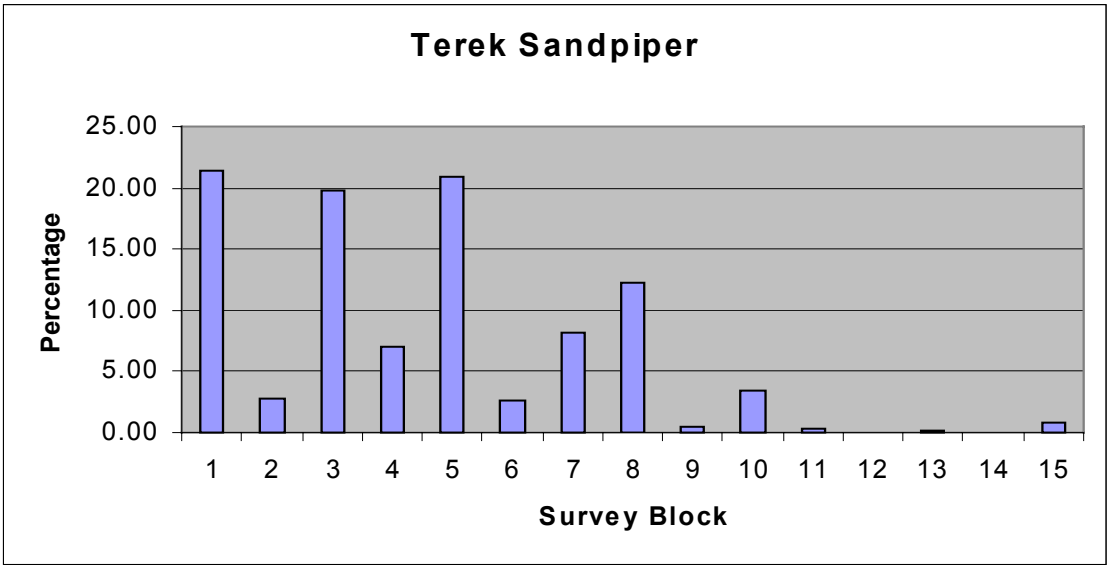


Figure 74. Percentage of Terek Sandpiper numbers by survey block.

Numbers

Throughout all surveys there were 142 ground records totalling approximately 15 700 Terek Sandpipers. These equate to approximately 4% of the records and 4% of the numbers of all group 1 species. There were also 12 aerial records of Terek Sandpipers. Thus Terek Sandpipers were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys.

The highest numbers of Terek Sandpipers were recorded in survey blocks 1, 3 and 5, while lowest numbers (when recorded) were in blocks 9, 11, 13, 14 and 15 (Figure 74). This species was not recorded in survey block 12. Further details, by survey block, can be found in Table B11, Appendix B.

The largest single flock, of 1 000 birds, was located in Joseph Bonaparte Gulf. This was previously discussed in the section relating to survey block 1. There were also ground records of 800 and 200 from nearby sites in Fog Bay (survey block 3) in late December 1992 and two records of 750 from nearby ground sites in Chambers Bay (survey block 5) in mid August 1992. The fourth significant block for this species was survey block 8. Here, two islands adjacent to Millingimbi, had two counts of 500 and 300 in mid June 1996. This is another example of a site where a June count, and another in July, were higher than counts done at the same sites in March and December.

The calculated minimum estimate of the peak number of Terek Sandpipers, likely to have been present in the Top End during these surveys, is at least 15 000 birds. As with Whimbrels this is likely to be under the true figure because of the many kilometres of creeks and channels not surveyed.

Seasonality

Terek Sandpipers, like Eastern Curlews, were recorded as having larger average flock sizes (Figure C22) and higher numbers as a percentage of combined group 1 species (Figure C23) during the June, July and August period. Further, of the 19 single flock counts in excess of 300 birds, eight were in June and July. However, with the more patchy distribution of Terek Sandpipers the timing of surveys at different locations would have influenced this result. For example, many of the better Terek Sandpiper areas were surveyed between June and August, while few were well covered between October and November. Nevertheless, this is unlikely to be the complete reason for the apparent high over-wintering numbers of this species in the Top End. There was also a high peak for the percentage of Terek Sandpipers in February but a single high count among a relatively low total number of shorebirds counted for this month is likely the main explanation for this peak.

The percentage of records of Terek Sandpipers of all group 1 species combined remained relatively constant throughout the year except for the month of January (Figure C24). No Terek Sandpipers were recorded among the small amount of shorebird surveys done in this month. Again this suggests that there that their overall Top End distribution remains relative consistent.

Minton (2000) reports first year Terek Sandpipers departing as late as mid May from the Broome area of Western Australia, but most go in late April. They start arriving in the last two weeks of August but most arrive in September. Lane (1987) reports birds arriving in Darwin in August and north west Western Australia in the first week of September, and departing from north west Western Australia in March and April.

Crawford (1997) found Terek Sandpipers at coastal sites in Darwin showed a substantial relative increase from August to September and then a second one from September to October in 1970, and a continual increase from August to November in 1971. This suggests that birds may arrive in Darwin at this time.

Breeding Plumage

The only comment relating to breeding plumage was made in late March 1999, when a group of 30 birds was recorded as having lots of breeding plumage.

TEREK SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Reasonably widespread, but more in western half of Top End	Coast Islands Wetlands	✔✔✔ ✔ R	15 000	Many birds present all year, highest numbers between June and October. Migrating birds probably arrive August to October and depart April to May. Some birds may move into Top End coast during June and July.

Plate 19. Roost near the mouth of the Finniss River in Fog Bay that included over 800 Terek Sandpipers, December 1992. Photo R. Chatto.

Common Sandpiper

Geographic Distribution

Common Sandpipers were recorded around most of the northern half of the Top End coast and the Port McArthur area (Figure 75). They were mostly recorded in the coastal areas, but there were some records from inland swamps.

This species is likely to be more abundant and have a distribution that is more extensive than has been recorded in these surveys. There are two main reasons for this. Firstly, this species was always located as single birds or small, loose aggregations of up to 4 or 5 birds. Nearly two thirds of the records in these surveys were of single birds. They were also rarely recorded from the air. Consequently, they were mostly recorded when they were present at the same sites as larger groups of shorebirds that were landed at to count. Secondly, they were another of the species that often spread thinly along the banks of the many mangrove-lined creeks and channels that were not extensively surveyed.

An example of possible under-representation of this species can be seen in Noske and Brennan (2002). G. Brennan, who resided on Groote Eylandt for 17 years, recorded Common Sandpipers as reasonably common, yet I recorded only a single specimen on one occasion during my surveys.

The higher number of recordings for this species around Darwin could be due to more time spent in this area. It is probable that more ground surveys would increase the number of records for this species in other similar bays and inlets or mangrove dominated sections of the coast around the Top End. However, my surveys still suggest the species is uncommon in the south east and south west of the Top End.

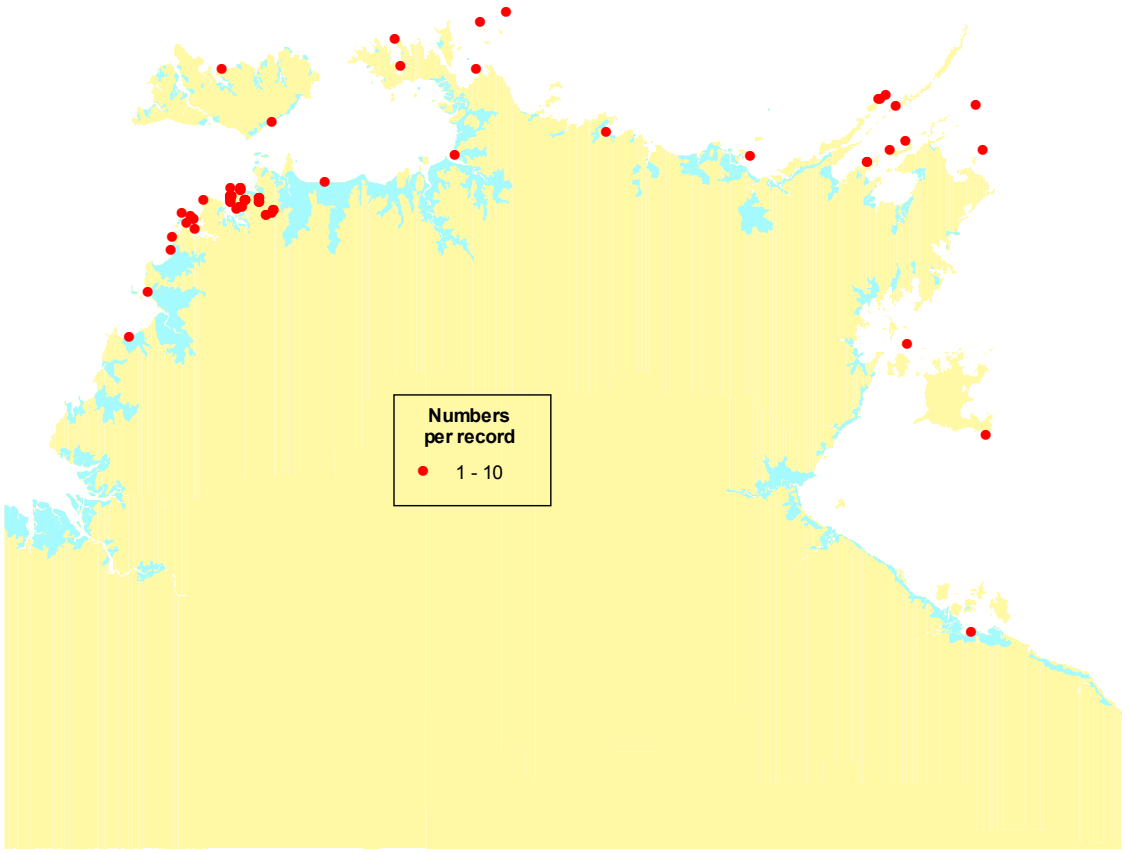


Figure 75. Distribution of all Common Sandpiper records.

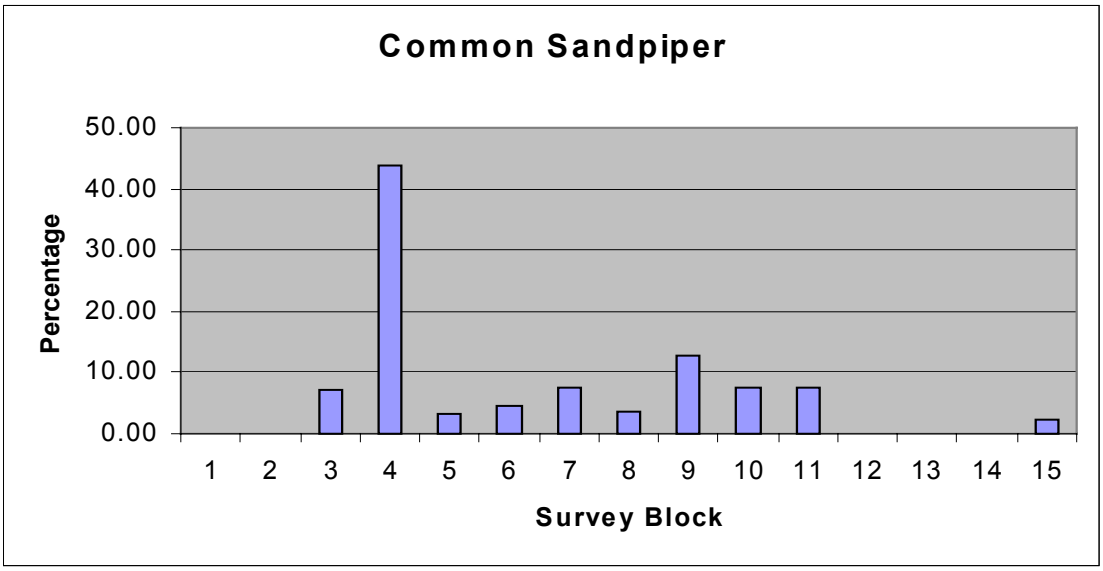


Figure 76. Percentage of Common Sandpiper numbers by survey block.

Numbers

Throughout all surveys there were 68 ground records totalling approximately 130 Common Sandpipers. These equate to approximately 2% of the records and <1% of the numbers of all group 1 species. There were also six aerial records of Common Sandpipers.

Although only individuals or small groups were recorded during my surveys, McCrie (*pers. comm.*) reports flocks of up to 150 seen at the Darwin sewage ponds, further suggesting that they may be more abundant than my results suggest.

The highest numbers of Common Sandpipers were recorded in survey block 4, while lowest numbers (when recorded) were in blocks 5, 6, 8 and 15 (Figure 76). This species was not recorded in survey blocks 1, 2, 12, 13 and 14. Further details, by survey block, can be found in Table B12, Appendix B.

The calculated minimum estimate of the peak number of Common Sandpipers, likely to have been present in the Top End during these surveys, is at least 180 birds. In light of the above this is certainly an under-estimate, probably a significant one.

Seasonality

The 60 individual records of Common Sandpipers show a clear increase in both records and numbers starting around August and remaining until December (Figures C25-27). This may indicate an arrival of birds in August. Although a large peak in numbers per record for March (Figure C25) is influenced by a single relatively large count (eight birds) amongst a low number of records for all March surveys, this count could also represent a small flock preparing to depart.

The percentage of records histogram (Figure C27) shows a lower percentage of records from March to July, which fits with the expected exodus of birds going north for breeding.

Crawford (1972) reports birds regularly arrive in Darwin from mid July and may form pre-migration concentrations during March and April.

Breeding Plumage

No comments were made in relation to this for Common Sandpipers.

COMMON SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Reasonably widespread, but more in northern half of Top End	Coast Islands Wetlands	✔ ✔ ✔	180	Numbers increase from August, suggesting arrival from breeding and decrease after April suggesting departure around this time.

Plate 20. Darwin Sewage Ponds (just to right of centre) where the large flocks of Common Sandpipers have been seen by Niven McCrie. Photo R. Chatto.

Grey-tailed Tattler

Geographic Distribution

Grey-tailed Tattlers were only recorded along the coast or in the immediately adjacent saline wetlands (Figure 77). They were not recorded on any inland wetlands. They were very abundant in some of the generally better shorebird areas, but then uncommon in other good shorebird areas. Grey-tailed Tattlers were most abundant along the north west part of the mainland coast, the coast between Millingimbi and Arnhem Bay, and the Port McArthur area. This latter area is probably their most important area in the Top End. In other areas with high numbers of migratory shorebirds, such as Chambers Bay and the northern part of Blue Mud Bay, they were much less abundant. Even though in low numbers around other sections of the coast, there were no long stretches without this species being recorded at least once. Perhaps the coast between the Port McArthur area and the Queensland boarder may be largely devoid of this species, as might some of the northern coast of the Gulf of Carpentaria.

Like Terek Sandpipers, Grey-tailed Tattlers frequently roosted in smaller groups in the bases of mangroves, particularly in larger bays where there was not much open area at high tide. As explained with Terek Sandpipers, some of these roosts may have been missed during some surveys.

Numbers

Throughout all surveys there were 165 ground records totalling approximately 9 900 Grey-tailed Tattlers. These equate to approximately 5% of the records and 3% of the numbers of all group 1 species. There were also 39 aerial records of Grey-tailed Tattlers. Thus Grey-tailed Tattlers were one of the more frequently recorded and abundant of the shorebirds seen during these surveys.

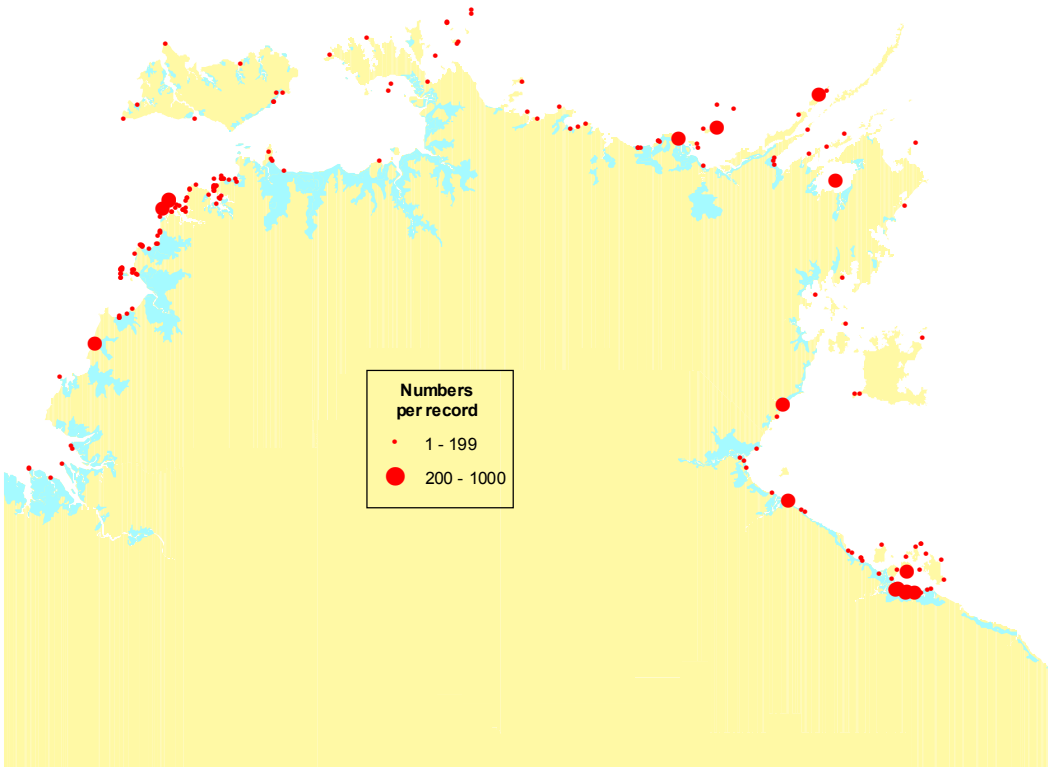


Figure 77. Distribution of all Grey-tailed Tattler records.

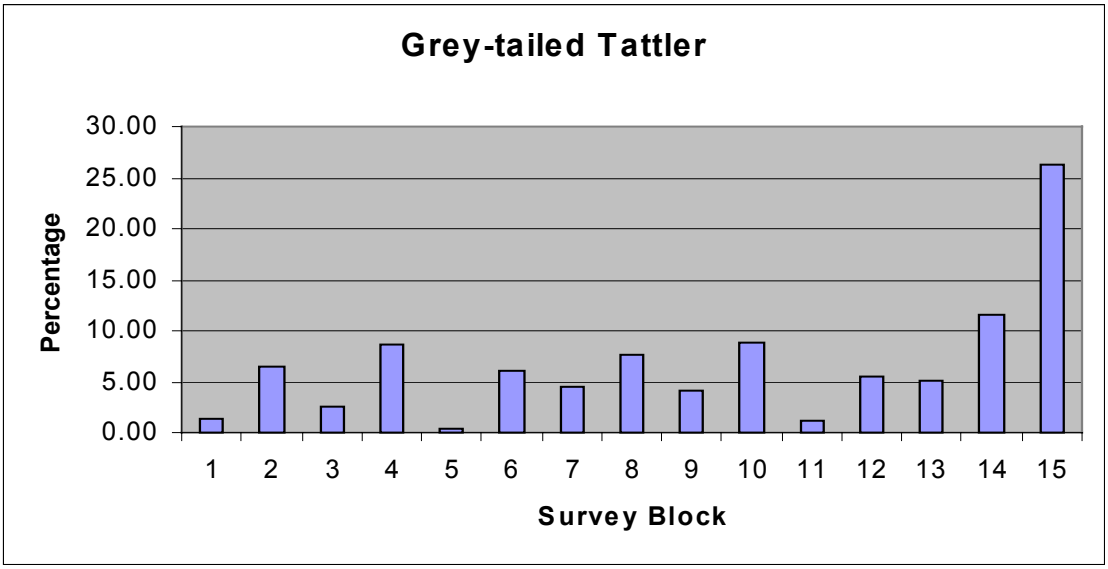


Figure 78. Percentage of Grey-tailed Tattler numbers by survey block.

The highest numbers of Grey-tailed Tattlers were recorded in survey blocks 14 and 15, while lowest numbers were in blocks 1, 5, and 11 (Figure 78). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B13, Appendix B.

The largest single flock count was 1 000. This was recorded in mid October 1996 in the Port McArthur area (survey block 15). There was also another 200 recorded in a ground count close to this site. These were counted during a helicopter survey of a few selected ground sites in the area so would be well under the true number in the complete Port McArthur area. Several other single flock counts of between 300 and 660 were also made in this general area in late May 1994, late July 1998 and September 1994 during other surveys. Hence it appears an important area for Grey-tailed Tattlers during both breeding and non-breeding seasons. Other particularly high single flock counts included 500 near the mouth of the Limmen River (survey block 14) in mid July 1998, 600 on Low Island in Arnhem Bay (survey block 13) in mid November 1993, 550 off Millingimbi (survey block 8) in late July 1998 and 400 on an island off Bynoe Harbour (survey block 4) in mid September 1993. Many of the larger roosting flocks were on inshore islands.

The calculated minimum estimate of the peak number of Grey-tailed Tattlers, likely to have been present in the Top End during these surveys, is at least 16 000 birds.

Seasonality

The two histograms relating to Grey-tailed Tattler numbers, again do not suggest readily obvious trends, and are also likely to be influenced by area biases in the surveys. Nevertheless, both indicate an increase in numbers per record (Figure C28) and the numbers as a percentage of all group 1 species combined (Figure C29), from June to July. This again suggests that Grey-tailed Tattler numbers in the Top End may also be high during the breeding season. Further evidence of this can be shown from the individual records. Of the top 25 single flock records (all in excess of 100 birds), 13 are between late May and mid August. Most of the large July counts were in the latter part that month, so the July peak may also suggest the first of the arriving birds.

Except for a small drop in April the histogram depicting the number of records of Grey-tailed Tattlers as a percentage of all group 1 shorebirds remained fairly constant throughout the year (Figure C30). This suggests no large and temporary changes in terms recording Grey-tailed Tattlers and a consistent overall distributional pattern in both breeding and non-breeding seasons.

Minton (1995) reports Grey-tailed Tattlers departing from the Broome area of Western Australia in late April. They then start to arrive in the last two weeks of August, but most arrive in September. Lane (1987) reports birds arrive on the north coast of Australia in late August and early September, with first year birds arriving about four weeks later. They depart the north west of Western Australia in April.

Breeding Plumage

No comments were recorded in relation to breeding plumage for this species during these surveys.

GREY-TAILED TATTLER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔✔	16 000	Birds present all year, migrants possibly start arriving late July producing higher numbers through to November. Most migrating birds probably leave during May
	Islands	✔✔		
	Wetlands	R		

Plate 21. Coast near the McArthur River, where a single flock of over 1 000 Grey-tailed Tattlers was recorded roosting, October 1996. Photo R. Chatto.

Ruddy Turnstone

Geographic Distribution

Ruddy Turnstones were recorded as reasonably widespread around the Top End coast (Figure 79). They had a greater preference for islands, and with a liking of rocky areas, they were one of the more commonly recorded shorebirds on islands further offshore. The most important areas located during these surveys for Ruddy Turnstones were North Perron Island, the islands off Bynoe Harbour, the small islands to the north and east of Croker Island, the islands off Millingimbi, the island chains off north east Arnhem Land, and the Sir Edward Pellew Islands. Ruddy Turnstones had a lesser preference for mangrove and mudflat dominated areas. Consequently they were less abundant in areas such as in the south west of the Top End, Chambers Bay and much of the mainland coast in the Gulf of Carpentaria. They were also very rarely recorded on inland wetlands

On some islands Ruddy Turnstones were found (presumably feeding) in long and short grassy areas in the middle of the island. They have also been seen on ovals in Port Headland, Western Australia (Bamford, *pers. comm.*).

Numbers

Throughout all surveys there were 149 ground records totalling approximately 3 700 Ruddy Turnstones. These equate to approximately 4% of the records and 1% of the numbers of all group 1 species. There were also 64 aerial records of Ruddy Turnstones. Thus Ruddy Turnstones were one of the more frequently recorded but less abundant of the shorebirds recorded during these surveys.

The highest numbers of Ruddy Turnstones were recorded in survey blocks 4, 7, 8 and 10, while lowest numbers were in blocks 5, 6, 12 and 13 (Figure 80). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B14, Appendix B.

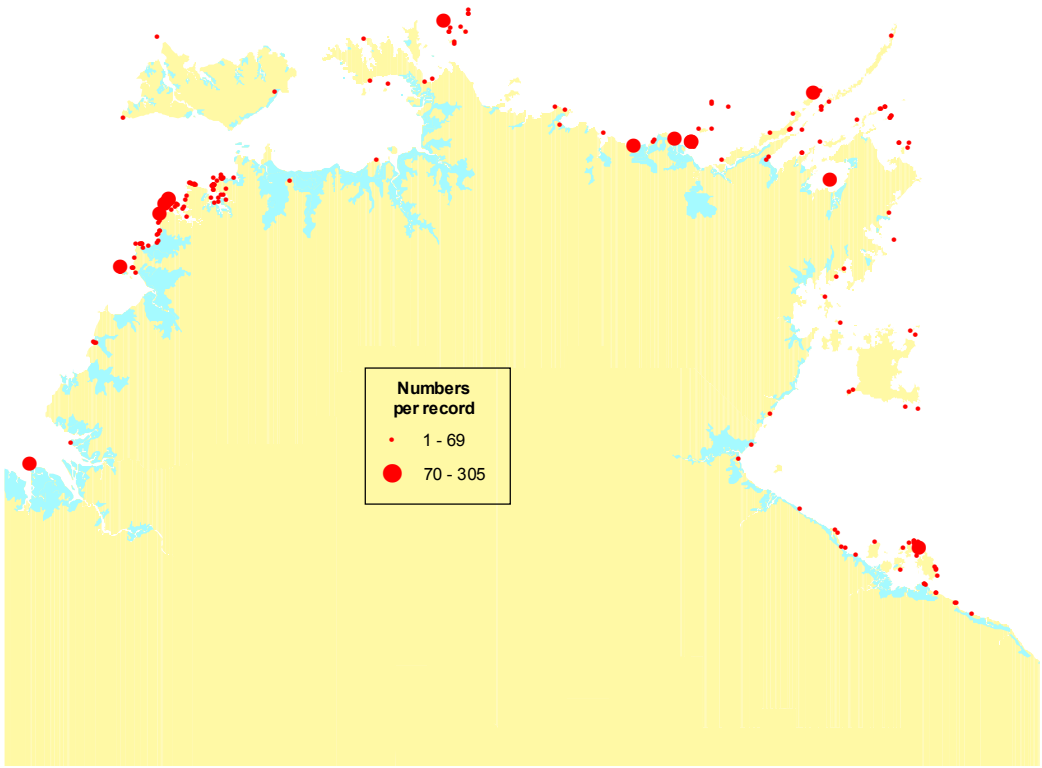


Figure 79. Distribution of all Ruddy Turnstone records.

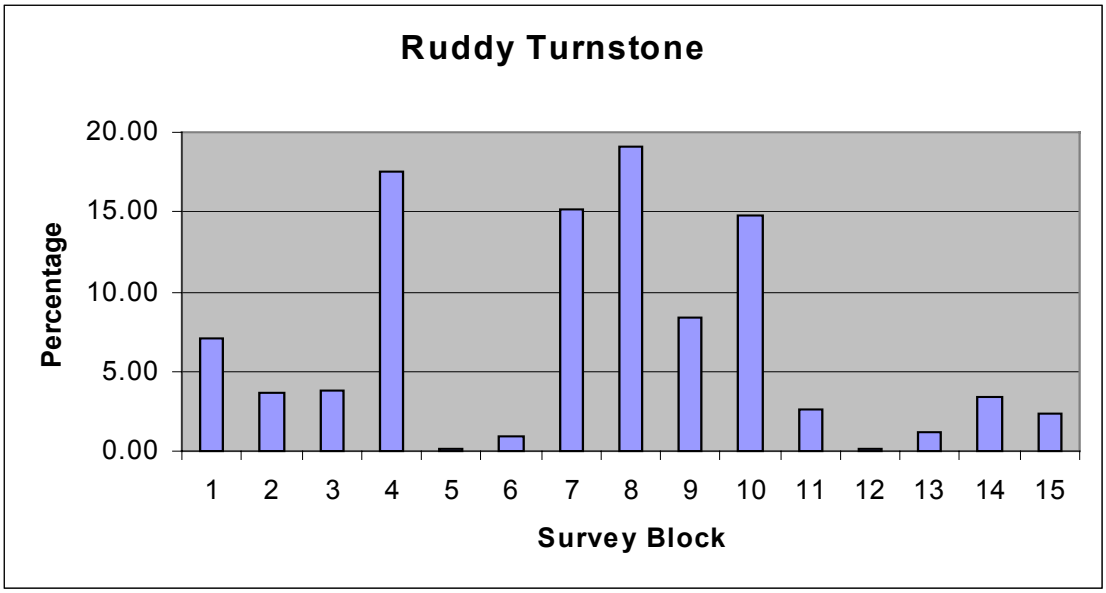


Figure 80. Percentage of Ruddy Turnstone numbers by survey block.

The largest single roosting flock was 305. This was in late July 1998 on an island off Millingimbi (survey block 8). This was easily the largest count for this species in four surveys done at this site, the next highest being of 60 birds. The other three were done in March, June and December. There was another single flock of 150 on a nearby island at the same time as the July record. It was also the largest of three surveys done at that site, the other two being in March and April. Although only a small number of surveys, and not a comprehensive cover of the surrounding area, this suggests that either birds begin arriving back from breeding in late July or that this area has very large over-wintering numbers.

The next highest single count was 300. This was an island off Bynoe Harbour (survey block 4) in mid September 1999. There was also a group 50 located on a nearby island on this survey. Unlike the previous example these counts were considerably higher than others done in the area in July. Again the counts are not directly comparable but it suggests that the situation on the islands off Bynoe Harbour is not the same as Millingimbi. This raises the need to look more closely at possible seasonal movements within the Northern Territory as well as in and out of the Northern Territory.

The calculated minimum estimate of the peak number of Ruddy Turnstones, likely to have been present in the Top End during these surveys, is at least 5 000 birds.

Seasonality

The histograms relating to Ruddy Turnstones are not easy to fully explain, and like many of the species discussed here are probably affected by area biases in the surveys. Nevertheless, both the histogram relating to numbers per record (Figure C31) and that relating to the number of Ruddy Turnstones as a percentage of all group 1 species combined (Figure C32), suggest a slight increase from the August to November period. This could be related to arriving birds. The July peak could be mostly due to large counts made on July 30, possibly including birds newly arrived after breeding. However, a higher peak in June supports the above comments relating to high over-wintering numbers in parts of the Top End.

The lack of higher peaks around the departure time of the year may be due to survey bias (for example, none of the main areas were ground counted in April but most were counted in September), or it could mean that Ruddy Turnstones do not form large groups prior to departure. The small drop after March in these two histograms could mean some birds were departing around this time.

Although slightly larger in magnitude than that of Grey-tailed Tattlers there was also a slight drop in the breeding season for the number of records as a percentage of all group 1 shorebirds but basically it also remained fairly constant throughout the year (Figure C33). This suggests no large temporary changes in terms of numbers of records and a consistent distributional pattern in both breeding and non-breeding seasons.

Minton (1995) reports Ruddy Turnstones departing from the Broome area of Western Australia in late April. They start arriving in the last two weeks of August but most arrive in September. Lane (1987) reports arrival in August in both Darwin and north west Western Australian, and a continuous departure passage through the latter area from late March to the third week of April.

Breeding Plumage

Breeding plumage comments were made on five occasions. Counts of between 10 and 40 birds were made on three occasions in early September and on one occasion in late March where lots of breeding plumage was recorded. Another count of 200 birds in late June recorded some breeding plumage being present.

RUDDY TURNSTONE SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔	5 000	Birds present all year, possibly begin arriving in late July and depart in March.
	Islands	✔✔✔		
	Wetlands	R		

Plate 22. Bare Sand and Quail Island area, where over 300 Ruddy Turnstones were recorded in a single group, September 1999. Photo R. Chatto.

Asian Dowitcher

Geographic Distribution

Asian Dowitchers were only recorded from six separate locations during these surveys (Figure 81). Four of these records were from within 50 kilometres of Darwin, one in Blue Mud Bay and one in the Port McArthur area. It is possible that these birds could be more numerous and widespread than these records suggest, especially given the dispersed nature of the records, however it is doubtful that they are very common in the Top End. Asian Dowitchers may have been present among either aerial *godwit spp.* counts or missed among Black-tailed or Bar-tailed Godwit individual species ground counts, because of the lack of close flock inspection in many of these surveys.

Higgins and Davies (1996) also report single records of 15 at Boucaut Bay and one at Millingimbi, both in October 1986. These were areas where I did not record them, but did record many godwits.

Numbers

Throughout all surveys there were eight ground records totalling approximately 130 Asian Dowitchers. These equate to <1% of the records and <1% of the numbers of all group 1 species. Thus Asian Dowitchers were one of the less frequently recorded and less abundant of the shorebirds recorded during these surveys.

Asian Dowitchers were only recorded in survey blocks 1, 4, 5, 6, 10 and 15, with the highest numbers easily being in survey block 15 (Figure 82). Further details, by survey block, can be found in Table B 15, Appendix B.

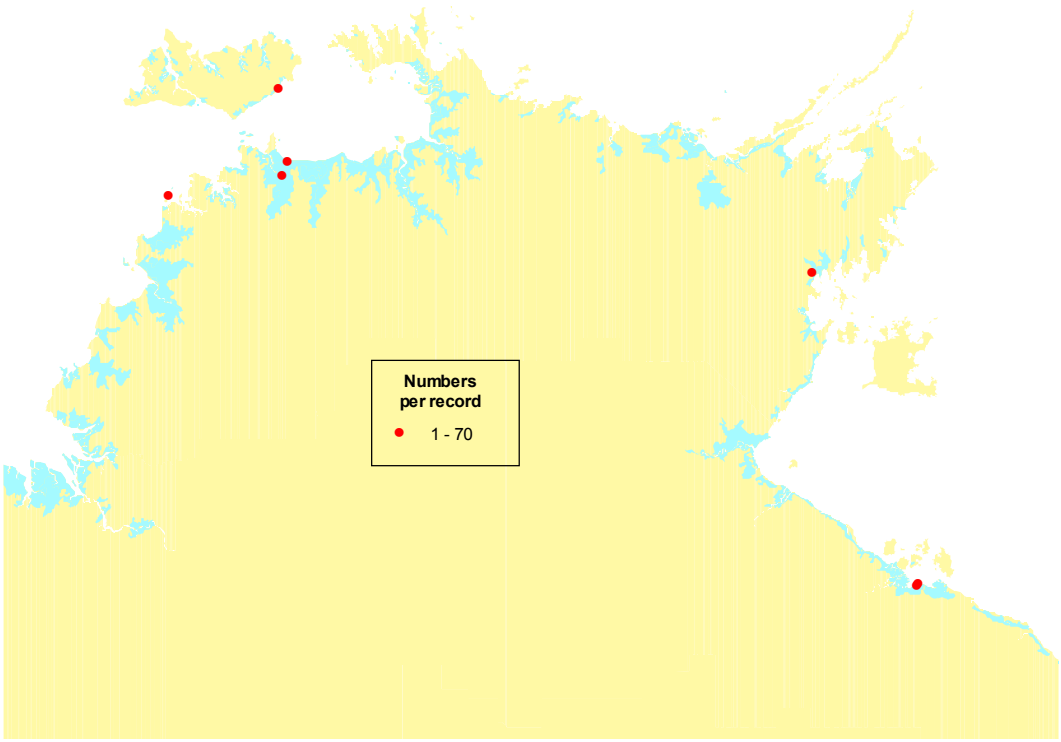


Figure 81. Distribution of all Asian Dowitcher records.

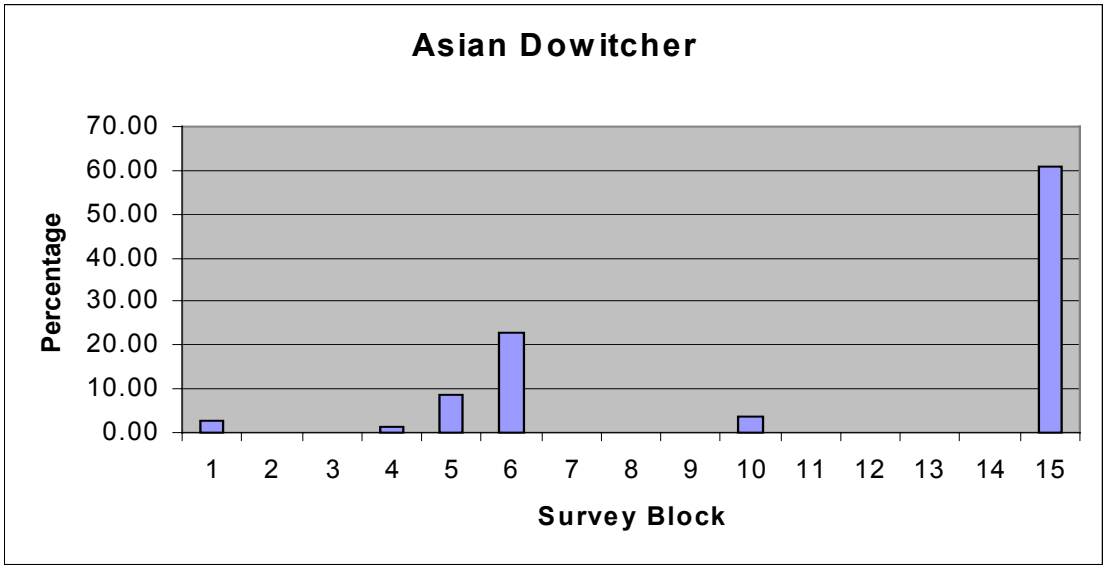


Figure 82. Percentage of Asian Dowitcher numbers by survey block.

The largest single count of Asian Dowitchers was 70 on saline swamp just behind the coast in the Port McArthur area (survey block 15). Surprisingly this was also a late July count and it is more than three times the number of any other Asian Dowitcher counts which were well spread over the different months of the year.

The calculated minimum estimate of the peak number of Asian Dowitchers, likely to have been present in the Top End during these surveys, is at least 190 birds.

Seasonality

Other than the comment made above, there are too few records to attempt to discuss seasonality for this species. Lane (1987) reports north west Western Australian arrival in early September and departure in the third week of April.

Breeding Plumage

The only comment relating to breeding plumage was that of the 70 birds seen in late July, there were a small percentage that had significant breeding colour.

ASIAN DOWITCHER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast Islands Wetlands	✔ R ✔	190	Too few records to say much. Scattered records throughout year. Possibly some departure in late May and some arrival in late July.

Great Knot

Geographic Distribution

Great Knots were widely distributed around the Top End coast, although they were mostly recorded along the north and north western coasts (Figure 83). Great Knots were mainly associated with mangrove and mudflat habitats within these areas. They were not recorded on inland swamps, except at exceptionally high tides and/or bad weather, and not often on islands other than the southern coast of the Tiwi Islands. The most significant areas for Great Knots were along the coast from the Daly River to Murgenella Creek (particularly the Fog Bay area), the coast from Junction to Buckingham Bays, and the coast from Port McArthur to the Roper River. Areas of least importance to Great Knots were the south west part of the Top End, the northern coast of the Tiwi Islands, Cobourg Peninsula and the coast to the east of there, and the islands and coast between the Buckingham Bay and the Roper River. Adding in the *knot spp.* distribution records does not greatly increase the distribution of Great Knots; however, it does suggest much higher numbers in the area north of Joseph Bonaparte Gulf and to the north east of Buckingham Bay.

Numbers

Throughout all surveys there were 245 ground records totalling approximately 90 000 Great Knots. These equate to approximately 7% of the records and 23% of the numbers of all group 1 species. There were also 40 aerial records of Great Knots. Thus Great Knots were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys.

The highest numbers of Great Knots were recorded in survey blocks 3, 7 and 8, while lowest numbers were in blocks 1, 9 and 12 (Figure 84). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B16, Appendix B.

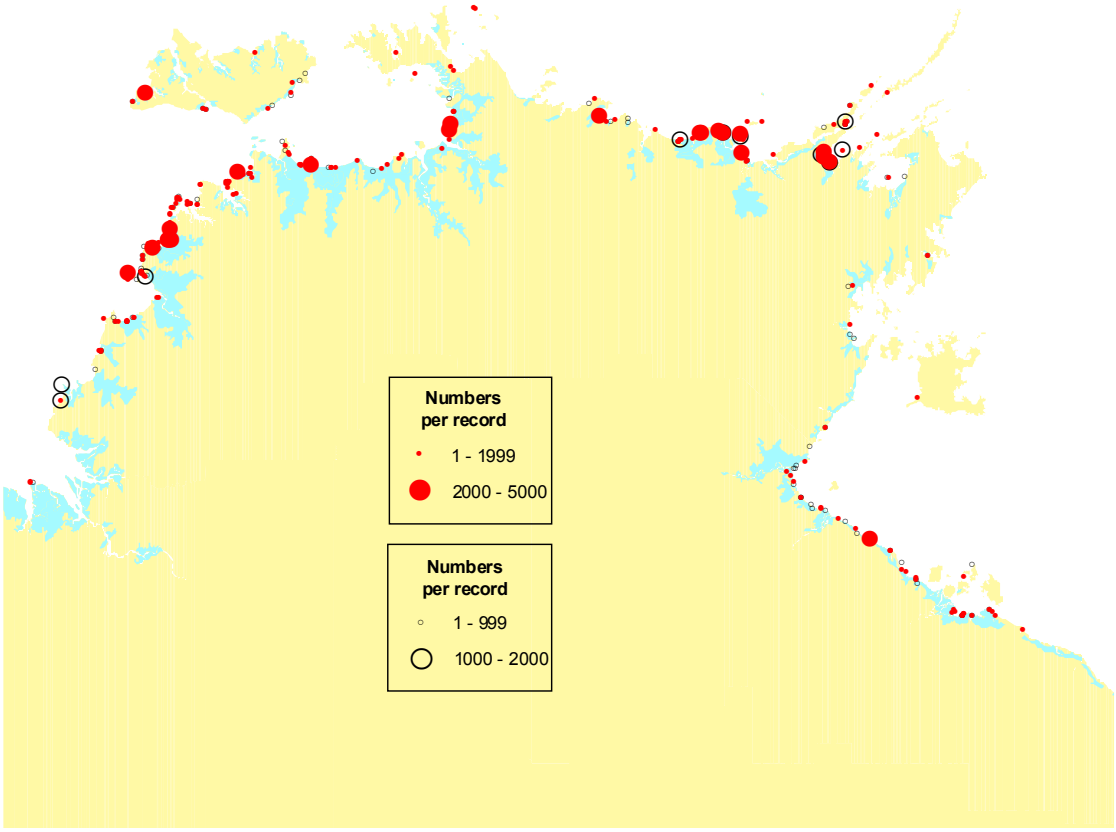


Figure 83. Distribution of all Great Knot records. (Hollow black circles represent *knot spp.* records).

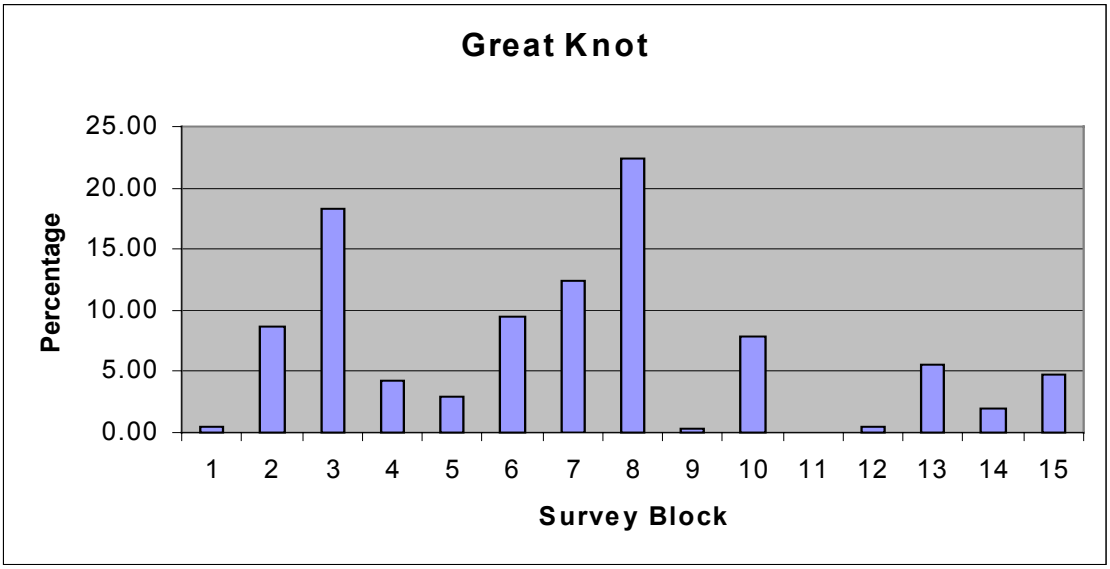


Figure 84. Percentage of Great Knot numbers by survey block.

The largest single ground count for Great Knots was 5 000. This was in Fog Bay (survey block 3) in late December 1992. Two other nearby sites had counts of 2 500 at the same time. There were certainly more Great Knots in the bay at the time but no count of the total area was carried out. Many aerial counts of Fog Bay were primarily recorded at *wader spp.* level. With a number of such counts being near or in excess of 25 000, and Great Knots being the dominant species there, it is likely that the above 10 000 Great Knots would have been less than the true number present at the time.

The next highest single ground count of 4 500 is from another of the more important areas for Great Knots. This was in late March 1999 (with most birds in good breeding plumage) in Castlereagh Bay (survey block 8). Three other sites between there and the eastern end of Boucaut Bay also had single ground counts of 2-3000 Great Knots so the numbers in this area were probably also well over 10 000.

The calculated minimum estimate of the peak number of Great Knots, likely to have been present in the Top End during these surveys, is at least 122 000 birds.

Seasonality

Both the number of Great Knots per record (Figure C34) and their numbers as a percentage of all group 1 species (figure C35) showed their highest peak in March suggesting a pre-departure increase in average flock size and relative numbers. Field notes made on a survey along the coast, north of the East Alligator River on 10 May 1992 suggested there had been a significant departure of birds since 23 April 1992. As Great Knots are a significant percentage of the shorebirds along this coast, perhaps departure continues into late April or early May. There was no such clearly higher peak in the August to October period suggesting that perhaps that the birds spread out more when they arrive and that they may also arrive over a considerable period of time. Great Knots flying in large 'V' formations, and likely to be newly arrived birds were seen as early as mid July in Fog Bay, however these are likely to be arriving before the main numbers.

Field notes made on surveys on 22 July 1998 along the south east Top End coast stated that Great Knots were among the most numerous of the shorebirds, and certainly the dominant knot present. Many were in breeding plumage and appeared to be newly arrived.

The number of Great Knot records as a percentage of all group 1 species was relatively consistent throughout the year, suggesting no large and sudden change in the number of times they were recorded compared to the other species or their overall distribution during the year (Figure C36).

Minton (1995) reports most Great Knots departing from the Broome area of Western Australia in the last week of March, while most arrive in the last week of August. Lane (1987) reports large numbers arrive in north west Western Australian in late August and early September, but juveniles and many males may not arrive until October/November. Departure from the north coast is in March and April. Garnett and Taplin (1990) reported birds in the Gulf of Carpentaria in late March appeared ready to move.

Crawford (1997) found counts of Great Knots at the coastal sites near Darwin showed a substantial relative increase from August to September and then a second continual period of increase from September 1970 through to January 1971, and a substantial increase from October to November 1971. These perhaps suggest birds arriving in Darwin at this time, and possibly in more than one wave. There was also a large drop in numbers between April and May suggesting departing birds.

Breeding Plumage

As there were quite a few (brief) notes made of the breeding plumage condition of Great Knots, they are included in a Table 13. Locations are not given but they were from well spread sites.

These notes show that many birds go into breeding plumage before migrating, then arrive back still in breeding plumage. Some birds remaining in the Top End during the breeding season also go into breeding plumage. Perhaps some of these birds went into breeding plumage with the intention of migrating and then chose not to migrate. Garnett (1986) also reports about 20% of the knots present in June in the south-east of the Gulf of Carpentaria in full breeding plumage.

The records of a low percentage of breeding plumage in mid August, following a high percentage in mid July, and then high again in early September may suggest a first wave arriving in July and a second wave arriving in September.

Table 13. Breeding plumage (BP) notes for Great Knot.

Date	Nos	Breeding plumage (BP) comment
24/3/99	4500	Vast majority in some stage of BP.
25/3/99	1000	Lots of BP.
23/4/96	170	Lots of BP.
12/5/93	630	Most partial BP some full or near full BP.
12/6/93	1200	Most in some stage of BP.
18/6/99	230	Lots of BP.
5/7/96	680	1% in full or near full BP.
17/7/98	1800	High percentage of birds in BP.
23/7/98	300	Small percentage in full or near full BP.
5/8/97	4000	Birds in various stages of BP through to full or near full BP.
18/8/92	750	Some birds with signs of BP.
6/9/96	300	Most birds with good amounts of BP.
8/9/93	120	Some BP.
9/9/93	480	Lot of birds in BP.

GREAT KNOT SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, but mostly northern and NW coasts.	Coast Islands Wetlands	✔✔✔ ✔ R	122 000	Many birds present all year. Departure and arrival possibly protracted or in separate main waves. Departure March to May and arrival late July to September.

Red Knot

Geographic Distribution

Red Knots were recorded around most of the Top End coast (Figure 85). Like Great Knots they were also mainly associated with mangrove and mudflat areas. Red Knots were usually present with Great Knots however as their numbers were usually much less they were not recorded to species level as often as Great Knots, particularly in aerial observations. Like Great Knots, they were also not recorded on inland swamps or on islands other than the Tiwi Islands.

The most important areas for Red Knots were the coast between the Daly River and the islands off Bynoe Harbour (particularly the Fog Bay area), the coast from Boucaut Bay to Buckingham Bay (including the Cadell Straits) and the coasts in the vicinity of the Roper River and Port McArthur. Areas of least importance to Red Knots included the south west part of the Top End, the northern coast of the Tiwi Islands, Cobourg Peninsula and the coast to the east of there, the islands and coast off north east Arnhem Land, and between Buckingham Bay and the Roper River. G. Brennan (in Noske and Brennan, 2002) confirms their rareness on Groote Eylandt by only recording them on one occasion over the 17 years he was living there.

Numbers

Throughout all surveys there were 144 ground records totalling approximately 13 800 Red Knots. These equate to approximately 4% of the records and 4% of the numbers of all group 1 species. There were also six aerial records of Red Knots. Thus Red Knots were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys.

The largest numbers of Red Knots were recorded in survey blocks 3, 8, 10 and 13, while lowest numbers (when recorded) were in blocks 1 and 12 (Figure 86). This species was recorded in all survey blocks except 9 and 11, which are both predominantly coastal island blocks. Further details, by survey block, can be found in Table B17, Appendix B.

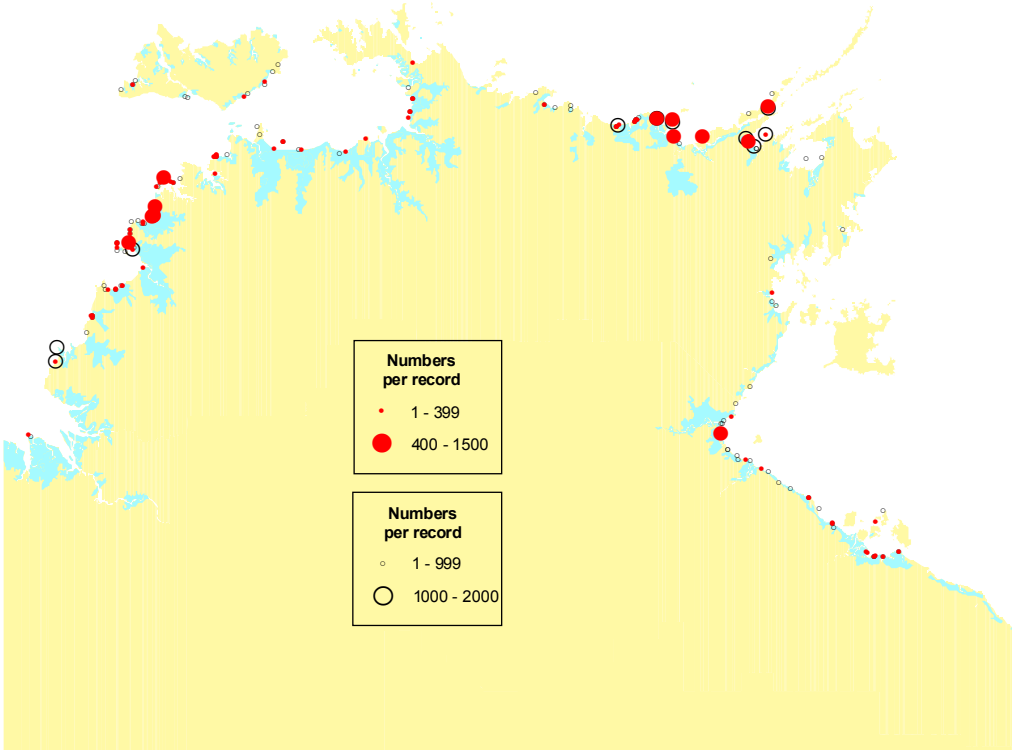


Figure 85. Distribution of all Red Knot records. (Hollow black circles represent *knot spp*. records).

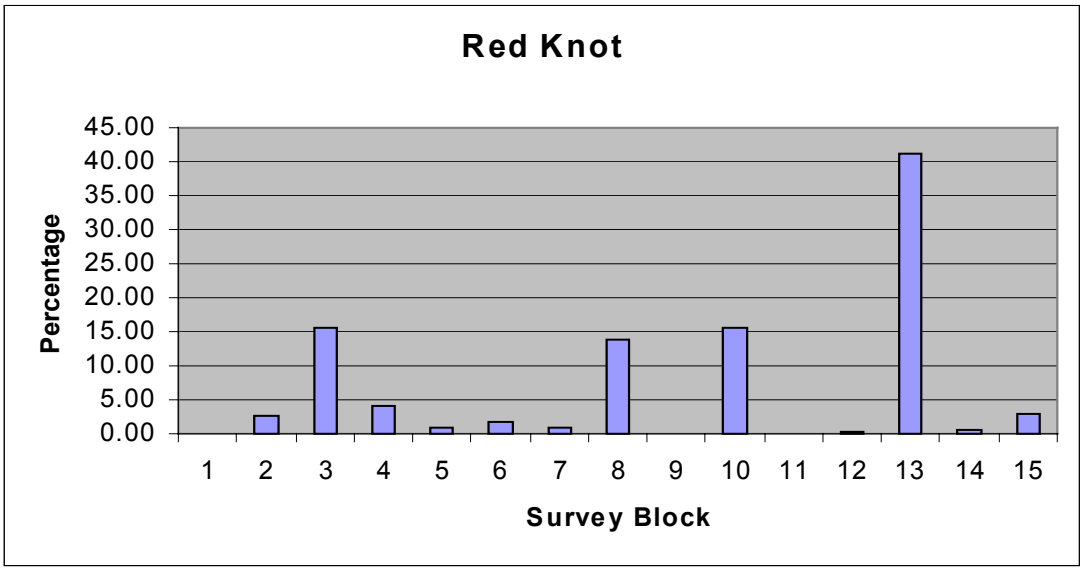


Figure 86. Percentage of Red Knot numbers by survey block.

The largest single ground count for Red Knots was 1 500. This was on the coast near the mouth of the Roper River (survey block 13) in mid October 1996. The next highest single flock count of 1 200 was in Fog Bay (survey block 3) in early September 1996. As was the case for Great Knots, many aerial counts of Fog Bay were only to *wader spp.* level. With counts of over 25 000 waders it is likely that more than 1 500 of these would have been Red Knots, during the September/October period at least. Other high single flock counts in this area were 1 000 in early August 1997 and 900 in mid June 1992.

There were 900 Red Knots recorded in a single flock on one of the islands off Millingimbi (survey block 8) in mid December 1998. Counts of only 100 were recorded at the same site in late March 1999 and mid June 1996.

The calculated minimum estimate of the peak number of Red Knots, likely to have been present in the Top End during these surveys, is at least 24 200 birds.

Seasonality

The monthly histograms for Red Knots (Figures C37-39) are difficult to interpret and are of no real value in trying to explain Red Knot seasonality. This is possibly partly due to the low number of confirmed records of Red Knots compared to the high numbers of *knot spp.* records, and the varied geographical distribution of Red Knots during the year. The 12 highest individual records for single flocks show most to be in March or the August to October period. It is interesting to note, that despite the small number of records, all the March records are in the north east of the Top End but only one of the August to October records is in that area. Perhaps this is an important area for Red Knots immediately prior to departure to their northern breeding grounds. In the other two main areas that Red Knots were found during these surveys this situation was reversed. Perhaps their post-breeding route is different, arriving in the north west of the Top End and then moving through the south west of the Gulf of Carpentaria on their way south. As they do not appear to be in this south west Gulf of Carpentaria area prior to their March presence in the north east of the Top End, perhaps they move into this departure area of the north east Top End via Cape York Peninsula rather than the Northern Territory. (Maybe many simply over-fly the Northern Territory on the northern migration). Regardless, Red Knot numbers vary seasonally in different parts of the Top End.

Further evidence of the southward movement through the Top End was the September capture of a Red Knot in Fog Bay that had been originally banded in New Zealand. Also, surveys of the coast and swamps in behind Junction Bay and through to Castlereagh Bay (both in the north east) revealed very large numbers of waders in mid November 2000 compared to surveys of the same area in July 1998.

Despite this, there were considerably fewer Red Knots (and Eastern Curlews) in the November surveys compared to the July surveys.

Garnett (1986) found Red Knots to be one of the most abundant species in the south-east Gulf of Carpentaria in September 1983, but much less in number by December. This suggests many birds have arrived by September and have moved further south by December. Garnett did not report this same influx and efflux in the March-May period. Although they had increased a little in numbers by June, these birds were not likely to continue migration. These observations also support the possibility of mostly one way migration movement through this area.

Minton (2000) reports Red Knots departing as late as mid May from the Broome area of Western Australia, but most go in late April. They start arriving in the last two weeks of August but most arrive in September.

Watkins (1993) reports that Red Knots arrive in north west Western Australia between the end of August and early September. They rapidly increases their weight here before migrating further, with numbers showing a 50% decline by November. Lane (1986) reports peak numbers in Darwin in September and October. On their return migration Lane suggests no evidence of passage through Darwin and only small flocks pass through the Gulf of Carpentaria in March and April.

Breeding Plumage

As there were quite a few (brief) notes made of the breeding plumage condition of Red Knots, they are included in a Table 14. Locations are not given but they were from well spread sites.

These notes show that many birds go into breeding plumage before migrating then arrive back still in breeding plumage. Red Knots remaining in the Top End during the breeding season may be less likely to go into breeding plumage than Great Knots although the latter had much higher flock sizes in order to find birds in breeding plumage.

Table 14. Breeding plumage (BP) notes for Red Knot.

Date	Nos	Breeding plumage (BP) comment
25/3/99	100	Lots of BP.
23/4/96	30	Lots of BP.
4/5/93	4	Partial BP.
18/6/99	20	Only one in BP.
16/7/96	2	One in full and one near full BP.
22/7/98	10	At least one in near full BP.
23/7/98	30	Small percentage in full or near full BP.
16/8/97	5	Only faint traces of BP.
8/9/93	40	Some BP.

RED KNOT SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, particularly NW and NE mainland	Coast Islands Wetlands	✔✔✔ R R	24 200	Complex, varies in different parts of the Top End. Arrive from late July but move on by November, depart March/April. Arrive through NW Top End and then on to SE, depart from NE (possibly coming via Qld rather than NT) with some possibly totally over-flying NT on northward migration.

Sanderling

Geographic Distribution

Sanderlings were infrequently recorded in these surveys. Although mainly on the west coast of the Top End they were also recorded from Bathurst Island, the Millingimbi area and Groote Eylandt (Figure 87). This species often frequents beach type habitats, which do not attract the large numbers of other shorebirds. As previously discussed, these sorts of low density shorebird areas are less frequently counted so it is possible that their distribution could be more widespread than recorded in these surveys. This species was also not recorded from the air very often.

The three areas with larger numbers of Sanderlings recorded were Turtle Point in Joseph Bonaparte Gulf, the Lee Point to Buffalo Creek area in Darwin, and Boucaut Bay.

Numbers

Throughout all surveys there were 21 ground records totalling approximately 800 Sanderlings. These equate to approximately 1% of the records and <1% of the numbers of all group 1 species. There were also two aerial records of Sanderlings. Thus Sanderlings were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

Sanderlings were mainly recorded in survey blocks 1, 3, 4, 8 and 11 (Figure 88). The remaining blocks had few or no records. Further details, by survey block, can be found in Table B18, Appendix B.

The largest single flock counts were between 100 and 200. These were at the sites mentioned above.

The calculated minimum estimate of the peak number of Sanderlings, likely to have been present in the Top End during these surveys, is at least 890 birds. In light of the above discussion, this is likely to be well under their true peak numbers.

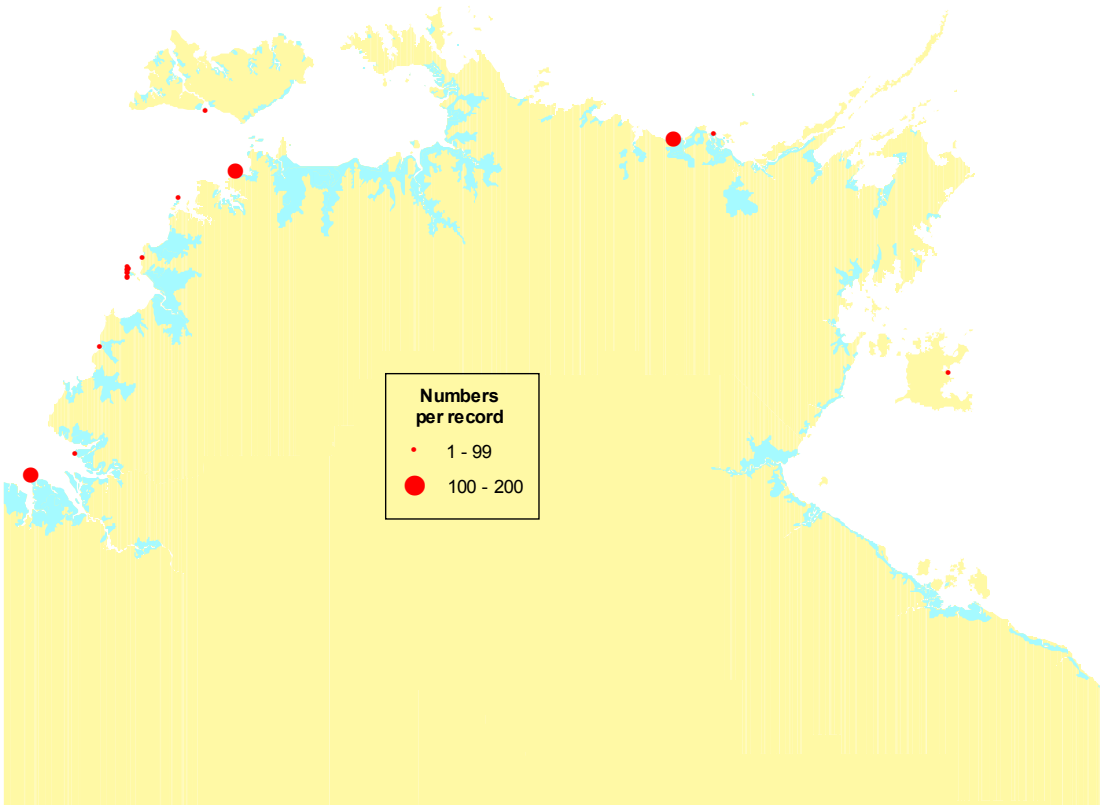


Figure 87. Distribution of all Sanderling records.

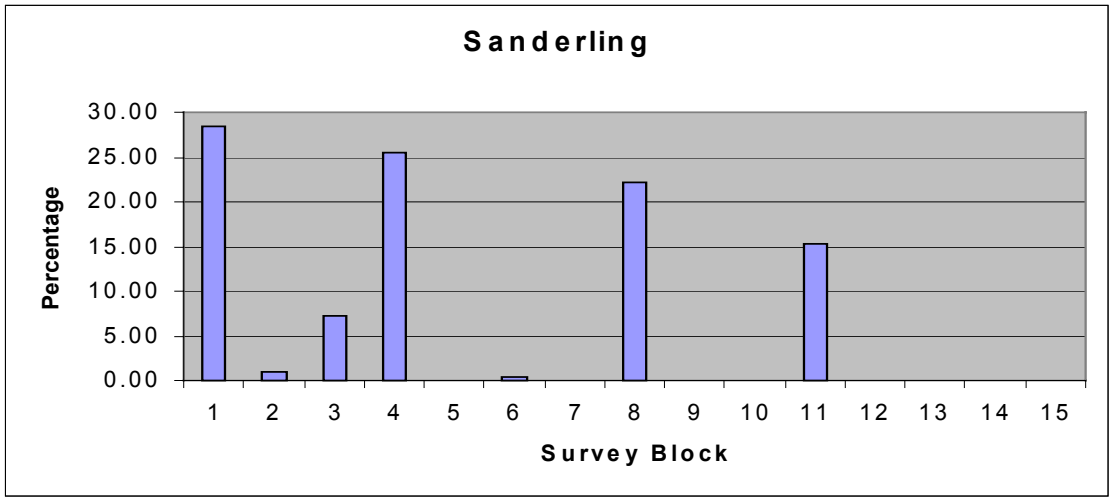


Figure 88. Percentage of Sanderling numbers by survey block.

Seasonality

With so few counts for this species and with three of the counts being double any of the others, interpretation of the monthly histograms could be a bit unreliable. In terms of both of the numbers histograms (Figures C40 and C41) there are two high peaks, one in March and one in November. The high peak in March relates to the fact that the second, third and fourth highest counts for Sanderling in these surveys were in this month, and they were clearly dominant over any other counts. This may be survey bias but is it is possible that it could also have been due to departing birds forming into flocks. The November peak is probably effected by the highest count being made in this month. As it was very late in the month is likely to be too late to represent arriving birds.

In terms of the number of records of Sanderlings as a percentage of all group 1 species combined, the highest percentages are in the months prior to departure (Figure C42). There is a continuing decline from February to April.

Minton (*pers. comm.*) says Sanderlings depart from the Broome area of Western Australia in late April. While they possibly start arriving in the last two weeks of August, most arrive in September.

Lane (1986) reports birds arrive into Australia during September. They then move through north west Western Australian and Darwin between September and November to cross the continent to southern Australia. Garnett (1986) reports they do not pass through the Gulf of Carpentaria in large numbers. On their northward journey Lane reports at least some passing through Darwin in March and April, with few passing through north west Western Australia.

Breeding Plumage

The only reference to breeding plumage was made in late June 1999 when some of a group of 15 birds were report to have some breeding plumage present.

SANDERLING SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	✔✔	890	Uncertain, possible departure from March to April. At other end of season number increase in November but not sure of meaning of this.
	Islands	R		
	Wetlands	R		

Red-necked Stint

Geographic Distribution

Red-necked Stints were recorded all around the Top End coast, some inland wetlands (mostly saline) and many of the offshore islands (Figure 89). The most significant areas were the north west coast of the Top End, Van Diemen Gulf, the coast from Junction to Castlereagh Bays, Blue Mud Bay, the coast near the mouth of the Roper River and the Port McArthur area. There were no large sections of coast in which there were no records of Red-necked Stints, except perhaps in survey block 2 and part of the mid north coast. However, neither of these areas had many ground surveys and aerial records of *wader spp.* from these areas may have included Red-necked Stints. Further, Red-necked Stints are likely to be more numerous than shown on the many open saline wetlands that run parallel to, and just inside, the coast from a little north of the Roper River to the Queensland border. Only a small proportion of the open saline wetlands were ground counted, but small waders (recorded only as *wader spp.* from the air) were spread throughout.

Numbers

Throughout all surveys there were 212 ground records totalling approximately 29 500 Red-necked Stints. These equate to approximately 6% of the records and 8% of the numbers of all group 1 species. There were also 17 aerial records of Red-necked Stints. Thus Red-necked Stints were one of the more frequently recorded and abundant of the shorebirds seen during these surveys.

The highest numbers of Red-necked Stints were recorded in survey blocks 6, 10 and 13, while lowest numbers were in blocks 2, 9 and 11 (Figure 90). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B19, Appendix B.

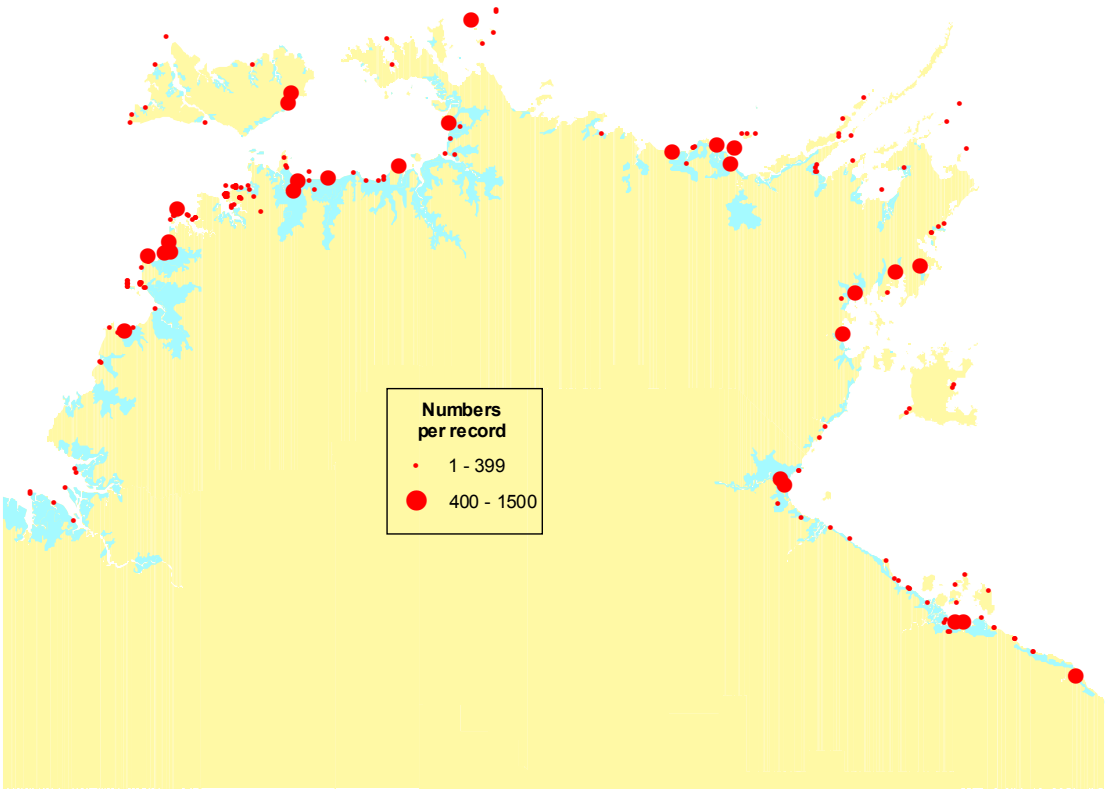


Figure 89. Distribution of all Red-necked Stint records.

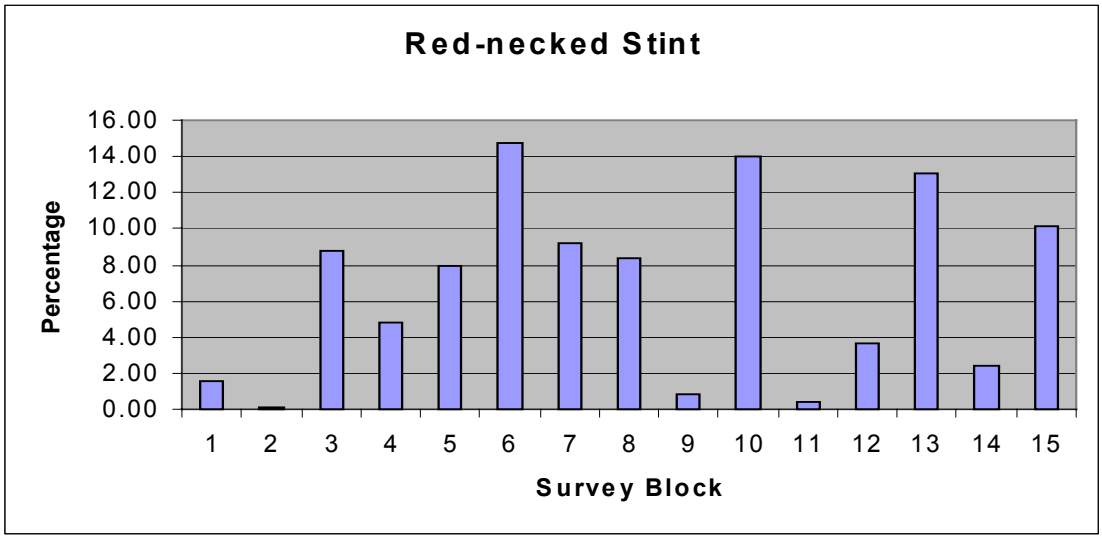


Figure 90. Percentage of Red-necked Stint numbers by survey block.

Plate 23. One of the many open saline splashes in the Port McArthur area, where over 1 000 Red-necked Stints were feeding, July 1998. Photo R. Chatto.

The largest single ground count for Red-necked Stints was 1 500. This was in Fog Bay (survey block 3) in late December 1992. The next highest single ground count of 1 200 was recorded in Blue Mud Bay (survey block10) in late July 1998, and the third highest single flock total of 1 000 birds was recorded in the Port McArthur area (survey block 15), also in late July 1998. In the case of this latter record another 200 were recorded at a nearby ground site at the same time. In all of these cases there were only a small number of ground counts done in the areas. However, in all three areas there were thousands of other waders in the vicinity at the time, which were not recorded to species level.

The calculated minimum estimate of the peak number of Red-necked Stints, likely to have been present in the Top End during these surveys, is at least 44 400 birds.

Seasonality

The histogram depicting the numbers per record (Figure C43) is erratic and of no use in attempting to deduce anything of seasonal nature for Red-necked Stints. The total numbers of Red-necked Stints as a percentage of all group 1 species (Figure C44) showed a slight drop in the over-wintering period, except for the month of July. This peak can be partially explained by the fact that all July ground surveys were in important Red-necked Stint areas. Even so, it is still possible that the high in July maybe due to large numbers of Red-necked Stints over-wintering in the Top End, or in the case of the late July counts, possibly including early arriving birds. The higher peaks in February were possibly the result of a number of surveys very late in the month, and hence may include birds flocking up prior to leaving.

Field notes made on a survey along the coast, north of the East Alligator River on 10 May 1992 suggested there had been a significant departure of birds since 23 April 1992. As there are reasonable numbers of Red-necked Stints along this coast, perhaps departure continues into late April or early May.

Apart from slightly higher peaks in February and July (discussed above), the number of Red-necked Stint records as a percentage of all group 1 species was relatively consistent throughout the year (Figure C45). This suggests that there were a similar number of records each month and therefore no large changes on their overall distribution resulting from inward or outward movements from the Top End.

Each of the histograms shows a jump from August to September, which could reflect arriving birds. This has some support from Garnett (1986) who found Red-necked Stints to be more abundant in the south-east Gulf of Carpentaria after September 1983. He also suggested a possible protracted arrival.

Minton (1995) reports Red-necked Stints were still to depart the Broome area of Western Australia by late April, while they arrive into the area from the last two weeks of August to early September.

Lane (1986) reports they first arrive in Australia in late August but large numbers do not appear until early September and leave between March and mid April.

Crawford (1997) found counts of Red-necked Stints at sites near Darwin showed a substantial relative increase from August through September to October in both 1970 and 1971, suggesting birds arriving at this time.

Breeding Plumage

The presence or lack of breeding plumage was recorded on six occasions in regard to Red-necked Stints. Surveys in mid July and mid August referred to none or very little breeding plumage on 450 birds. Three records in mid September, from observation of nearly 1 000 birds, suggested some (about 20% in one case) breeding plumage present. A late March record of 100 birds revealed a lot of breeding plumage present.

RED NECKED STINT SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, but less in SW.	Coast Islands Wetlands	✔✔✔ ✔✔ ✔✔	44 400	Many birds present all year. Possible arrival August/September and departure March/May.

Sharp-tailed Sandpiper

Geographic Distribution

The most important Sharp-tailed Sandpiper areas were the Daly and Finniss River areas, from Darwin to Murgenella Creek and the Port McArthur area (Figure 91). Elsewhere around the Top End smaller numbers were only patchily recorded but nevertheless still fairly widespread. Sharp-tailed Sandpipers occasionally roosted with other waders on the coast, but were usually recorded feeding on wetlands in behind the coast, particularly those areas in behind the southern and eastern shores of Van Diemen Gulf. There were also a few records from offshore islands. Noske and Brennan (2002) report them to be uncommon on Groote Eylandt.

Numbers

Throughout all surveys there were 130 ground records totalling approximately 18 500 Sharp-tailed Sandpipers. These equate to approximately 4% of the records and 5% of the numbers of all group 1 species. There were also nine aerial records of Sharp-tailed Sandpipers. Thus Sharp-tailed Sandpipers were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys.

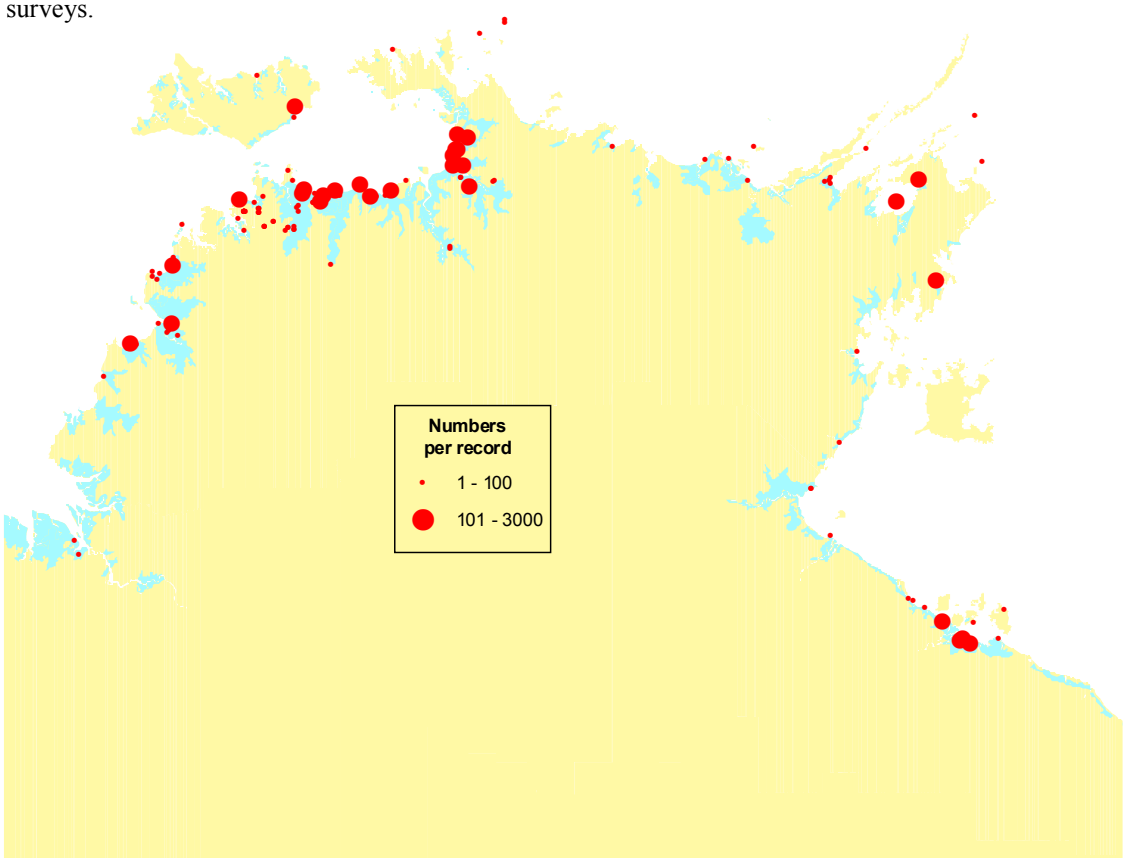


Figure 91. Distribution of all Sharp-tailed Sandpiper records.

The highest numbers of Sharp-tailed Sandpipers were recorded in survey blocks 5 and 6. The remaining blocks, except block 9, which had no records, had few Sharp-tailed Sandpipers recorded (Figure 92). Further details, by survey block, can be found in Table B20, Appendix B.

The largest single flock count was 3 000. This was in early May 1993 on a wetland near the mouth of the East Alligator River in survey block 5. (Further explanation of this count is discussed under the Marsh Sandpiper section). There was likely to have been many more Sharp-tailed Sandpipers in this area. The next largest count of 2 400 was from another wetland in this same area in late April 1992.

On this occasion there were another four counts of separate ground sites in the area that totalled 2 500 Sharp-tailed Sandpipers. Again it is likely that there were many more Sharp-tailed Sandpipers in this general area at the time.

The third largest single flock count is also mentioned here because it covers the other main area where high numbers for Sharp-tailed Sandpipers (for the Top End) were recorded during these surveys. This refers to the wetlands behind the Chambers Bay area (survey block 5). Here the largest single flock count of 2 000 was made on the same day as the early May count referred to above. Also on this day another 500 birds were counted at a second nearby site. No other counts were made in this area on this day but it is likely that many more Sharp-tailed Sandpipers were present in these extensive wetlands.

The calculated minimum estimate of the peak number of Sharp-tailed Sandpipers, likely to have been present in the Top End during these surveys, is at least 20 100 birds.

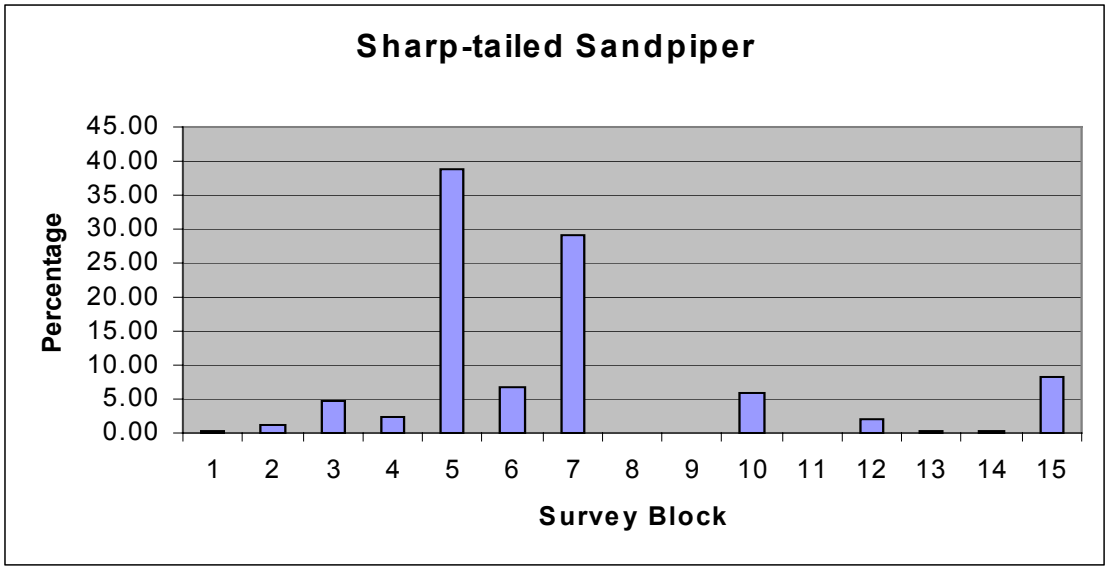


Figure 92. Percentage of Sharp-tailed Sandpiper numbers by survey block.

Seasonality

Sharp-tailed Sandpipers have a complex pattern of movement through the Top End. The number of Sharp-tailed Sandpipers per record (Figure C46) and their total numbers as a percentage of all group 1 shorebirds combined (Figure C47) both show clear peaks in the April and May period. A sharp drop in June suggests most birds are not leaving until during May. Surveys for this time covered many more areas than just the main Sharp-tailed Sandpiper areas, so survey bias is unlikely to be having a large effect. There is clearly a short-term influx into the Top End in April and May, and from the above distribution and numbers comments, this influx is restricted to only part of the Top End. Morton *et al* (1991), for example, reported that Sharp-tailed Sandpipers were not present in the wetlands of Kakadu during the period of their northward migration. The area where they were very abundant in my surveys at this time was less than 100 kilometres to the north west of the Kakadu wetlands so they appear very choosy about where they go at this time of year. My surveys were on wetlands that were closer to the coast and more saline than those in Morton's Kakadu surveys.

Another area where Sharp-tailed Sandpipers may also frequent prior to their northward migration out of Australia is the wetlands in the south east of the Gulf of Carpentaria, although these are mostly in Queensland and not covered by my surveys. Here, Garnett (1986) reported that by April the tall grasslands interspersed with freshwater swamps had many waders, the most abundant of which was the

Sharp-tailed Sandpiper, with likely more than 10 000 present. He suggested that these were birds from south east Australia that were calling in and gathering sufficient fuel to continue the migration north.

My surveys in late July 1996 on the Northern Territory side of the Gulf of Carpentaria revealed that by this time there were no Sharp-tailed Sandpipers present even though there were reasonable numbers of other migratory shorebirds, including Curlew Sandpipers.

The two histograms mentioned above also show smaller peaks in the September through to December period suggesting some, but much smaller numbers move through the area when returning from breeding. Morton *et al* (1991), however, reports that Sharp-tailed Sandpipers were one of the more common waders of freshwater wetlands in Kakadu during late dry season. Their 1980's surveys recorded them as most abundant from September onwards, and moving out with the first good rains. The only ground surveys of the Kakadu wetlands that I did around this time were in mid October 2001. These revealed only small numbers of Sharp-tailed Sandpipers, but there had been some recent good rains. My surveys of other areas in the Top End at this time certainly showed Sharp-tailed Sandpipers to be uncommon. In wetlands in the south east of the Gulf of Carpentaria referred to above, Garnett (1986) found few Sharp-tailed Sandpipers along the coast while the inland swamps were mostly dry, bare plains at this time of year. Consequently, the passage through the Top End on their southward migration also appears short term and restricted in area.

The number of records as a percentage of all group 1 records (Figure 48) show few or no records through the June and July period. This suggests that few Sharp-tailed Sandpipers remain in the Top End during the over-wintering season, unlike many of the other migratory shorebirds discussed in this report.

Crawford (1997) found counts of Sharp-tailed Sandpipers in wetlands near Darwin showed a continual decrease from October 1970 through to March 1971, suggesting movement from a more saline area out into newly inundated freshwater swamps, or perhaps further south.

Minton (*pers. comm.*) says Sharp-tailed Sandpipers depart the Broome area of Western Australia in late March, while they arrive into the area from mid August. Lane (1986) reports they first arrive in north west Western Australia in mid August but large numbers do not appear until early September and leave between March and mid April. Lane also reports temporary influxes in Darwin between August and December.

Breeding Plumage

The only reference to breeding plumage was that a flock of 30 birds had 'some' in mid September, but breeding plumage is not as obvious as some other species eg Curlew Sandpiper.

SHARP TAILED SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Reasonably widespread, but most in NW, and to lesser extent, the SE	Coast Islands Wetlands	R ✔ ✔✔✔	20 100	Large numbers only present (in a few areas) during northward migration. Many arrive from the south to certain Top End areas in April, fatten up, and migrate out of Aust. during May. Lesser numbers after breeding, arriving September with most then continuing further south.

Curlew Sandpiper

Geographic Distribution

Curlew Sandpipers had a similar but slightly more extensive distribution than Sharp-tailed Sandpipers (Figure 93). The main areas for Curlew Sandpipers were the Fog Bay and Chambers Bay areas and the Port McArthur area. Elsewhere around the Top End smaller numbers of Curlew Sandpipers were patchily recorded but nevertheless still fairly widespread. Though sometimes roosting with other waders on the coast, Curlew Sandpipers were more often recorded feeding on wetlands in behind the coast. There were considerably fewer records from offshore islands for this species compared to Sharp-tailed Sandpipers.

Numbers

Throughout all surveys there were 124 ground records totalling approximately 14 000 Curlew Sandpipers. These equate to approximately 4% of the records and 4% of the numbers of all group 1 species. There were also seven aerial records of Curlew Sandpipers. Thus Curlew Sandpipers were one of the more frequently recorded and abundant of the shorebirds recorded during these surveys.

The highest numbers of Curlew Sandpiper were recorded in survey blocks 5, 10, 13 and 15, while lowest numbers (when recorded) were in blocks 1, 11 and 14 (Figure 94). This species was recorded in all survey blocks except 2 and 9. Further details, by survey block, can be found in Table B21, Appendix B.

The largest single flock count was 1 300. This was from a single ground count on an island in the Port McArthur area (survey block 15) in late September 1994. There were no other ground or aerial counts in this area on this day. The next largest count was 800. This was recorded on a wetland in the northern Blue Mud Bay area (survey block 10) in late July 1998. As with the previous count there were no other ground or aerial counts in this area on this day.

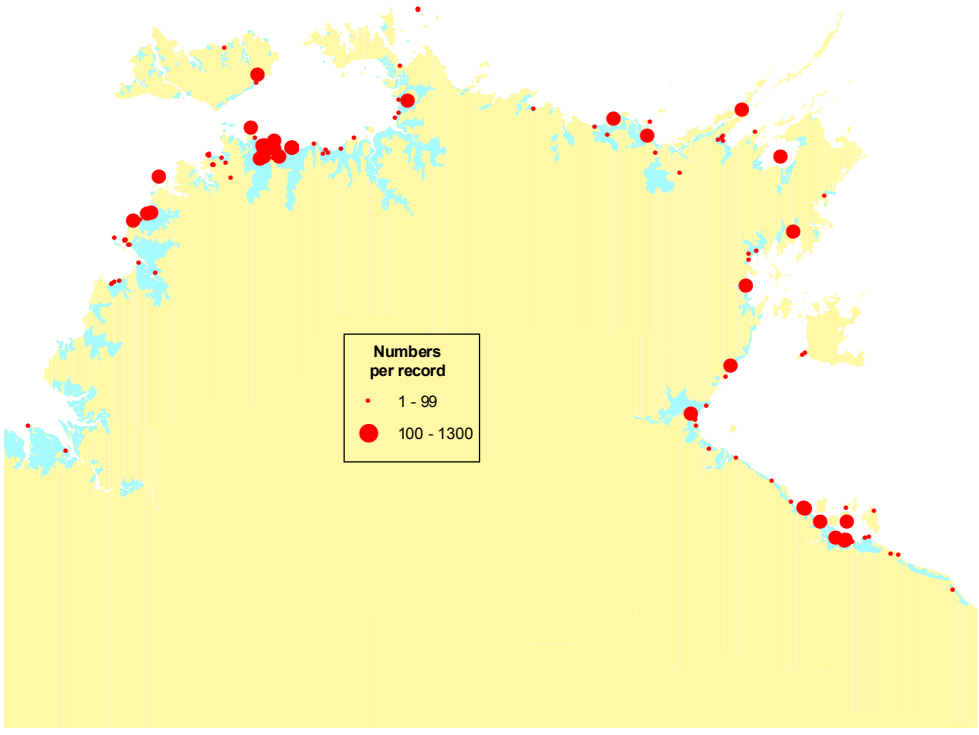


Figure 93. Distribution of all Curlew Sandpiper records.

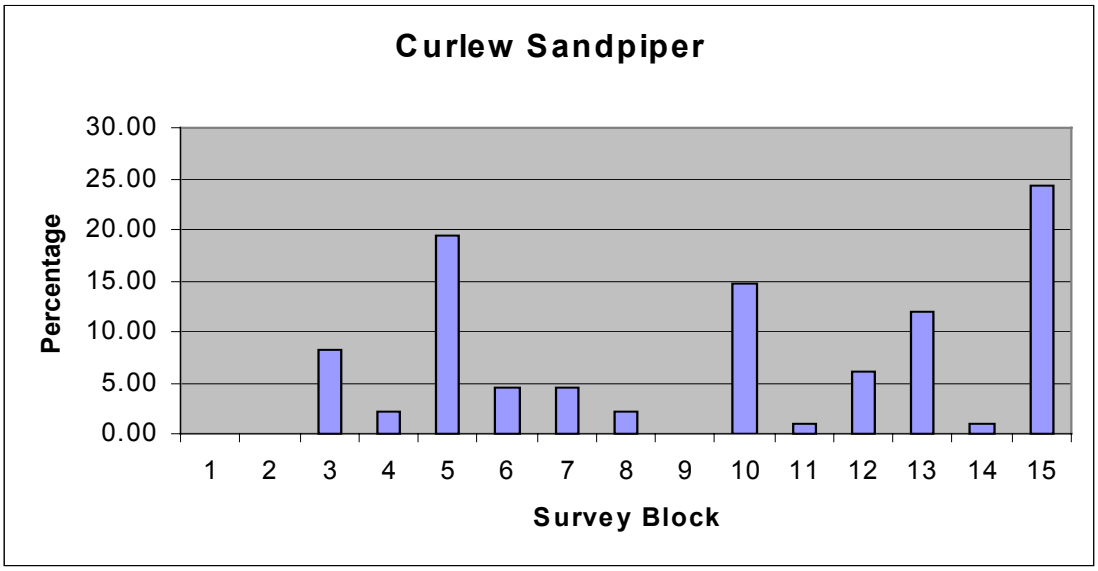


Figure 94. Percentage of Curlew Sandpiper numbers by survey block.

The third largest single flock count is also mentioned here because it covers the main area where high numbers for Curlew Sandpipers (for the Top End) were recorded during these surveys. This was in the wetlands behind the Chambers Bay area (survey block 5). Here the highest single flock count of 750 was recorded in mid August 1992. Also on this day another 300 birds were counted at a second nearby site. There were no other counts in this area on this day.

The calculated minimum estimate of the peak number of Curlew Sandpipers, likely to have been present in the Top End during these surveys, is at least 17 800 birds.

Seasonality

All three types of histogram (Figures C49-51) suggest low numbers of Curlew Sandpipers during the later part of the wet season, before a possible build-up in April/May. A higher peak in May and then a sharp drop in June suggest many birds are not leaving until during May. This is a similar situation to Sharp-tailed Sandpipers in terms of birds, not having been in the Top End for a while, moving back in before departing to the north. A low peak in June followed by a high July peak may have been influenced by differences in the surveys done during these months. In June there were very few ground surveys done in the main Curlew Sandpiper areas, but in July all four of the main ground surveys were in important Curlew Sandpiper areas. July surveys however, were mostly in the later part of the month so could also reflect the first of the newly arrived birds. (Of course if this is the case it must involve birds that have previously migrated north before those mentioned that might be leaving in May).

There are slightly higher peaks in all three histograms around the August to October period. This could also be reflecting arriving birds, but they do not suggest any sudden major influxes. The high August peak could also be influenced by survey bias. In August there were a relatively low number of surveys and all were in the area between the Daly and the East Alligator Rivers, which are significant Curlew Sandpiper areas. September and October surveys on the other hand were more numerous and widespread, thus reducing possible survey bias and making them more likely to truly be reflecting birds returned from breeding. There also appears to be more Curlew Sandpipers than Sharp-tailed Sandpipers remaining in the Top End after arriving back from breeding, however, they too move on after December.

Garnett (1986) suggested Curlew Sandpipers could be transient visitors to the south east Gulf of Carpentaria area during September on their way further south. They had not returned by April.

Minton (1995) reports Curlew Sandpipers were still to depart the Broome area of Western Australia by late April. They start arriving in the last two weeks of August but most arrive in September. Lane (1986)

reports they first arrive in north west Western Australia from mid August and that juvenile birds arrive 4-6 weeks after the adults, with most of these here by mid September. Many of these birds then move on to south and south east Australia. On their departure, they begin leaving north west Western Australia in late March with a few not leaving to late April. Minton suggests that the northward migration occurs on a broader front with fewer birds in north west Western Australia than the southward migration.

Breeding Plumage

Breeding plumage of Curlew Sandpipers is quite obvious; hence they tended to have more comments made on them during these surveys (Table 15).

There is insufficient information here to say much, however a few things can be suggested. A small percentage in breeding plumage in late April could mean that many have left or they are still coming into breeding plumage, but with such small numbers it is hard to say one way or the other. Given there are no records of breeding plumage for the 1 400 or so birds recorded during the month of May, perhaps the former is the case. This also suggests some Curlew Sandpipers, more so than Sharp-tailed Sandpipers, may over-winter in the Top End. There were only low percentages in breeding plumage during the over-wintering season but the 20/8/92 note would suggest that some birds could have begun arriving back. From late August through September into early October most birds seem to arrive having lost most of their breeding plumage and/or lose it fairly quickly after they arrive.

Table 15. Breeding plumage (BP) notes for Curlew Sandpiper.

Date	Nos	Breeding plumage (BP) comment
19/4/94	20	Small percentage of BP.
23/4/92	50	Small percentage of BP.
17/7/98	600	Very little sign of BP.
23/7/98	500	Small percentage in full or near full BP.
23/7/98	50	2% had reasonable amount of BP.
30/7/92	10	At least one in BP.
18/8/92	300	Some in BP.
18/8/92	75	Some in BP.
20/8/92	750	Quite a lot with some BP remaining.
8/9/96	640	Small percentage of BP.
8/9/96	580	Only a few left with any BP.
13/9/96	30	Some BP.
29/9/96	1300	Odd one still with fading BP.
3/10/94	210	Not many with any BP.
8/10/94	200	Only the odd one with any BP.
9/10/96	200	A few birds with some BP still remaining.

CURLEW SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, but few in SW	Coast Islands Wetlands	✔ R ✔✔✔	17 800	Similar to Sharp-tailed Sandpipers in early part of year ie move into certain areas during northward migration in April, fatten up, and migrate out of Aust. during May. Curlews may leave a little earlier and return a little earlier ie from August. More Curlew Sandpipers remain in Top End for a longer period before continuing further south.

Broad-billed Sandpiper

Geographic Distribution

With the exception of the north coast and northern parts of the east coast Broad-billed Sandpipers have a fairly extensive distribution (Figure 95). They were located at a number of locations between Joseph Bonaparte and Van Diemen Gulfs, north east Arnhem Land and in the south east of the Top End. All records were on the mainland.

Numbers

Throughout all surveys there were 29 ground records totalling approximately 900 Broad-billed Sandpipers. These equate to approximately 1% of the records and <1% of the numbers of all group 1 species. Thus Broad-billed Sandpipers were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

Broad-billed Sandpipers were recorded in survey blocks 1, 3, 5, 7, 10, 13 and 15, with the highest numbers in survey blocks 13 (Figure 96). Further details, by survey block, can be found in Table B22, Appendix B.

There were two counts of 200 birds and three counts of 100 birds made during these surveys. All five counts were well separated from each other in terms of distribution. Counts of 200 were made at roosts in Joseph Bonaparte Gulf (survey block 1) and near the mouth of the Roper River (survey block 13). Counts of 100 were made in Fog Bay (survey block 3), wetlands associated with the downstream Adelaide River (survey block 5) and the northern part of Blue Mud Bay (survey block 10). There were no other Broad-billed Sandpipers counted near any of these locations on the same days, but complete ground coverage was not done.

The calculated minimum estimate of the peak number of Broad-billed Sandpipers, likely to have been present in the Top End during these surveys, is at least 2 000 birds.

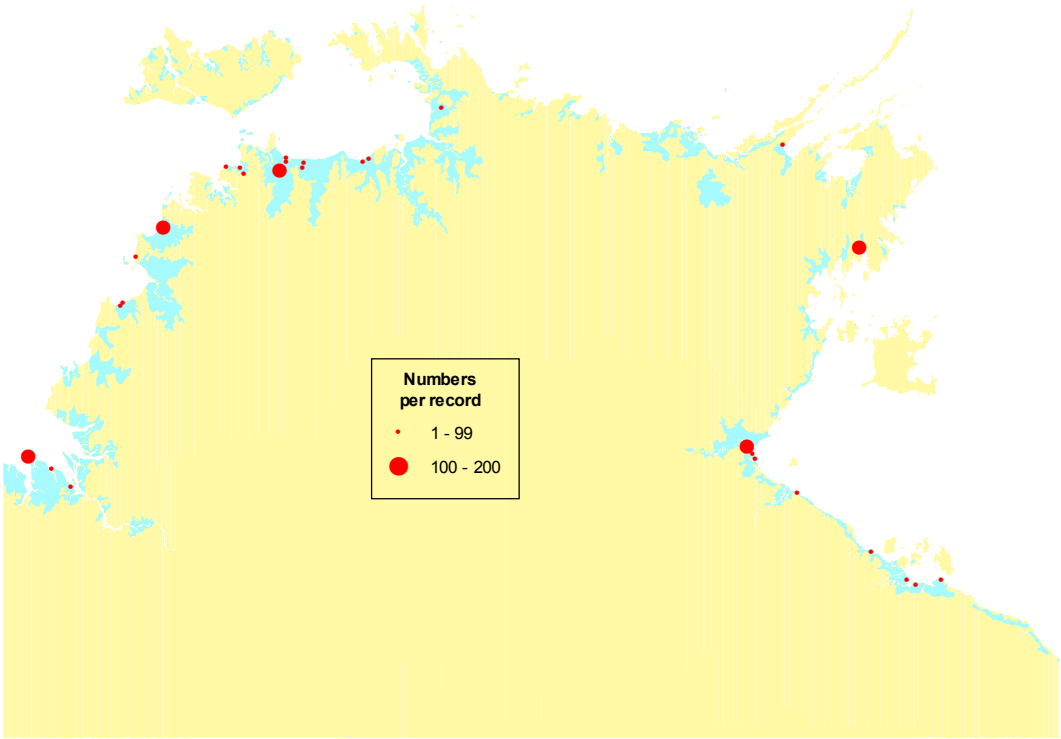


Figure 95. Distribution of all Broad-billed Sandpiper records.

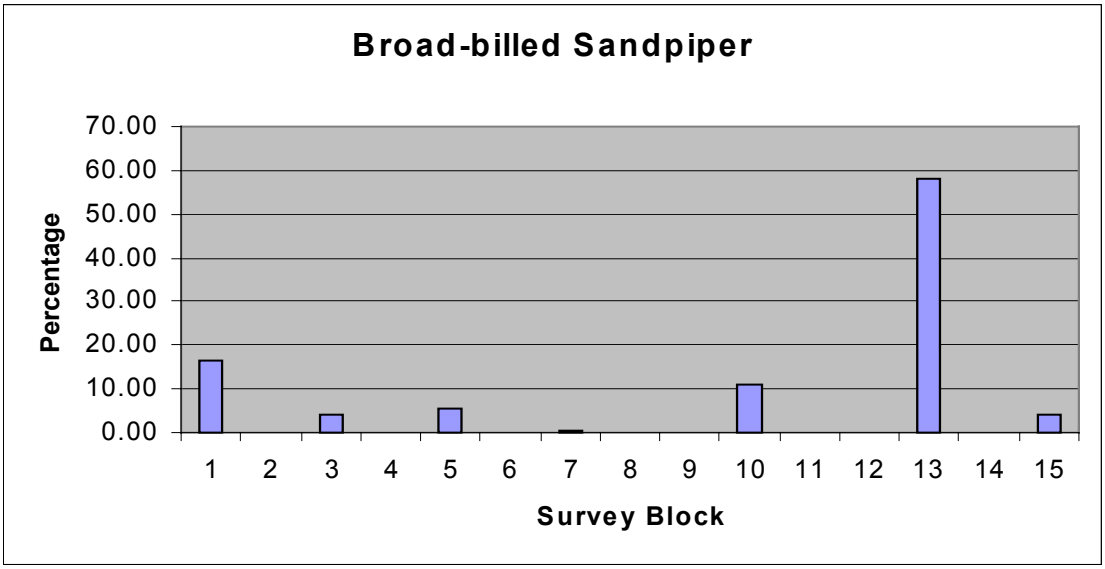


Figure 96. Percentage of Broad-billed Sandpiper numbers by survey block.

Seasonality

The low number of records makes analysis of the monthly histograms (Figures C52-54) more difficult, however it is interesting to note that three of the five counts of 100 or more birds were recorded in mid to late July. This is the main reason for the higher peak in July in all three histograms. Unfortunately there were no counts done at other times of year at the same sites of each of these July counts. Consequently it is not possible to say if there were more birds present at other times, but the counts as such suggest relatively high numbers of Broad-billed Sandpipers may over-winter in these areas or that they begin arriving back from the Northern Hemisphere in late July. The other period with a consistently high peak is the March/April period. This may be associated with departing birds forming into more easily observable, larger flocks.

Minton (*pers. comm*.) says Broad-billed Sandpipers depart the Broome area of Western Australia in mid April.

Breeding Plumage

No comments were made with respect to breeding plumage for this species during these surveys.

BROAD-BILLED SANDPIPER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, but scattered	Coast Islands Wetlands	✔ R ✔	2 000	Insufficient records to say confidently. Birds recorded in most months. Possible departure March/April and arrival September/October. High counts in late July could indicate fist wave of arrivals or high over-wintering numbers.

Pacific Golden Plover

Geographic Distribution

Except for one record of five birds in the north east, all Pacific Golden Plovers were recorded in the north west of the Top End (Figure 97). They were recorded on offshore islands as well as on the coast and wetlands of the mainland. Some of the records of Pacific Golden Plovers on offshore islands were made of birds that were spread thinly amongst tall, dry grass areas in a manner akin to quail.

The majority of the records were from around Darwin but this is more a reflection of the amount of time spent in this area and the fact that a few birds are attracted to watered lawn areas each year. Some of the records of these birds would thus have been made incidentally from time to time rather than as part of project surveys, particularly in the early years.

Garnett and Taplin (1990) report the south-east Gulf of Carpentaria as one of the most important areas for Pacific Golden Plovers, but Noske and Brennan (2002) report them as uncommon on Groote Eylandt. They were not observed anywhere in the Gulf of Carpentaria during my surveys, however few if any ground surveys were done in the appropriate habitats at the right time of the year in this area.

Numbers

Throughout all surveys there were 25 ground records totalling approximately 170 Pacific Golden Plovers. These equate to approximately 1% of the records and <1% of the numbers of all group 1 species. Thus Pacific Golden Plovers were one of the less frequently recorded and less abundant of the shorebirds recorded during these surveys.

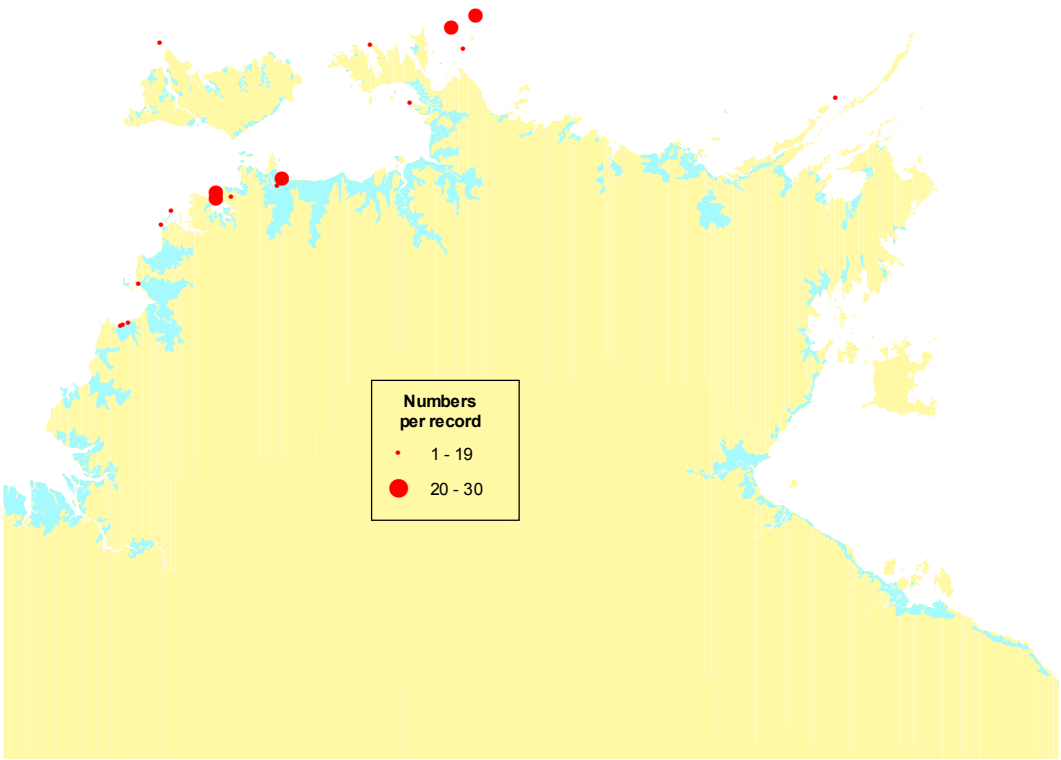


Figure 97. Distribution of all Pacific Golden Plover records.

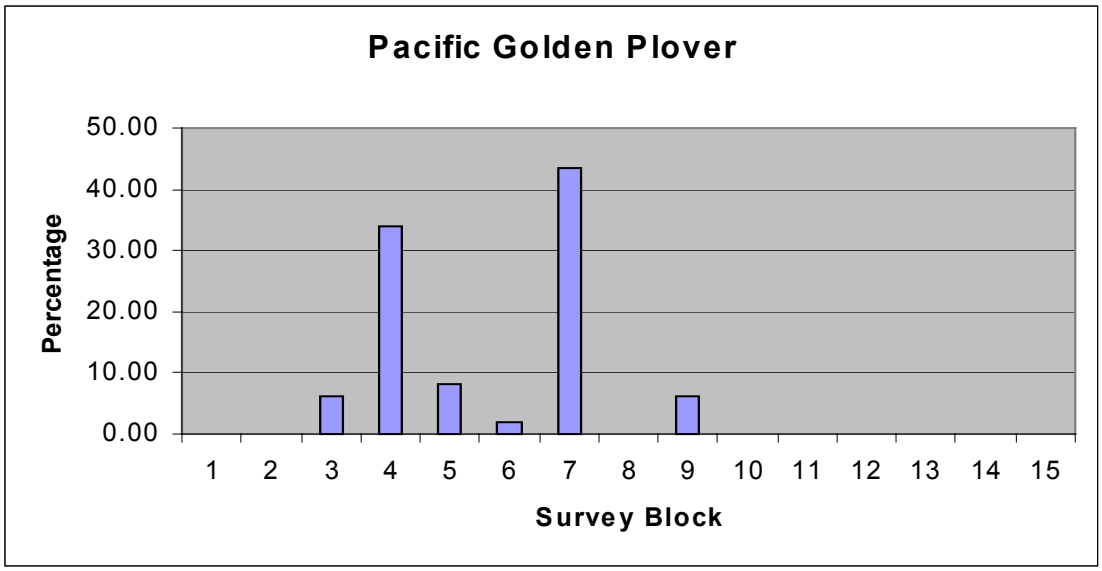


Figure 98. Percentage of Pacific Golden Plover numbers by survey block.

Pacific Golden Plovers were recorded in survey blocks 3, 4, 5, 6, 7 and 9, with the highest numbers in survey blocks 4 and 7 (Figure 98). Further details, by survey block, can be found in Table B23, Appendix B.

There was one count of 30 birds and four counts of 20 birds made during these surveys. Two of these counts were made in Darwin (survey block 4), one in Chambers Bay (survey block 5) and two on small offshore islands to the north east of Croker Island (survey block 7). The latter two islands have no wetlands present. Also as these latter two records were made in early October on northerly islands, it is possible that these were birds calling in at their first point of land since crossing the Arafura Sea from the north.

The calculated minimum estimate of the peak number of Pacific Golden Plovers, likely to have been present in the Top End during these surveys, is at least 200 birds.

Seasonality

With such a small number of records it is difficult to deduce season patterns of occurrence for Pacific Golden Plovers from the three histograms (Figures C55-57). They were recorded in all months of the year except for May and June, but there does not seem to be any sudden changes. Higher numbers of birds seem to be present from October through to April. The high peak in the numbers per record histogram in July (Figure C55) may not be a true reflection of the situation because it is from only the one count. Nevertheless it is this month that Frith and Hitchcock (1974) reported more of their observations for this species than in any other month in their surveys of Cobourg Peninsula.

Minton (*pers. comm.*) says Pacific Golden Plovers depart the Broome area of Western Australia in early March, while they arrive into the area from mid September to late October. Lane (1986) reports they first arrive in Australia in September, with the main influx in October and early November, but then numbers often decrease sharply. He also reports them to leave from mid February to May, with most leaving in April.

Crawford (1997) reported that counts of Pacific Golden Plovers at the coastal sites near Darwin showed a substantial increase in numbers from August to September, and then a second increase from October to November in 1970. In the following year there was a continual increase from August to October. These observations possibly suggest birds arriving into Darwin at this time.

Garnett and Taplin (1990) state that even though they thought the south east Gulf of Carpentaria was one of the most important areas for Pacific Golden Plovers they only recorded small numbers in the Bing Bong area in their late March 1990 surveys. G. Brennan (in Noske and Brennan, 2002) on the other hand reports his largest group (34) on the mine-site tailing dams on Groote Eylandt in late March 1992. He also reported smaller numbers in April 1987 and August 1990.

Breeding Plumage

The only note made on breeding plumage was of a single bird in partial breeding plumage in mid September 1993.

PACIFIC GOLDEN PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted, mostly in NW	Coast Islands Wetlands	✔ ✔ ✔	200	Insufficient records to say confidently. Birds recorded in most months but highest numbers from October to April.

Plate 24. The East Point area of Darwin where Pacific Golden Plovers roost along the coast and feeding on the watered grass areas of the reserve, March 1991. Photo R. Chatto.

Grey Plover

Geographic Distribution

Grey Plovers were recorded all around the coast of the Top End, and some of the offshore islands (Figure 99). They were found on both mudflats and sandy beach habitats, and never far from the coast. The most significant areas were from Anson Bay though to Murgenella Creek, from Boucaut Bay through to Buckingham Bay and from Numbulwar through to the Port McArthur area. There were no large sections of coast in which there were no records of Grey Plovers, however this is one of the species for which a greater ease of identification from the air allows many more confirmed sighting to be added to the map.

Numbers

Throughout all surveys there were 156 ground records totalling approximately 5 300 Grey Plovers. These equate to approximately 5% of the records and 1% of the numbers of all group 1 species. There were also 119 aerial records of Grey Plovers. Thus Grey Plovers were one of the more frequently recorded but less abundant of the shorebirds recorded during these surveys.

The highest numbers of Grey Plovers were recorded in survey block 5, 10, 13 and 15, while lowest numbers were in blocks 1, 9, 11 and 14 (Figure 100). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B24, Appendix B.

The largest single ground count for Grey Plovers was 750. This was in Chambers Bay (survey block 5) in late August 1992. Two other nearby sites had counts of 450 at the same time. There were certainly more Grey Plovers in the area, but no other counts were done in the bay at this time.

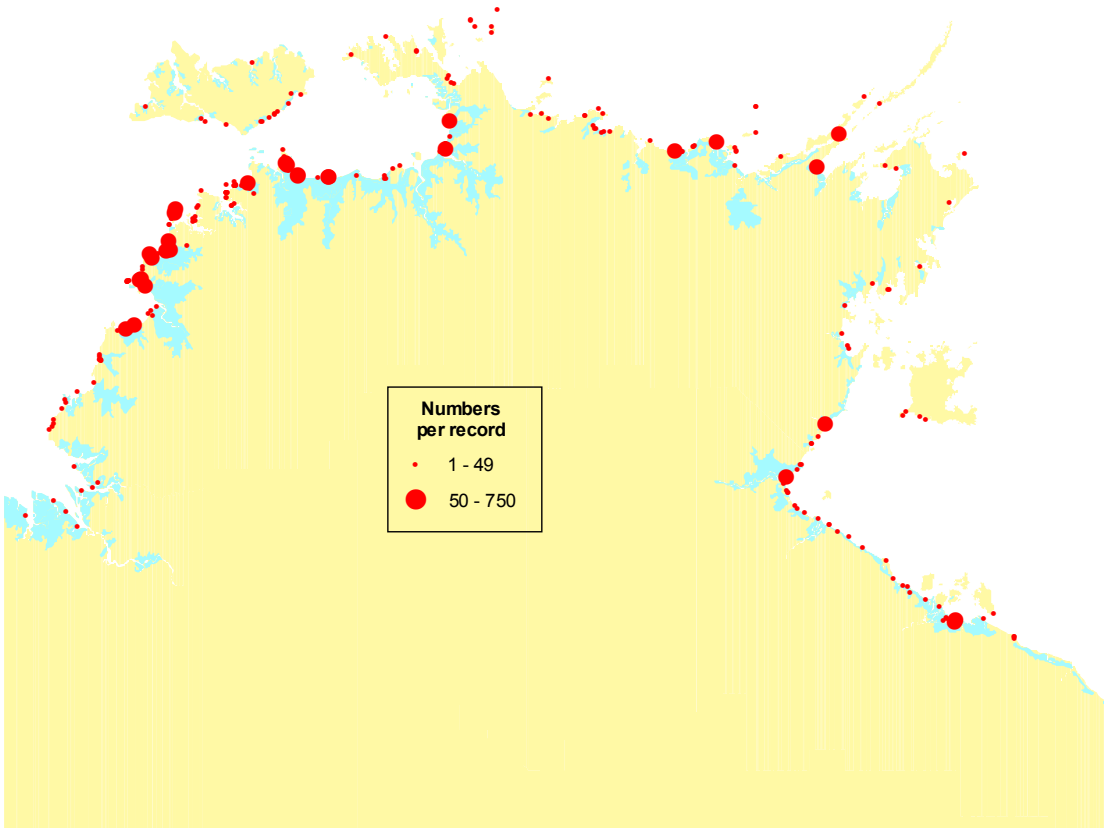


Figure 99. Distribution of all Grey Plover records.

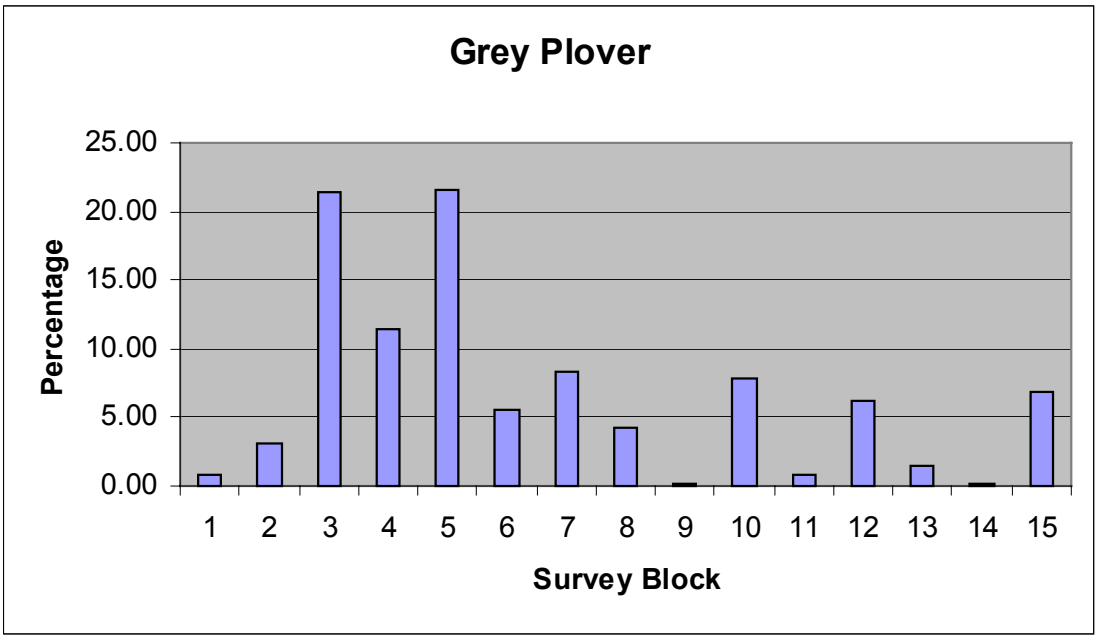


Figure 100. Percentage of Grey Plover numbers by survey block.

The next highest single ground count of 500 is from another of the more important areas for Grey Plovers. This was from Fog Bay (survey block 3) in late December 1992. Another ground count in this immediate area on this day revealed 120 birds. Again, these two counts would not represent all Grey Plovers present at this time.

The calculated minimum estimate of the peak number of Grey Plovers, likely to have been present in the Top End during these surveys, is at least 5 400 birds.

Seasonality

The number of Grey Plovers per record (Figure C58) and their total numbers as a percentage of all group 1 shorebirds combined (Figure C59) both show large and sudden peaks in August and smaller peaks in September, in an otherwise fairly even graph. Most of these birds were recorded in the latter third of August. This suggests not only a probable influx of Grey Plovers at this time but also that birds are arriving in groups that have yet to disperse around the coast from their arrival areas. This latter point is supported by a drop in the histogram recording the number of records as a percentage of all group 1 shorebirds combined for the month of August (Figure C60).

From September on there is a drop in the flock size and the number of Grey Plovers as a percentage of all species. At the same time there is an increase in the number of records as a percentage of all species. These suggest that the birds are spreading out over a greater area from September onwards.

There are no sudden changes in any of the histograms during the March to May period suggesting departure is perhaps not as sudden or with large groups building up prior to leaving.

Minton (*pers. comm.*) states that Grey Plovers depart the Broome area of Western Australia in late March to mid April. They start arriving in the last two weeks of August but most arrive in September. Lane (1986) reports they probably arrive over north west and north Australia in early September and continue to move south in October and November. Lane also reports departing birds to pass through Darwin in late March and leave the north west Western Australia area by mid-April.

Breeding Plumage

There were eight references to Grey Plover breeding plumage during these surveys. In mid May three counts totalling just under 200 birds had very little breeding plumage on most birds. Five counts

between mid August and mid October, also totalling just under 200 birds, recorded a small amount of breeding plumage in August but by early September the notes mentioned quite a lot of breeding plumage at each count. This perhaps could also be suggesting that Grey Plovers begin to arrive between late August and early September.

GREY PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast Islands Wetlands	✔✔✔ ✔ R	5 400	Some birds present all year, highest numbers likely between August and January. Most probably arrive Aug/Sept with large flocks present which then disperse around the coast. Departure flocks not as large and time uncertain but likely around April.

Plate 25. A particularly large and regular roost of shorebirds, seabirds and waterbirds at the western end of Chambers Bay. Among these birds in August 1992 were over 750 Grey Plovers. Photo R. Chatto.

Red-capped Plover

Geographic Distribution

Red-capped Plovers were recorded around most of the Top End coast, many inland wetlands and a small number of offshore islands (Figure 101). They were most often recorded in large feeding groups on open saline wetlands and sandy intertidal areas, or as pairs scattered around the coast. The more significant areas for Red-capped Plovers were around the saline wetlands associated with the Finniss and Adelaide Rivers, the area around Millingimbi and the extensive open saline wetlands in south east of the Top End. They were only rarely recorded from the freshwater wetlands further inland. This was also found by Morton *et al* (1991) who referred to them as uncommon in their early 1980's surveys of freshwater wetlands in Kakadu.

The distribution records of Red-capped Plovers show a number of potentially suitable areas with an apparent absence of birds. It is likely that this distribution map will be incomplete because pairs or small groups along the Northern Territory are often on sandy beaches where few other species are present. Consequently, as well as the likelihood of being missed from the air, ground counts in such areas were not common because of the lack of a large enough number of birds to warrant landing. Some of the records of these scattered pairs of Red-capped Plovers were made incidentally when doing seabird or marine turtle nesting surveys on sandy beaches.

Numbers

Throughout all surveys there were 120 ground records totalling approximately 5 100 Red-capped Plovers. These equate to approximately 4% of the records and 1% of the numbers of all group 1 species. There were also eight aerial records of Red-capped Plovers. Thus Red-capped Plovers were one of the more frequently recorded but less abundant of the shorebirds seen during these surveys.

The highest numbers of Red-capped Plovers were recorded in survey blocks 10 and 13, while lowest numbers were in blocks 1, 7, 11 and 12 (Figure 102). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B25, Appendix B.

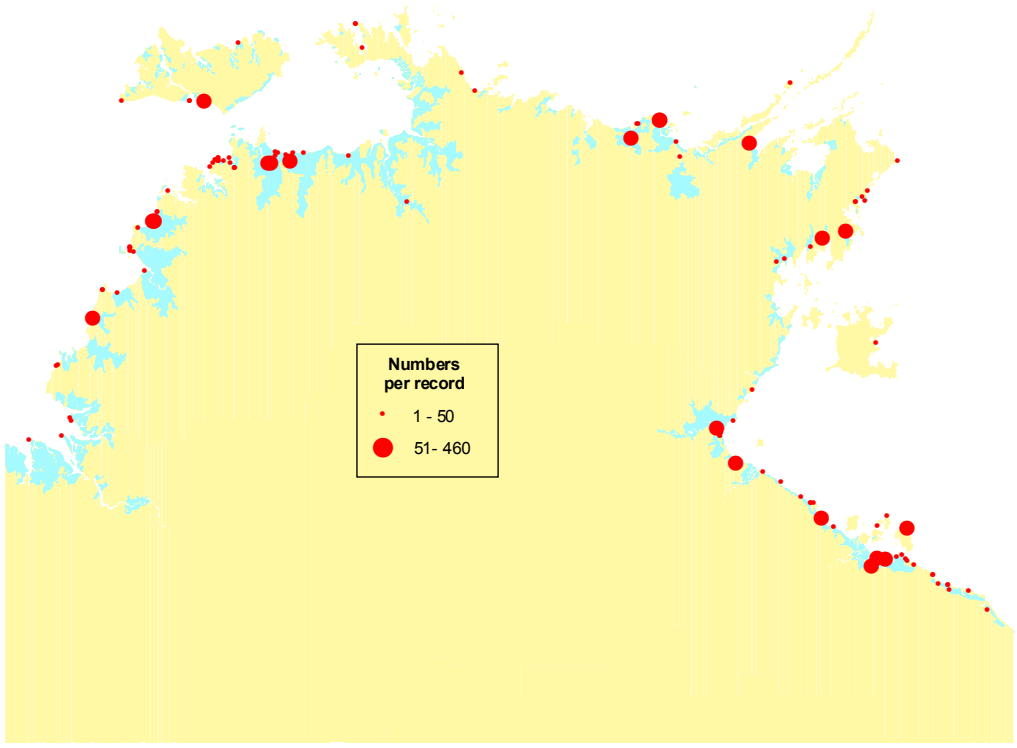


Figure 101. Distribution of all Red-capped Plover records.

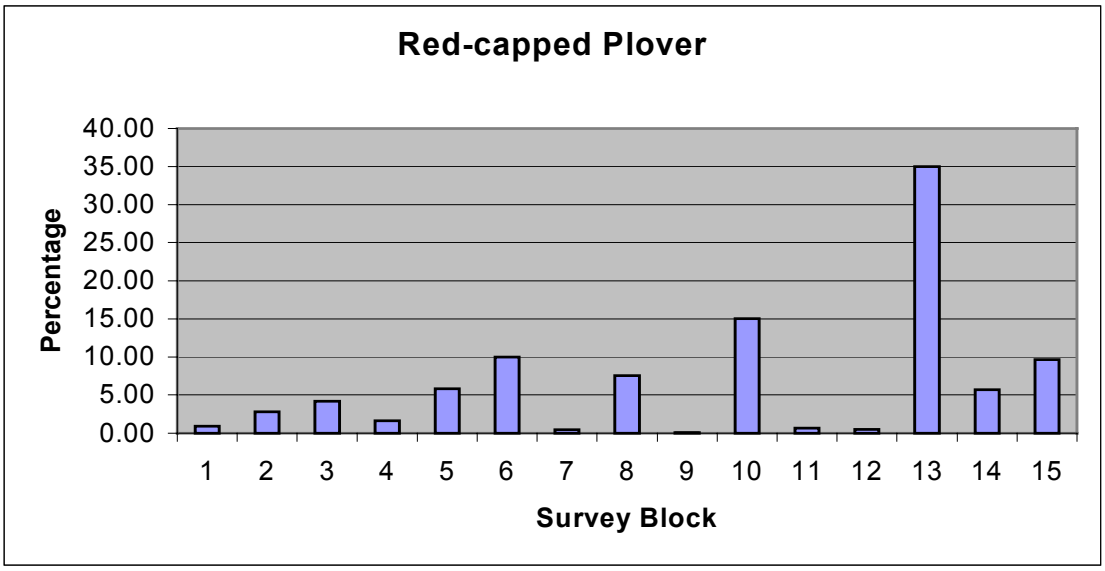


Figure 102. Percentage of Red-capped Plover numbers by survey block.

The largest single flock count for Red-capped Plovers was 500. This was recorded on an island off Millingimbi (survey block 8) in mid June 1996. These birds were roosting with many other waders and would spread out over the sandy intertidal areas to feed at lower tides. The next largest single flock count of 460 was made on a wetland adjacent to the downstream Adelaide River (survey block 5) in mid September 1993. This was one of five ground sites counted in the immediate area on that day. Red-capped Plovers were not recorded at the other four sites but these were chosen to represent different habitat types that were less suitable for this species. No counts were made of other similar wetlands in the area that may have had more Red-capped Plovers. Another similarly high single flock count (400) was made on a wetland in the northern part of Blue Mud Bay (survey block 10) in late July 1998. There were also another 50 birds in a flock a short distance from this one, but they were the only two ground sites done in the area at that time.

Although the three largest single counts were not made in the south east, this is where the largest number of Red-capped Plovers are found in the Top End. Dry season numbers are clearly in their thousands on the many open saline wetlands that run parallel to, and just inside, the coast from just north of the Roper River to the Queensland border. Sample counts were never higher than 300 on an individual saline splash but only a small number were sampled compared to the number present, and small waders were spread throughout. Red-necked Stints were also common on many of these wetlands when they had water present, but Red-capped Plovers were also present on some of these wetlands even when dry and salt covered.

The calculated minimum estimate of the peak number of Red-capped Plovers, likely to have been present in the Top End during these surveys, is at least 9 900 birds. Peak numbers are likely to be higher than this given the under-counted dry season birds of the south east Top End.

Seasonality and Breeding

The number of Red-capped Plovers per record (Figure C61) and percentage of total group 1 numbers (Figure C62) show a dry season rise from May through to September. The low in August is most likely attributable to the survey bias mentioned a number of times already in this report. The individual database records also show that the majority of the larger groups were recorded in the June to September period (with most in June and July), and that there is a large influx of Red-capped Plovers to the Top End coastal wetlands during the dry season. The number of Red-capped Plover records as a percentage of combined group 1 species also shows a clear rise around this time of the season (Figure C63). This suggests that as well as their numbers rising during this time of year, their distribution also

expands. For the remainder of the year the percentage of records of this species remains relatively constant.

All three histograms indicate low numbers from January to April. Garnett and Taplin (1990) also noted that this species was only present in small numbers on the mudflats between the Roper River and the Queensland border in their late March 1990 surveys. Garnett (1986) reported that Red-capped Plovers using the coast of the south east of the Gulf of Carpentaria during the winter were almost absent by December. He also recorded breeding at several inland sites during April.

There were 11 confirmed breeding records of this species between March and November (most in May to July) during my surveys. All breeding records for this species were of scattered pairs around the coast. It is easy to miss such breeding pairs so those recorded are likely to be significantly under the real numbers. However, there was no 'colonial' breeding located on these surveys, and the birds present in large groups during the dry season were not breeding at these sites.

Crawford (1997) found counts of Red-capped Plover at the coastal sites near Darwin showed a substantial relative decrease in numbers from October to November 1970, and these low numbers remained until an increase in June and July the next year. This supports observations made during my surveys of birds departing the coastal areas over the wet season when a lot of their wetland feeding habitat becomes too deep.

RED-CAPPED PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔	9 900	Mix of resident, breeding population of scattered pairs and small groups around the coast, and a large influx of mostly non-breeding birds to coastal wetlands, mainly between June and September.
	Islands	✔		
	Wetlands	✔✔✔		

Lesser Sand Plover

Geographic Distribution

Lesser Sand Plovers were recorded all around the Top End coast and some offshore islands (Figure 103). They were only very occasionally recorded on inland wetlands, usually open saline ones close to the coast. The most significant areas for Lesser Sand Plovers were along the coast from Anson Bay to Murgenella Creek, the coast from Junction to Arnhem Bays, Blue Mud Bay and the Port McArthur area. Areas of least importance to Lesser Sand Plovers were the northern coast between Cobourg Peninsula and Junction Bay and the far north east corner of the Top End. Adding in the records of *sand plover spp.* does not greatly increase the Lesser Sand Plover's confirmed distribution, however it does suggest the possibility of larger numbers in some places, if these records are not dominated by Greater Sand Plovers.

Numbers

Throughout all surveys there were 262 ground records totalling approximately 30 000 Lesser Sand Plovers. These equate to approximately 8% of the records and 8% of the numbers of all group 1 species. Thus Lesser Sand Plovers were one of the more frequently recorded and abundant of the shorebirds seen during these surveys.

The highest numbers of Lesser Sand Plovers were recorded in survey blocks 3, 7 and 12, while lowest numbers were in blocks 1, 8, 9 and 11 (Figure 104). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B26, Appendix B.

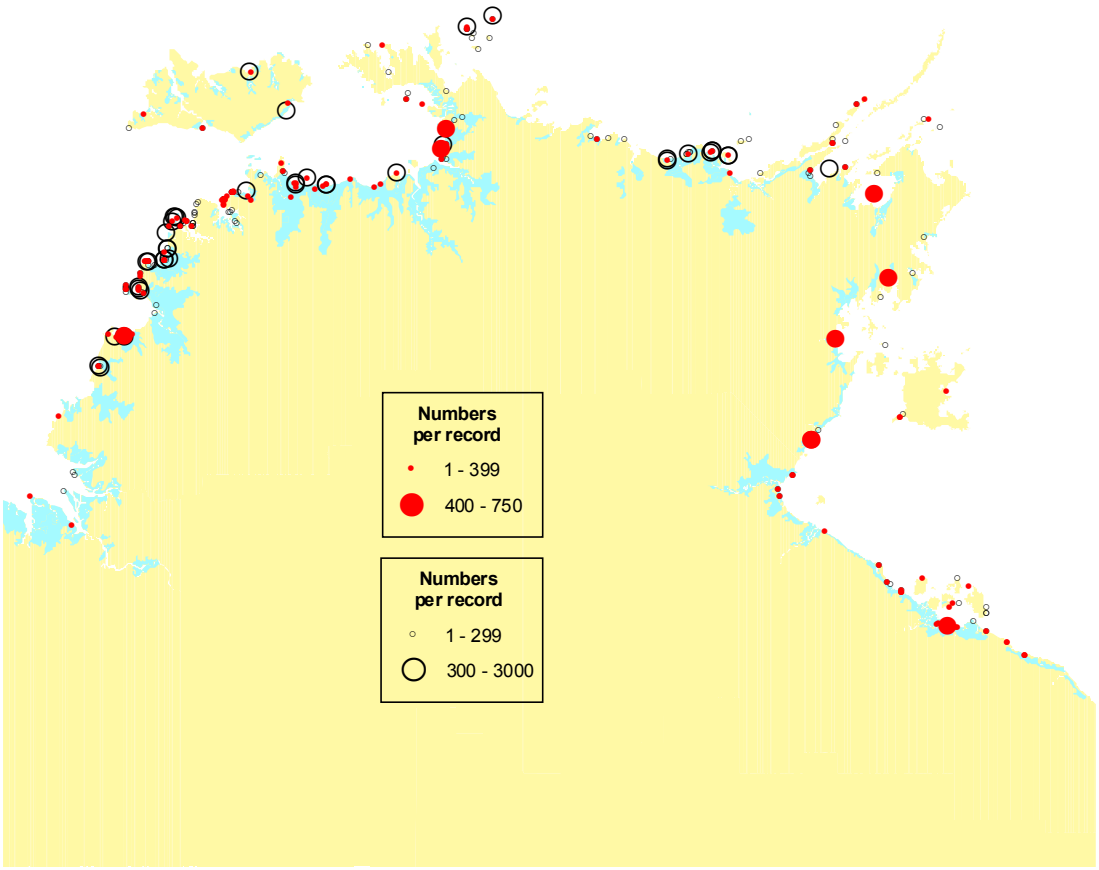


Figure 103. Distribution of all Lesser Sand Plover records. (Hollow black circles represent *sand plover spp.* records).

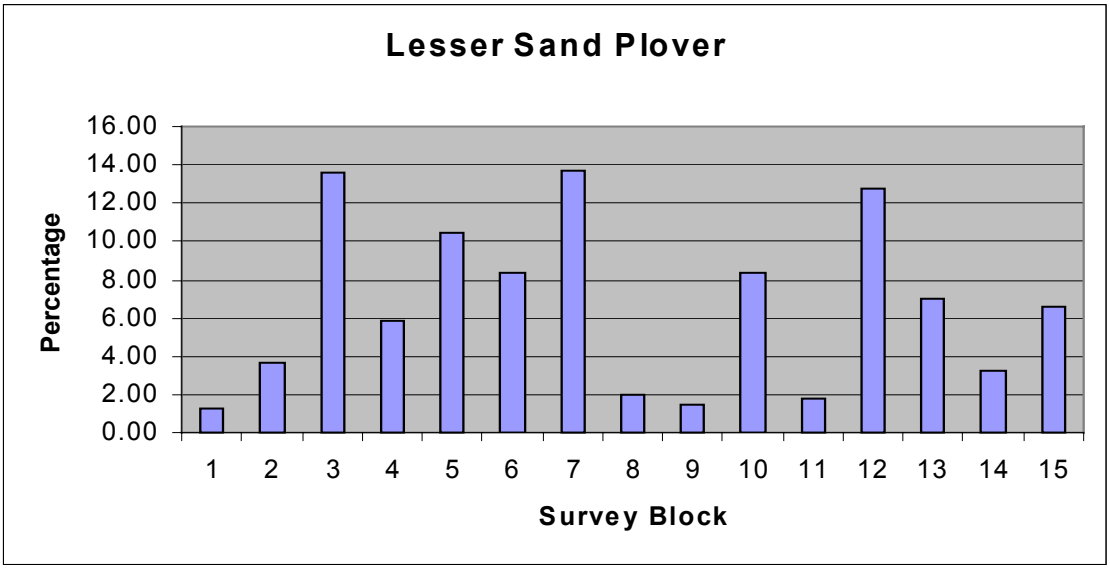


Figure 104. Percentage of Lesser Sand Plover numbers by survey block.

The largest single ground count for Lesser Sand Plovers was 750. This was a roost on the island in the middle of Arnhem Bay (survey block 10) in mid November 1993. No other counts were recorded from Arnhem Bay on that day so this high tide roost probably only contained a proportion of the Lesser Sand Plovers that were feeding in Arnhem Bay on the lower tides. The next largest single roost was a count of 600, and there were another 400 at a nearby roost. This was on the coast near Numbulwar (survey block 12) in early October 1996.

These counts may not actually represent the largest flocks of Lesser Sand Plovers. There were five counts of mixed Lesser and Greater Sand Plovers made during these surveys that were between 1 500 and 3 000. This latter count also had a nearby count of 750. These were recorded from Anson, Fog, Chambers and Castlereagh Bays at various times between mid June and late December. Keeping in mind that these ground counts are for the most cases just counts at one or two sites in the area, the total number of sand plovers in the general area is probably still considerable higher.

The calculated minimum estimate of the peak number of Lesser Sand Plovers, likely to have been present in the Top End during these surveys, is at least 39 000 birds.

Seasonality

The histograms depicting the Lesser Sand Plovers per record (Figure C64) and number as a percentage of all group 1 species (Figure C65) show a drop after April and a rise in September, suggesting departing and returning birds. The high February and low March results in these histograms may be a result of survey bias, but Marchant and Higgins (1993) suggest that numbers often increase in February at some sites in northern Australia.

The number of Lesser Sand Plover records as a percentage of all group 1 species was relatively consistent throughout the year (Figure C66), suggesting no large change in the number of times they were recorded compared to the other species and relatively consistent overall distribution.

A note made on a survey along the coast, north of the East Alligator River on 10 May 1992 suggested there had been a significant departure of birds since 23 April 1992. As there are reasonable numbers of Lesser Sand Plovers along this coast, perhaps departure continues into late April or early May.

Minton (*pers. comm.*) says Lesser Sand Plovers depart the Broome area of Western Australia in the third week of April.

All of the histograms show an increase from August to September. This agrees with the results of Lane (1986) and Crawford (1997). Lane reported Lesser Sand Plovers arrived in the Darwin region between September and November with the peak in October, and Crawford found counts of Lesser Sand Plovers at the coastal sites near Darwin showed a substantial relative increase from August to September in 1970. In the following year Crawford found the increase was from September to October.

Breeding Plumage

As there were quite a few (brief) notes made of the breeding plumage condition of Lesser Sand Plovers, they are included in a Table 16. Locations are not given but they were from well spread sites.

These notes show that some flocks at least had good numbers of Lesser Sand Plovers in breeding plumage until early May. This alone does not indicate if these birds are still to leave or if they are going into breeding plumage and remaining in Australia. However, the low numbers of birds in breeding plumage through the over-wintering period perhaps suggests the former. The low numbers of birds in breeding plumage in September and October (and none after this) suggests they are loosing most of their breeding plumage before, or soon after arriving back.

Table 16. Breeding plumage (BP) notes for Lesser Sand Plover.

Date	Nos	Breeding plumage (BP) comment
12/3/99	50	20% with some BP, nil with full chest colour.
25/3/99	50	Lots of BP.
13/4/94	100	Most in BP.
11/5/93	166	33% in part to near full BP.
24/5/99	75	5 in part BP, none in full BP.
25/5/99	100	1 in BP.
25/5/99	150	Some BP.
18/6/99	30	Small amount of BP.
30/6/99	300	2 in BP.
16/7/98	200	Few with a little BP.
10/9/96	10	Little if any BP.
12/9/96	200	Little BP on the odd bird but most with none.
26/9/96	475	Some BP.
8/10/96	400	1 in 20 in BP.
9/10/96	30	Some in BP.

LESSER SAND PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔✔	39 000	Many birds present all year, but most present between September and April. Exodus of migrating birds suggested in March but could continue to late April and early May. Migrating birds return August/September.
	Islands	✔✔		
	Wetlands	R		

Greater Sand Plover

Geographic Distribution

Greater Sand Plovers were recorded all around the Top End coast and some offshore islands (Figure 105). They had a similar distribution to Lesser Sand Plovers though perhaps the Lesser was more numerous on the east coast and the Greater more numerous on the west coast, the Tiwi Islands and around the Millingimbi area. Greater Sand Plovers were also only very occasionally recorded on inland wetlands, usually only the open saline ones close to the coast.

The most significant areas for Greater Sand Plovers were Joseph Bonaparte Gulf, the coast from Anson Bay to Murgenella Creek, the coast from Junction to Arnhem Bays, and the Port McArthur area. Areas of least importance to Greater Sand Plovers were the northern coast between Cobourg Peninsula and Junction Bay and the far north east corner of the Top End. Adding in the records of *sand plover spp.* does not greatly increase the Greater Sand Plover's confirmed distribution, however it does suggest the possibility of larger numbers in some places, if these records are not dominated by Lesser Sand Plovers.

Numbers

Throughout all surveys there were 235 ground records totalling approximately 31 000 Greater Sand Plovers. These equate to approximately 7% of the records and 8% of the numbers of all group 1 species. Thus Greater Sand Plovers were one of the more frequently recorded and abundant of the shorebirds seen during these surveys.

The highest numbers of Greater Sand Plovers were recorded in survey blocks 3, 6 and 8, while lowest numbers, where recorded, were in blocks 9, 12 and 15 (Figure 106). This species was recorded in all survey blocks except 11 but it is possible that combined sand plover records from this block may have included Greater Sand Plovers. Further details, by survey block, can be found in Table B27, Appendix B.

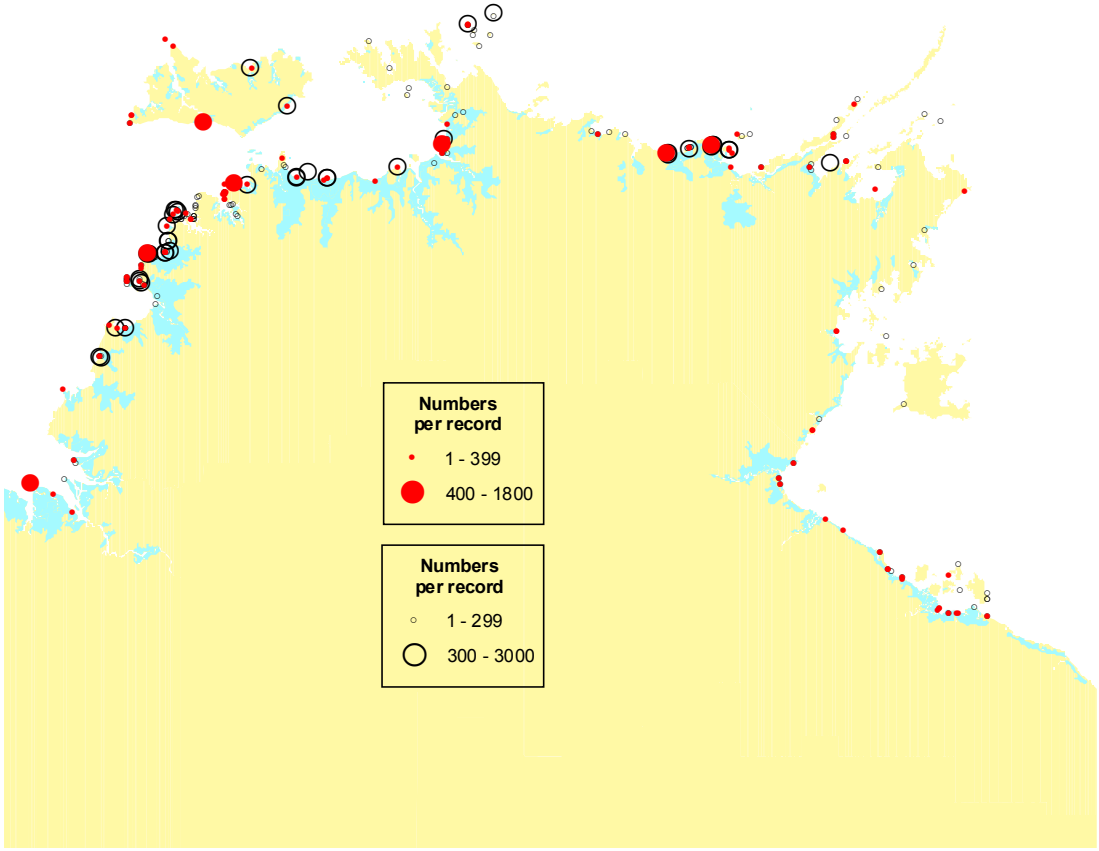


Figure 105. Distribution of all Greater Sand Plover records. (Hollow black circles represent *sand plover spp.* records).

The largest single ground count for Greater Sand Plovers was approximately 1 800. This estimate was derived from a sample count of 200 of a mixed flock of 2 000 sand plovers. It was a roost at the southern end of Fog Bay (survey block 3) in mid July 1998. It was one of three ground counts done in the southern part of Fog Bay on that day. The other two sites did not have any sand plovers present but there were no other group 1 shorebird records to species level in this bay on this day. The next highest single roost was an estimation of 1 000 but this again was deduced from a sample count of a mixed group of 1 500 sand plovers at a site in Boucaut Bay (survey block 10) in mid June 1996. At the only other ground site done in this bay on this day there were another 500 mixed sand plovers but no sample count was done on this group.

As time only permitted small sample counts of only one section of the flock each time, it is possible that the percentage of Greater Sand Plovers could have been different in other sections of the flock, thus affecting the numbers listed above.

These counts may not actually represent the largest flocks of Greater Sand Plovers. There were five counts of mixed Lesser and Greater Sand Plovers made during these surveys that were between 1 500 and 3 000. This latter count also had a nearby count of 750. These were recorded from Anson, Fog, Chambers and Castlereagh Bays at various times between mid June and late December. Keeping in mind that these ground counts are for the most cases just counts at one or two sites in the area, the total number of sand plovers in the general area is probably still considerably higher at most of these sites.

The calculated minimum estimate of the peak number of Greater Sand Plovers, likely to have been present in the Top End during these surveys, is at least 40 300 birds.

Seasonality

The number of Greater Sand Plovers per record (Figure C67) and their numbers as a percentage of all group 1 species both show a peak through the over-wintering months (Figure C68). This suggests flock sizes are greater at this time, and that Greater Sand Plovers are at a higher percentage of all group 1 shorebirds combined at this time compared to other times of the year. It suggests, but does not necessarily mean, they are in higher numbers. Nevertheless, the graphs are difficult to explain. As Greater Sand Plovers and Lesser Sand Plover (which had a totally different set of histograms) are often found together, it is possible that some sample counts of larger flocks could have been incorrectly biased towards Greater Sand Plovers. Perhaps Greater Sand Plovers may be more numerous on the outer parts of the mixed flocks and hence be over-proportionally represented in the count.

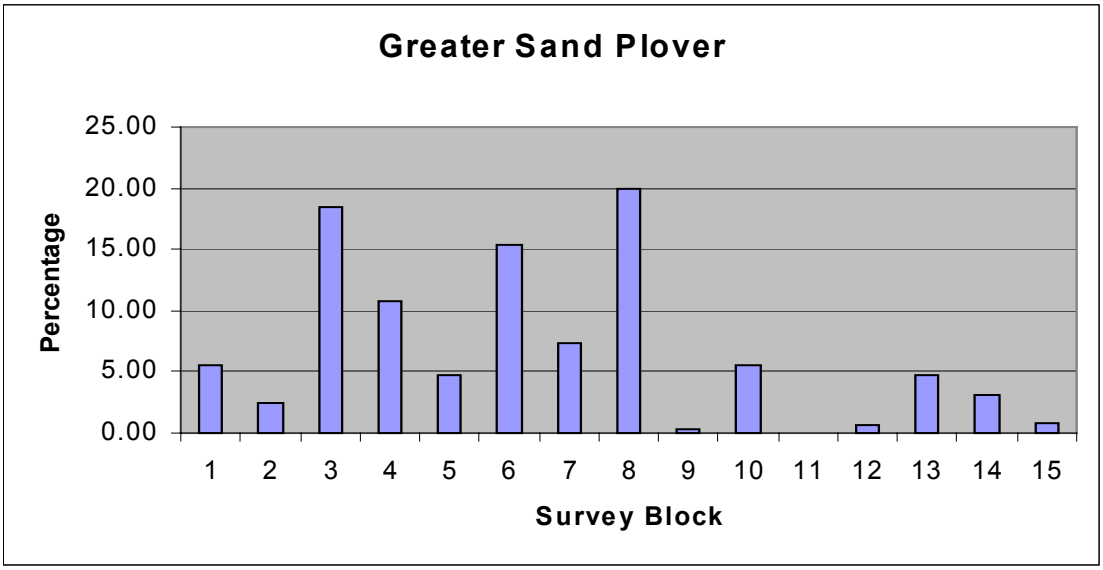


Figure 106. Percentage of Greater Sand Plover numbers by survey block.

When the same analysis is applied to all sand plover records (ie both single species and paired species records) the same tendency to a peak in the over-wintering months also occurs (Figures C70-72). Perhaps this indicates that, like the analysis suggested for Eastern Curlews, there are more sand plovers in the Top End during this period than has been previously thought. Certainly more research is required in this area though.

The percentage of Greater Sand Plover records of all group 1 species was relatively consistent throughout the year, suggesting no large change in the number of times they were recorded compared to the other species (Figure C69).

Field notes made on a survey along the coast, north of the East Alligator River on 10 May 1992 suggested there had been a significant departure of birds since 23 April 1992. As there are reasonable numbers of Greater Sand Plovers along this coast, perhaps departure continues into late April or early May.

Lane (1987) reports birds arrive in Darwin and the north west Western Australia coast of Australia from mid August to September. He also says that some leave north west Western Australia by October and November and a temporary influx occurs in Darwin in October.

Crawford (1997) reports counts of Greater Sand Plovers at the coastal sites near Darwin showed a substantial relative increase from August to September in both 1970 and 1971, which perhaps suggest arriving birds at this time in Darwin.

Minton (2000) reports first year Greater Sand Plovers departing as late as mid May from the Broome area of Western Australia. They start arriving in late July to early August but most arrive in late August and September. They, along with Eastern Curlews, are among the first to arrive into the area.

Breeding Plumage

Notes made on the breeding plumage of Greater Sand Plovers showed a similar story to that previously discussed for Lesser Sand Plovers.

GREATER SAND PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast Islands Wetlands	✔✔✔ ✔✔ R	40 300	Possible survey bias but data suggests highest numbers between June and September. Could include large numbers of partial migrants arriving but not continuing. Birds leaving country likely March to May and returning August to September.

Oriental Plover

Geographic Distribution

Oriental Plovers were only recorded on four occasions during these surveys. All records were between the Moyle River on the west coast and Darwin (Figure 107). Like Little Curlews they were also probably under-recorded in these surveys because they may have moved out onto the dry and/or burnt grasslands after their arrival in the Top End. Although this distribution may not be complete, more detailed surveys of Kakadu (Bamford, 1990) and Morton *et al* (1991) still only recorded them in small numbers (only in October and November). Also Roger Jaensch (*pers. comm.*) failed to find any in suitable habitat on Lake Finniss (near Darwin) in surveys done on 1 September and 1 October 1993. Oriental Plovers, like Little Curlews had arrived at wetlands throughout the Barkly Tableland blacksoil plains (south and south east of the survey area) by mid September. John Woinarski (*pers. comm.*) also reports them as common in the Victoria River Grasslands (south west of the survey area) in at least September.

Garnett (1986) counted small numbers of Oriental Plovers on the grass plains inland from the coast in the south east Gulf of Carpentaria during December but none were seen on wetlands closer to the coast during any of my surveys. This species was not seen on Groote Eylandt by G. Brennan (in Noske and Brennan, 2002).

Numbers

Throughout all surveys there were four ground records totalling approximately 150 Oriental Plovers. These equate to <1% of the records and <1% of the numbers of all group 1 species. Thus they were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

Oriental Plovers were only recorded in survey blocks 2, 3 and 4 (Figure 108). Further details, by survey block, can be found in Table B28, Appendix B.

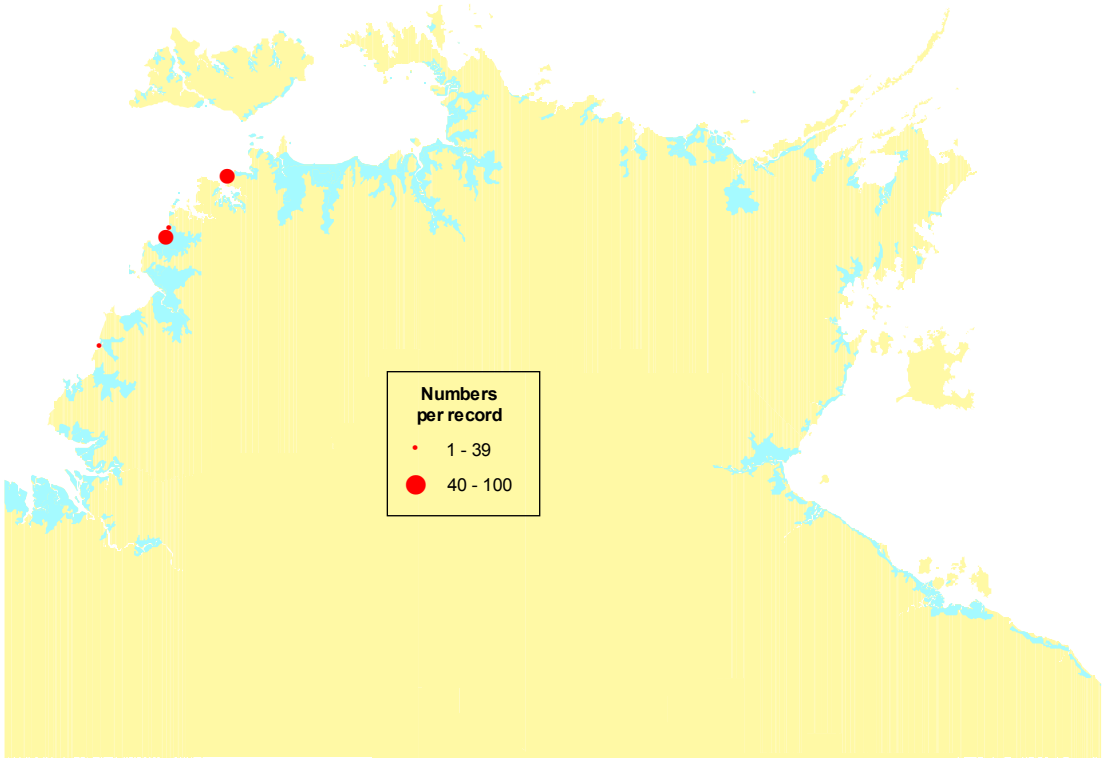


Figure 107. Distribution of all Oriental Plover records.

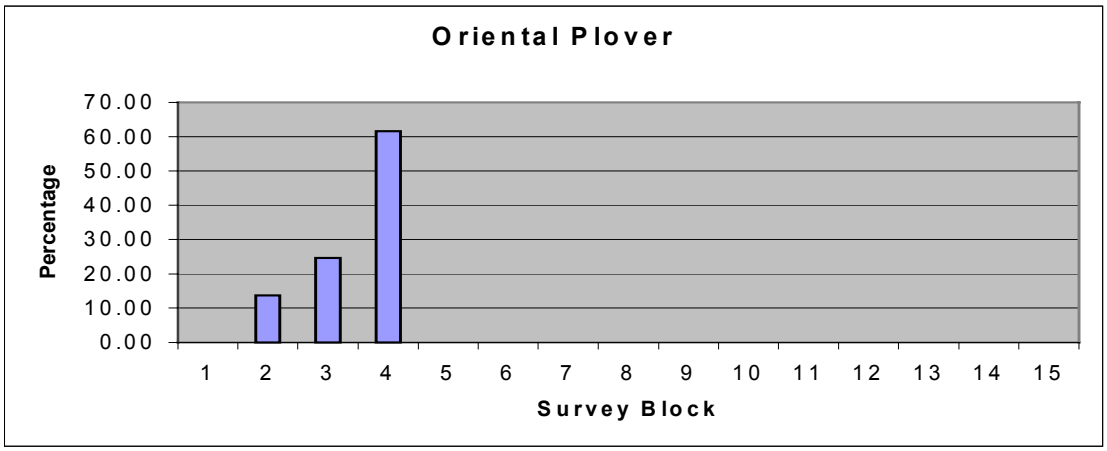


Figure 108. Percentage of Oriental Plover numbers by survey block.

The highest single count was of 100 birds on a Darwin beach (survey block 4) in late November 1991. This is probably a regular occurrence here at this time of year but because my surveys were not frequent at this site they were only recorded on the one occasion. McCrie (*pers. comm.*) for example reports a flock of 150 in this area in September 1998 and again in October 2002. The only other count of more than ten birds in my surveys was of 40 birds in Fog Bay (survey block 3) in early September 1993.

The calculated minimum estimate of the peak number of Oriental Plovers, likely to have been present in the Top End during these surveys, is at least 130 birds. This analysis obviously not suitable for this species, which in light of the above, probably has much higher (short-term) peak numbers in the Top End.

Seasonality

Little can be said on the seasonality of Oriental Plovers from the limited number of records collected during these surveys. The large record (100 birds) was made in Darwin in November as mentioned above, while the other three records were all in September. This suggests few Oriental Plovers visit the Top End and that they may just past through on their southward migration. Crawford (1972) supports this in part by recording birds on the coast in the influx period 31 August to 27 November, but he also reported birds in the outgoing efflux between 10 March and 3 April.

Minton (*pers. comm.*) says Oriental Plovers depart the Broome area of Western Australia during early to mid March. He also says a few birds arrive into the area from mid September, but most in the second half of October.

Marchant and Higgins (1993) report all coastal records around Darwin between 1967-72 were late August to late November, while birds were observed arriving into Arnhem Land in late September and early October. They also report that there are only few records from coastal northern Australia in the March/April period and even fewer records from north west Western Australia at this time.

Breeding Plumage

No comments were recorded on breeding plumage of Oriental Plovers during these surveys.

ORIENTAL PLOVER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted, records in the NW only.	Coast Islands	✔ ✔	130	Most of the relatively few birds were recorded in the September to November period as they stop briefly on their way further south. Few birds return on northward migration

Wetlands	✔

Black-fronted Dotterel

Geographic Distribution

Black-fronted Dotterels had a fairly restricted distribution as recorded in these surveys (Figure 109). All records were from wetlands, with no birds being recorded on the coast or offshore islands. They were usually found in small numbers on small wetlands that did not have large numbers of shorebirds. Consequently, they may have been present on other such wetlands that were not ground counted, and their distribution more extensive than shown here. Their presence at some of these sites could also have been irregular. For example Bamford (1990) reported them as one of the more abundant shorebirds in the Kakadu freshwater wetlands during his surveys of the late 1980's, whereas Morton *et al* (1991) referred to them as uncommon in their surveys of the Kakadu wetlands during the early 1980's.

The few records in my surveys were made from only two areas other than Darwin. These were in the far south east and the far south west of the Top End.

Garnett and Taplin (1990) also noted that this species was scarce in their late March 1990 surveys of freshwater swamps between the Roper River and the Queensland border. Marchant and Higgins (1993) have no records for this species in the eastern half of the Top End, Frith and Hitchcock (1974) report them to be absent from Cobourg Peninsula and G. Brennan (in Noske and Brennan, 2002) did not report any in his many years living on Groote Eylandt.

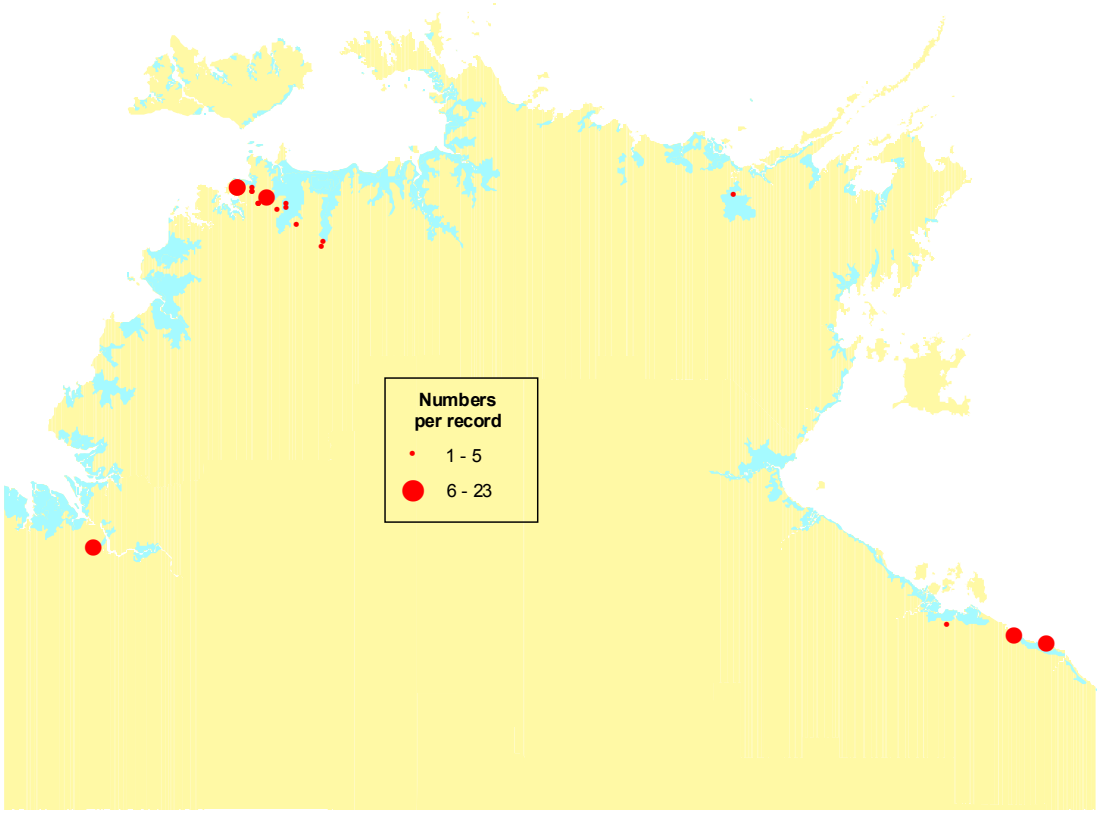


Figure 109. Distribution of all Black-fronted Dotterel records.

Numbers

Throughout all surveys there were 33 ground records totalling approximately 110 Black-fronted Dotterels. These equate to approximately 1% of the records and <1% of the numbers of all group 1 species. Thus Black-fronted Dotterels were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

Black-fronted Dotterels were only recorded in survey blocks 1, 4, 5, 8 and 15, with the highest numbers in survey block 4 (Figure 110). The higher numbers in survey block 4 was influenced by the large number of surveys done on small wetlands around Darwin. Further details, by survey block, can be found in Table B29, Appendix B.

The largest single group count was only 23 (survey block 4). The next largest was 15 (survey block 15). The rest were all under 10, with most being of 1-3 birds.

The calculated minimum estimate of the peak number of Black-fronted Dotterels, likely to have been present in the Top End during these surveys, is at least 110 birds.

Seasonality and Breeding

Although there were only a small number of records, the three histograms (Figures C73-75), all showed birds between May and October. This suggests the species is a dry season visitor to the survey area, however I have seen the odd one around Darwin during the wet season.

No breeding was confirmed during my surveys but Bamford (1990) reported them breeding in Kakadu.

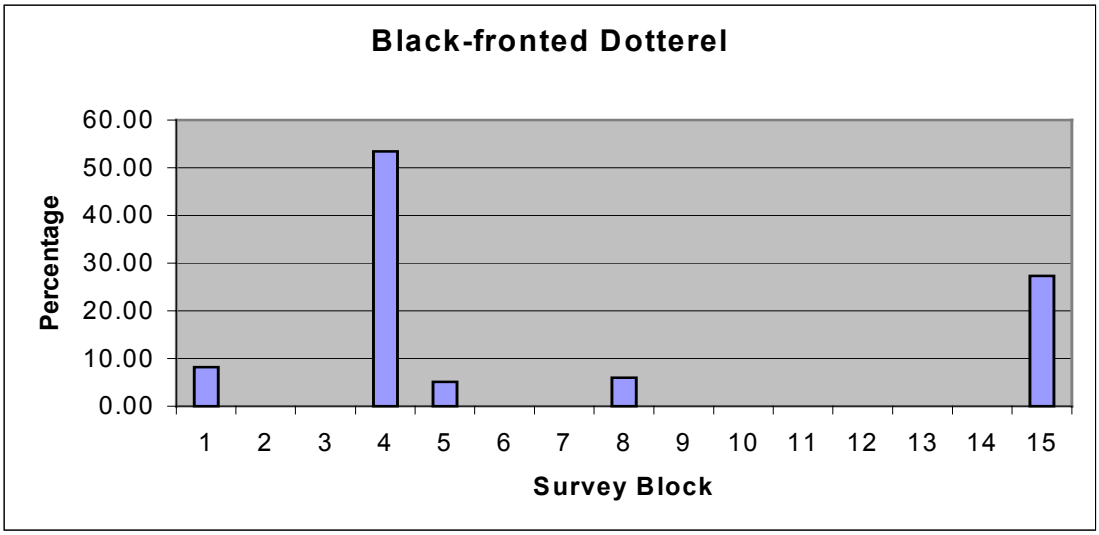


Figure 110. Percentage of Black-fronted Dotterel numbers by survey block.

BLACK-FRONTED DOTTEREL SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	110	Dry season, mostly non-breeding visitor, between May and October.
	Islands	R		
	Wetlands	✔		

Red-kneed Dotterel

Geographic Distribution

Although found in my surveys to be more widely spread than the Black-fronted Dotterels, there are still many gaps in the recorded distribution of Red-kneed Dotterels around the Top End (Figure 111). All records were on wetlands, with no birds being recorded on the coast or on offshore islands. The most important area was found to be the wetlands around, and to the east and west, of Darwin.

Their presence of Red-kneed Dotterels at some sites could have been irregular. Except for a small area in north east Arnhem Land, Marchant and Higgins (1993) have no records for this species in the eastern half of the Top End and G. Brennan (in Noske and Brennan, 2002) did not report any in his many years living on Groote Eylandt. I found birds in each of these areas.

Numbers

Throughout all surveys there were 56 ground records totalling approximately 1 150 Red-kneed Dotterels. These equate to approximately 2% of the records and <1% of the numbers of all group 1 species. There were also six aerial records of Red-kneed Dotterels. Thus Red-kneed Dotterels were one of the less frequently recorded and less abundant of the shorebirds seen during these surveys.

The highest numbers of Red-kneed Dotterels were recorded in survey blocks 5 and 10, while lowest numbers, where recorded, were in blocks 7, 8 and 15 (Figure 112). This species was not recorded in survey blocks 2, 6, 9, 12, 13 and 14. Further details, by survey block, can be found in Table B30, Appendix B.

The largest single group count was 200. This was recorded on two occasions, both in July. One count was in a wetland behind Chambers Bay (survey block 5) and the other in a wetland in the northern Blue Mud Bay area (survey block 10).

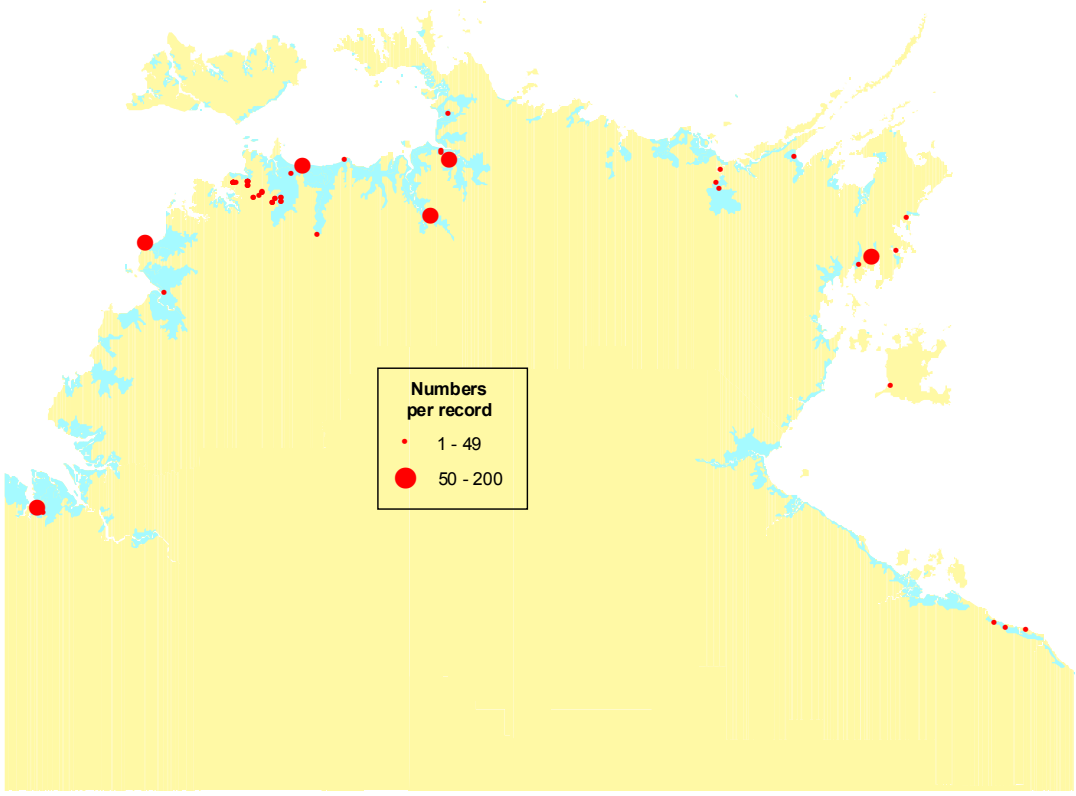


Figure 111. Distribution of all Red-kneed Dotterel records.

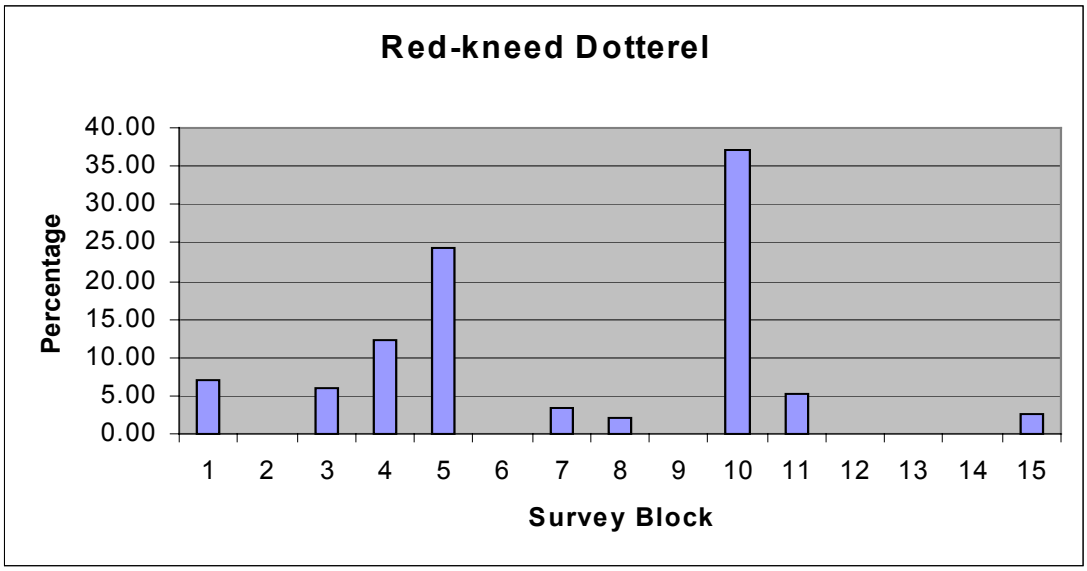


Figure 112. Percentage of Red-kneed Dotterel numbers by survey block.

The calculated minimum estimate of the peak number of Red-kneed Dotterels, likely to have been present in the Top End during these surveys, is at least 1 300 birds.

Seasonality and Breeding

Although there were only a small number of records for this species (Figures C76-78), all were between April and December. This may suggest that this species is also mainly a dry season visitor to the coastal areas of the Top End, although some birds may stay on until the main rains come, and thus a little longer than the Black-fronted Dotterel. The top three single counts from my surveys were all in July. Roger Potts (*pers. comm.*) reported more than 1 000 Red-kneed Dotterels at the Tanami mine site (southern, inland Northern Territory) in mid January 2002. This gives further support to the possibility of this species moving out of coastal Northern Territory in the wet season.

Although two juvenile birds were recorded with two adults in late May 1999 there were no confirmed breeding records made for this species during these surveys. Bamford (1990) did not find them breeding in Kakadu.

RED-KNEED DOTTEREL SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Restricted	Coast	R	1 300	Dry season, mostly non-breeding visitor, between May and October. Some birds stay on longer than Black-fronted Dotterels, remaining until the rains of December.
	Islands	R		
	Wetlands	✔		

SHOREBIRDS – BY SPECIES
GROUP 2 SPECIES

Beach Thick-knee

Geographic Distribution

Beach Thick-knees were recorded around the entire Top End coast and most offshore islands (Figure 113). They were only absent in areas which were completely dominated by mangroves and intertidal mudflats. Even where there was the narrowest of strips of sand between the mangroves and the forest these birds or their tracks could be found. As such there were very few areas around the Top End coast where these birds were not recorded during these surveys. Some such areas included the inner Port McArthur area, Blue Mud Bay, Castlereagh Bay and parts of Van Diemen Gulf. Beach Thick-knees were almost always recorded in groups of 1, 2 or 3. Single birds were most often recorded from the air and probably represented only one of a pair on most occasions while trios were probably quite often two adults and one young. Nocturnal aggregations of a number of birds from the surrounding area sometimes occur in marine turtle hatching areas but the majority of observations in these surveys were during the day when the birds are spread, one pair per territory, around the coast and islands.

Numbers

Throughout all surveys there were 787 ground and aerial records totalling approximately 1 200 Beach Thick-knees. The minimum estimate, calculated by totalling individual survey block totals of Beach Tick-knees around the Top End coast, is 350 pairs.

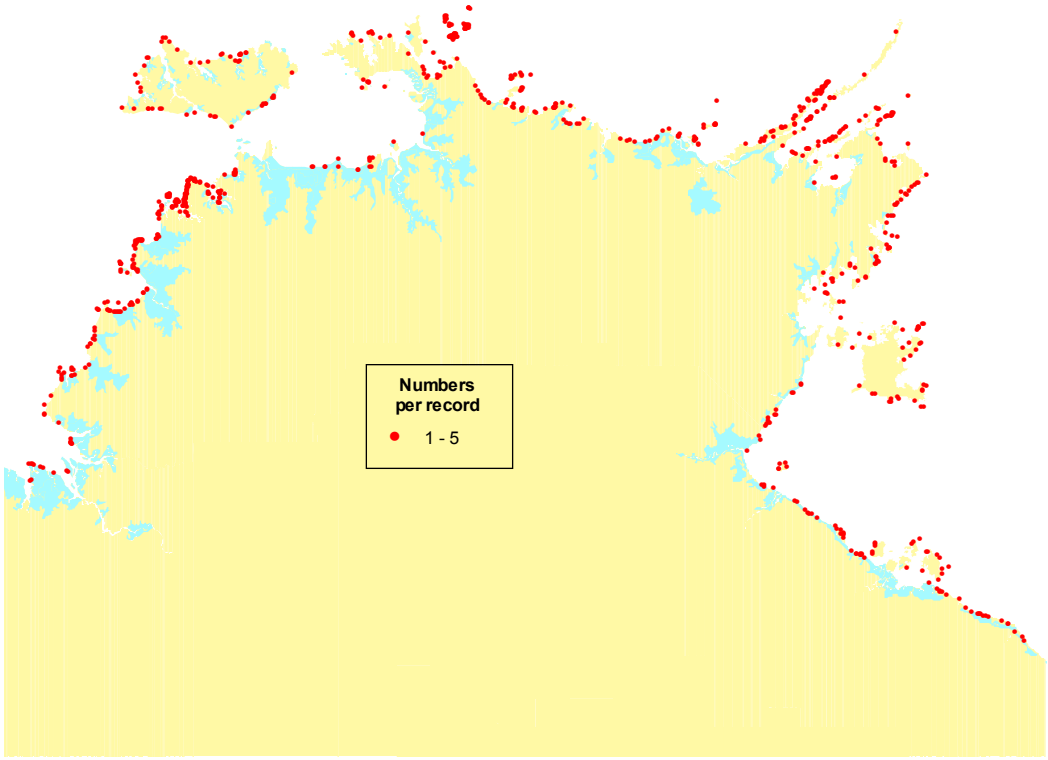


Figure 113. Distribution of all Beach Thick-knee records.

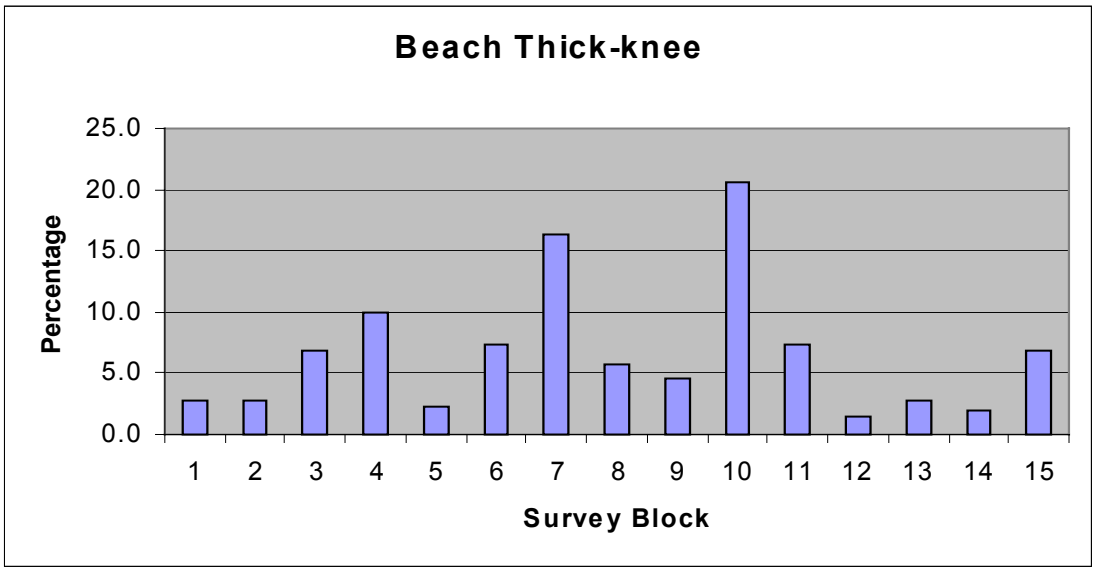


Figure 114. Percentage of beach Thick-knee numbers by survey block.

The highest numbers of Beach Thick-knees were recorded in survey blocks 4, 7 and 10, while lowest numbers, where recorded, were in blocks 1, 2, 5, 12, 13 and 14 (Figure 114). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B31, Appendix B.

Seasonality and Breeding

These surveys gave no indication of any large seasonal changes in numbers of Beach Thick-knees around the Top End coast. This is supported by Marchant and Higgins (1993), who concluded that this species is largely sedentary.

There were not many breeding records confirmed during these surveys (mainly because time was not available to confirm suspected breeding in most cases) and those that were recorded, were not all during the same period of the year. Recently fledged young were recorded in September and December, a small chick in July and single eggs in March and September. Suspected breeding activity (ie defending birds) was recorded 17 times from all around the Top End coast. These were spread through all months except January and August (when not much ground survey work was done), although the September/October period had more records than any other period.

Marchant and Higgins (1993) report breeding from July to at least October in northern Australia, with eggs recorded in the Northern Territory in mid September and early October.

BEACH THICK-KNEE SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast Islands Wetlands	✔✔ ✔✔ R	700	Birds present all year, no major seasonal changes observed. Breeding recorded most months but mostly dry season, particularly September/October.

Pied Oystercatcher

Geographic Distribution

Pied Oystercatchers were recorded from all around the Top End coast and most islands (Figure 115). They were nearly always found on the coast but occasionally roosted on wetlands just in behind the coast. This was usually due to bad weather or very high tides. Although other species of shorebirds may also have a similarly extensive range, the ease of identification of the Pied Oystercatcher means they are far less likely to be missed during both ground and aerial surveys. Except for the southern coast of Cobourg Peninsula and the cliffy coast to its east, there was virtually no section of the entire Top End coast or offshore islands where Pied Oystercatchers were not recorded.

Although most records were of pairs of birds spaced around the coast and islands, there were some places where Pied Oystercatchers formed quite large roosting flocks. There were around 30 records of flocks in excess of 50 birds. All, except one record in Fog Bay, were in the eastern half of the Top end. The area from the eastern end of Boucaut Bay to the islands off Millingimbi, Buckingham Bay and an inlet in the northern part of Blue Mud Bay consistently contained roosting flocks in excess of 75 birds. Although not in large groups, they were also particularly numerous along the coast in the south east of the Top End.

Numbers

Throughout all surveys there were 910 ground and aerial records totalling approximately 7 400 Pied Oystercatchers. (There were also 68 records totalling approximately 200 *Oystercatcher spp*.). Two thirds of the confirmed Pied Oystercatcher records were of 1 or 2 birds, and less than 10% were records of greater than ten birds. The Top End population estimate of Pied Oystercatchers, made by totalling the numbers estimated for each survey block, suggests a minimum population of 1 700.

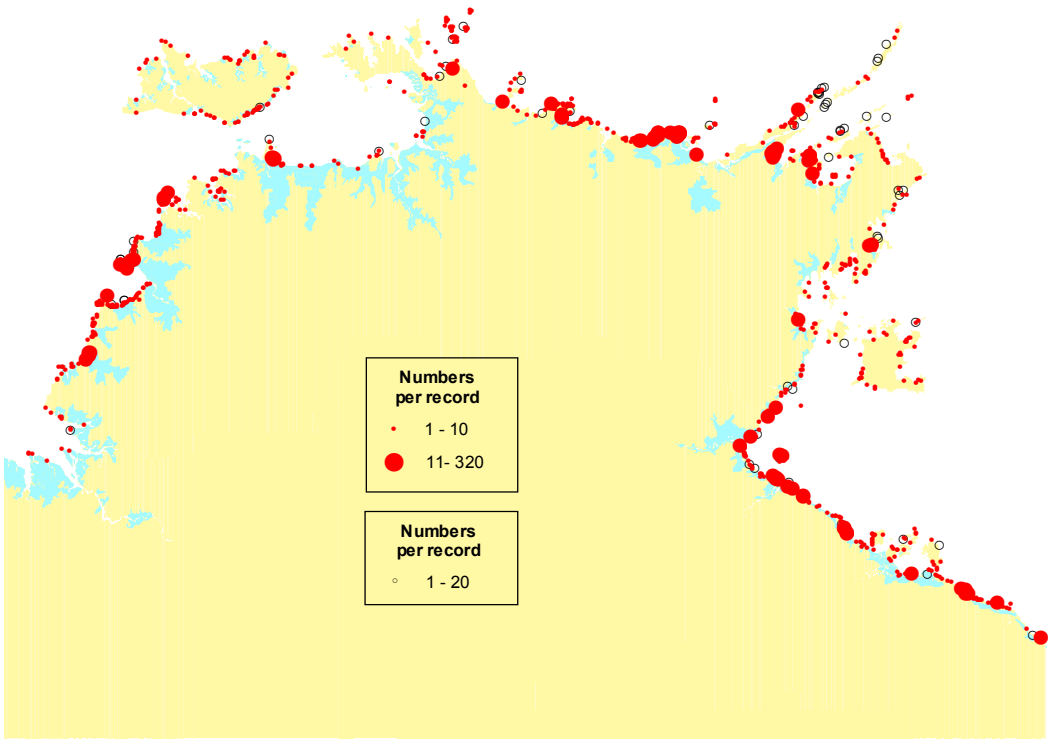


Figure 115. Distribution of all Pied Oystercatcher records. (Hollow black circles are *oystercatcher spp*. records).

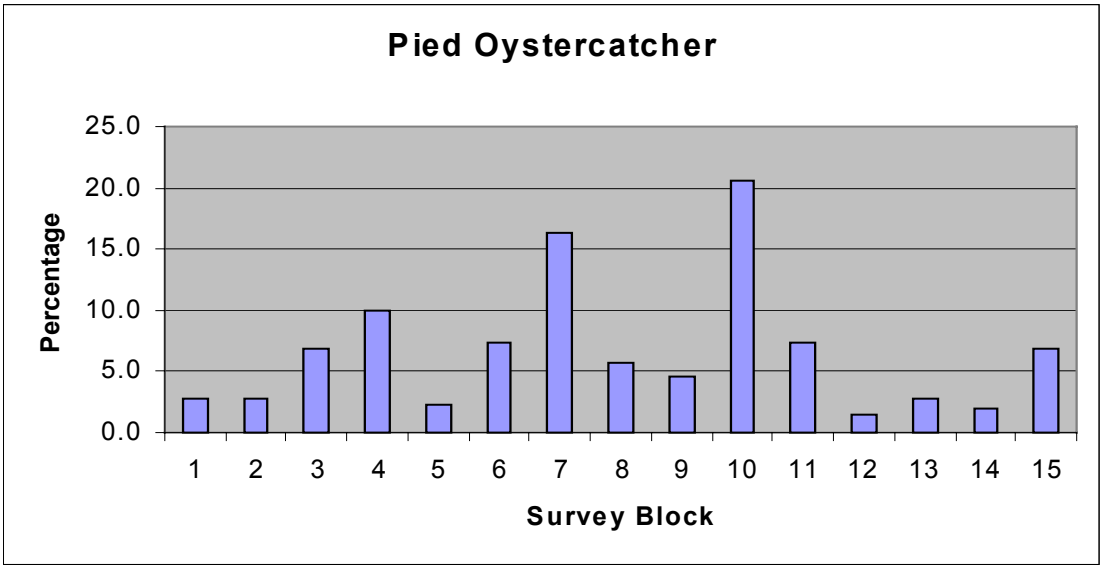


Figure 116. Percentage of Pied Oystercatcher numbers by survey block.

The highest numbers of Pied Oystercatchers were recorded in survey blocks 7 and 10, while lowest numbers, where recorded, were in blocks 1, 2, 5, 12, 13 and 14 (Figure 116). This species was recorded in all survey blocks. Further details, by survey block, can be found in Table B32, Appendix B.

The largest flocks of Pied Oystercatchers were on one of the islands off Millingimbi (survey block 8). Some of the records here, the largest being 320 in a single roost (with another 200 in a nearby roost), were more than three times that of those anywhere else.

Seasonality and Breeding

Pied Oystercatchers were recorded in all coastal surveys throughout the year and there was no obvious indication of any large seasonal changes in numbers. The consistency of being able to record most Pied Oystercatchers in all surveys means applying their total monthly counts to total survey hours is, although still very approximate, a little more practical for this species. This gives the highest number of birds per survey hour in December, followed by June and July. August to November had the lowest. As most of the breeding records were in August to September, the June/July high may represent birds active prior to nesting. August to November may be low because sitting birds were not always detected and December may be showing an influx of young into the population.

During these surveys there were at least 12 confirmed, or probable, breeding records made of Pied Oystercatchers. These have been previously detailed in the earlier survey block summaries but in terms of a monthly summary, one was in May, one in June, one in August, eight in September, and one in October.

PIED OYSTERCATCHER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread	Coast	✔✔	1 700	Birds present all year, no major seasonal changes observed. Breeding mostly dry season, particularly later dry season.
	Islands	✔✔		
	Wetlands	R		

Sooty Oystercatcher

Geographic Distribution

Sooty Oystercatchers were primarily recorded on islands, particularly those with rocks and reefs. This habitat is more common in the eastern half of the Top End. The majority of records and numbers of birds were on the islands in north east Arnhem Land (Figure 117). Except for Darwin, the islands off Bynoe Harbour and North Perron Island, where few were recorded, there were no Sooty Oystercatchers recorded on the western coast of the Top End.

Numbers

Throughout all surveys there were 181 ground and aerial records totalling approximately 450 Sooty Oystercatchers. (There were also 68 records totalling approximately 200 O*ystercatcher spp*.). As with Pied Oystercatchers most records were of pairs of birds. Two thirds of the confirmed Sooty Oystercatcher records were of 1 or 2 birds, and less than 10% were records of greater than 5 birds. The Top End population estimate of Sooty Oystercatchers, made by totalling the numbers estimated for each survey block, suggests a minimum population of around 240.

The highest numbers of Sooty Oystercatchers were recorded in survey blocks 8 and 9, while lowest numbers, where recorded, were in blocks 11, 12, 14 and 15 (Figure 118). This species was recorded in all survey blocks except 1 and 2. Further details, by survey block, can be found in Table B33, Appendix B.

The largest single flock of Sooty Oystercatchers was only 30. This was in mid December 1998 and was on the same island off Millingimbi (survey block 8) where the large flocks of Pied Oystercatchers were located.

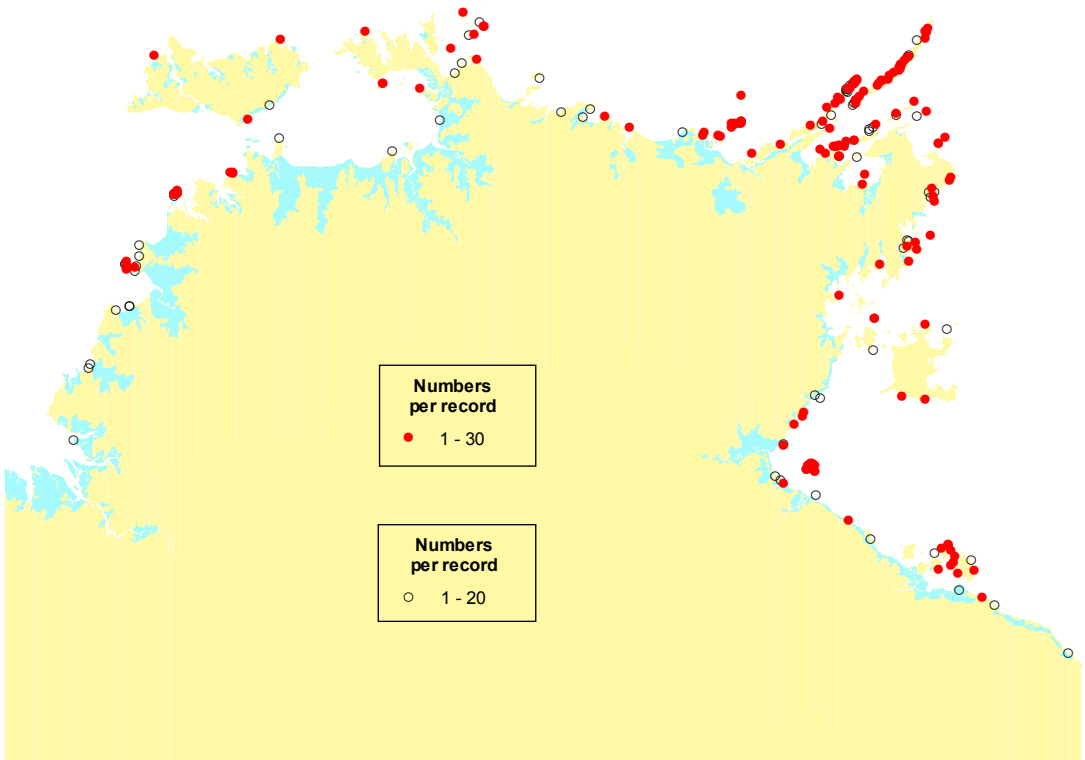

Numbers per record
1 - 30
Numbers per record
1 - 20

Figure 117. Distribution of all Sooty Oystercatcher records. (Hollow black circles are *oystercatcher spp*. records).

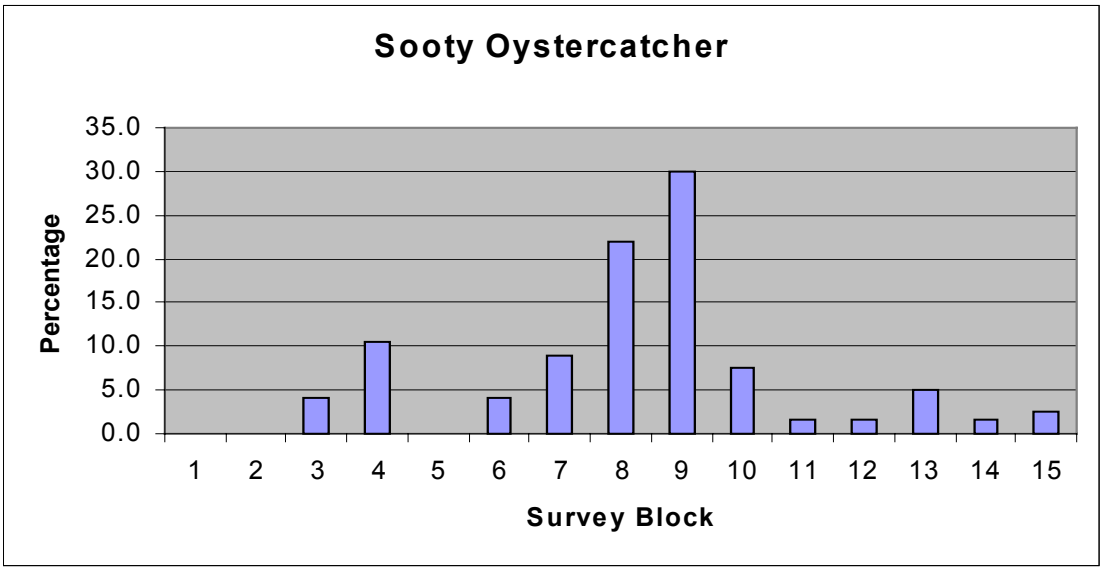


Figure 118. Percentage of Sooty Oystercatcher numbers by survey block.

Seasonality and Breeding

Sooty Oystercatchers were recorded in all coastal surveys in the northern and eastern parts of the Top End and there was no obvious indication of any large seasonal changes in numbers. Monthly totals adjusted by a very approximate breakdown of monthly survey hours showed the highest peaks in November and December, which like Pied Oystercatchers, possibly represents an influx of young into the populations. For the remainder of the year relative numbers were fairly constant.

During these surveys there were at least 14 confirmed, or probable, breeding records made of Sooty Oystercatchers. These have been previously detailed in the earlier survey block summaries but in terms of a monthly summary, two were in May, one in August, four in September, four in October, one in November and two in December.

SOOTY OYSTERCATCHER SUMMARY

Top End Distribution	Habitat	Status	Minimum Estimate Of Peak Top End Population	Seasonality
Widespread, particularly in the eastern Top End. Mostly restricted to islands	Coast Islands Wetlands	✔ ✔✔ R	240	Birds present all year, no major seasonal changes observed. Breeding mostly dry season, particularly later and through to early wet season

SHOREBIRDS – BY SPECIES
LESS COMMON SPECIES

Spotted Redshank

A single record from Darwin in November 1983, but not accepted by the BARC (Higgins and Davies, 1996). Not recorded in my surveys, but accepted records from elsewhere in Australia.

Spotted Greenshank

A single record from Darwin in March 1974, but not accepted by the BARC (Higgins and Davies, 1996). Not recorded in my surveys and no accepted records from anywhere in Australia.

Green Sandpiper

There have been a small number of records for the Northern Territory including Kakadu (September 1979), Darwin Sewage Farm (December 1982) and Leanyer Swamp, Darwin (December 1983). Only one [BARC case number 239 and written up in the Australian Bird Watcher 18(6) 229-232] so far accepted. Not recorded in my surveys.

Wandering Tattler

A number of single records from around Darwin (Higgins and Davies, 1996) but all very doubtful. Not recorded in my surveys, but no attempts were made to look closely at most Grey-tailed Tattler flocks.

Little Stint

A number of single records from around Darwin (Higgins and Davies, 1996). Not recorded in my surveys.

Long-toed Stint

Several records from around Darwin (Higgins and Davies, 1996). Two recorded in September 1994 at Knuckies Lagoon in Darwin on one occasion during my surveys.

Baird's Sandpiper

A single accepted record at Palmerston, near Darwin in October 1983 (Higgins and Davies, 1996). Not recorded in my surveys.

Pectoral Sandpiper

Seventeen records from Darwin area between 1967 and 1989 (Higgins and Davies, 1996). Seen most years at Knuckies Lagoon, Darwin (McCrie, *pers. comm.*). Not recorded in my surveys.

Stilt Sandpiper

A single acceptable record from Darwin in August 1980 (Higgins and Davies, 1996). Not recorded in my surveys.

Ruff

A few records from around Darwin between 1976 and 1980 (Higgins and Davies, 1996). Most recent record at Leanyer Swamp, Darwin (McCrie, *pers. comm.*). One record of a single bird in May 1993 on wetlands adjacent to the Daly River in my surveys.

Red-necked Phalarope

A few records from around Darwin between 1974 and 2001, eg Palmerston Sewage Ponds in February 1987 (Northern Territory Naturalist 10:17) and Darwin Sewage Ponds in March 2001 (McCrie, *pers. comm.*). Not recorded in my surveys.

Ringed Plover

A single record from Darwin in February 1980 (Higgins and Davies, 1996). Not recorded in my surveys.

Little Ringed Plover

A few records from between Darwin and Kakadu between 1973 and 1982 (Higgins and Davies, 1996). One reported in Sandy Billabong, Kakadu in 1989 (Bamford, *pers. comm.*). Up to seven birds, but usually 2-3 birds at Darwin Sewage Ponds in most years (McCrie, *pers. comm.*). Not recorded in my surveys.

Kentish Plover

A single confirmed record (BARC case number 170) from Darwin in November 1988 by N. McCrie [Australian Bird Watcher 16(3) 91-95)]. Not recorded in my surveys.

Caspian Plover

Two unconfirmed records near Darwin in 1974 (Higgins and Davies, 1996). Confirmed (BARC case number 218) at Lake Finniss, east of Darwin [Australian Bird Watcher 18(2) 81-6.] Not recorded in my surveys.

Plate 26. Kentish Plover, Buffalo Creek, Darwin, November 1988. Photo N. McCrie.

ESTIMATION OF TOP END SPECIES PEAK NUMBERS

As discussed in the 'Methods" section, it is difficult to estimate the number of each shorebird species using the Top End. Nevertheless, because of the frequent use of total population estimates in shorebird research and management, and some obvious underestimations in previously quoted figures for some species in the Northern Territory, an attempt is made here to produce such figures. These figures will be very approximate and will more likely be under than over the real figures, but will certainly improve previous figures for some species.

The individual peak estimates for each species in each survey block is shown in Appendix B. The total for each species for all survey blocks combined is given in Table 17. Also shown in this table is the current Australian population estimate (Watkins, 1993).

Table 17. Northern Territory coast and coastal shorebird species peak number estimates.

Species	Estimate of Top End Population - to nearest 10 or 100 (these surveys)	Estimate of Australian Population (Watkins)
Snipe spp.	20	36 000
Black-tailed Godwit	44 000	81 000
Bar-tailed Godwit	53 000	165 000
Little Curlew	12 500	18 000
Whimbrel	5 100	10 000
Eastern Curlew	6 800	19 000
Common Redshank	80	N/A
Marsh Sandpiper	12 100	9 000
Common Greenshank	7 600	20 000
Wood Sandpiper	40	6 000
Terek Sandpiper	15 000	18 000
Common Sandpiper	180	3 000
Grey-tailed Tattler	16 000	36 000
Ruddy Turnstone	5 000	14 000
Asian Dowitcher	190	~500
Great Knot	122 000	319 000
Red Knot	24 200	153 000
Sanderling	890	8 000
Red-necked Stint	44 400	353 000
Sharp-tailed Sandpiper	20 100	166 000
Curlew Sandpiper	17 800	188 000
Broad-billed Sandpiper	2 000	8 000
Pacific Golden plover	200	9 000
Grey Plover	5 400	12 000
Red-capped Plover	9 900	95 000
Lesser Sand Plover	39 000	20 000
Greater Sand Plover	40 300	74 000
Oriental Plover	130	40 000
Black-fronted Dotterel	110	17 000
Red-kneed Dotterel	1 300	26 000
Beach Thick-knee	700	1 000
Pied Oystercatcher	1 700	10 000
Sooty Oystercatcher	240	4 000
Total	507 980	1 605 500

FUTURE RESEARCH

This report has concentrated on reporting the location of shorebird concentrations and relative abundance of species, rather than studying individual species or sites in detail. Nevertheless these surveys have clearly shown that there are internationally important numbers of shorebirds and a large amount of significant shorebird habitat used by a diverse assemblage of species in the Top End. The surveys have also shown that there is still a lot of important research that needs to be done to better understand the ecology, particularly the movements within the Top End, of most species of shorebirds. To this end, the priority for future shorebird research in the Northern Territory should be to select some of the sites documented in this report and look more closely at the seasonal use of those sites. 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.

This work 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 shorebird habitat, and before the eventual pressures associated with increasing human populations begin to assert an influence.

The large amount of data collected on shorebirds during this project was only given restricted analysis in order to produce this report. Further analysis of this data will be able to further improve our knowledge of the distribution and status of shorebirds in the Top End.

Plate 27. ….. and of course the usual sunset finishing photo. Near Buffalo Creek, October 1995. Photo R. Chatto.

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Minton, C. Australian Wader Studies Group

Potts, R. Tanami mine site.

Saalfeld, K. Parks and Wildlife Commission, Darwin.

Woinarski, J. Parks and Wildlife Commission, Darwin.

APPENDICES

APPENDIX A
SUMMARY OF SPECIES DATA FOR INDIVIDUAL SURVEY BLOCKS

Table A 1. Survey Block 1.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Terek Sandpiper	33.89	1000	(6)	6	0
Greater Sand Plover	22.65	700	(6)	5	0
Bar-tailed Godwit	9.60	300	3&6*	5	4
Red-necked Stint	7.09	200	(6)	7	0
Great Knot	5.39	300	(3)	2	0
Lesser Sand Plover	4.78	300	(6)	2	0
Ruddy Turnstone	3.54	200	(6)	2	0
Broad-billed Sandpiper	3.34	200	(3)	4	0
Sanderling	2.54	100	(3)	3	0
Grey-tailed Tattler	2.28	50	(3)	6	0
Whimbrel	1.11	30	(3)	5	10
Red-kneed Dotterel	0.92	50	(6)	2	0
Red-capped Plover	0.88	50	(6)	4	0
Sharp-tailed Sandpiper	0.62	35	(3)	2	0
Common Greenshank	0.49	20	(3)	7	4
Grey Plover	0.46	20	(3)	2	6
Red Knot	0.15	10	(3)	1	0
Black-fronted Dotterel	0.09	6	(6)	1	0
Eastern Curlew	0.06	2	(7)*	3	9
Snipe spp.	0.06	4	(3)	1	0
Curlew Sandpiper	0.05	2	(3)	2	0
Asian Dowitcher	<0.05	1	(3)	1	0
Black-tailed Godwit	<0.05	1	(3)	0	1
Common Redshank	0	0		0	0
Common Sandpiper	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
March Sandpiper	0	0		0	0
Oriental Plover	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	3	(3)	9	13
Pied Oystercatcher	Not calculated	2	(7)	5	9
Sooty Oystercatcher	Not calculated	0		0	0

* These species had their highest count made from the air. Bar-tailed Godwit 500 (10 – ie October) and Eastern Curlew 20 (5 – ie May).

Table A 2. Survey Block 2.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	52.76	750	(4)*	10	0
Black-tailed Godwit	10.73	600	(8)	4	4
Lesser Sand Plover	7.15	50	(3)^	8	0
Bar-tailed Godwit	6.70	400	(4)	4	4
Grey-tailed Tattler	5.21	300	(8)	3	0
Greater Sand Plover	4.93	40	(11)^	8	0
Red Knot	3.13	48	(9)*	9	0
Terek Sandpiper	2.23	75	(4&8)	2	0
Whimbrel	1.53	40	(4)#	5	6
Red-capped Plover	1.40	75	(11)	6	0
Sharp-tailed Sandpiper	1.12	75	(4)	1	0
Ruddy Turnstone	0.91	55	(8)	3	0
Grey Plover	0.83	25	(8)	4	12
Common Greenshank	0.60	100	(9)	1	3
Eastern Curlew	0.45	25	(8)	3	3
Red-necked Stint	0.16	6	(9)	2	0
Oriental Plover	0.09	6	(9)	1	0
Sanderling	0.04	3	(9)	1	0
Marsh Sandpiper	0.03	2	(3)	1	0
Asian Dowitcher	0	0		0	0
Broad-billed Sandpiper	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Common Sandpiper	0	0		0	0
Curlew Sandpiper	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	2	(5)	4	19
Pied Oystercatcher	Not calculated	2	(8)#	2	25
Sooty Oystercatcher	Not calculated	0		0	0

* A count of 2000 mixed Knots in March may have had higher numbers of one or both species than is shown in this table.

^ A count of 600 mixed Lesser and Greater Sand Plovers in August may have had higher numbers of one or both species than is shown in this table.

These species had their highest single counts made from the air – Whimbrel 100(8) and Pied Oystercatcher 35(3).

Table A 3. Survey Block 3.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	34.31	5000	(12)	62	12
Greater Sand Plover	11.48	1800	(7)*	52	0
Bar-tailed Godwit	11.48	2000	(8)	47	24
Lesser Sand Plover	8.15	500	(12)*	50	0
Red-necked Stint	5.97	1500	(12)	35	4
Black-tailed Godwit	5.84	1500	(9)^	22	38
Red Knot	5.83	1200	(9)	28	4
Terek Sandpiper	4.83	800	(12)	36	6
Curlew Sandpiper	2.28	700	(12)	19	2
Marsh Sandpiper	2.18	800	(12)#	11	1
Grey Plover	1.77	500	(12)	38	11
Sharp-tailed Sandpiper	1.56	500	(12)	15	3
Common Greenshank	0.72	200	(9)#	29	9
Whimbrel	0.71	120	(9)^	30	14
Red-capped Plover	0.64	200	(9)	18	0
Eastern Curlew	0.62	80	(9)	23	13
Grey-tailed Tattler	0.61	120	(5)	29	6
Little Curlew	0.34	300	(12)^	1	1
Ruddy Turnstone	0.29	300	(5)	20	7
Red-kneed Dotterel	0.12	80	(7)	2	0
Broad-billed Sandpiper	0.12	100	(12)	4	0
Sanderling	0.10	40	(12)	7	2
Oriental Plover	0.05	40	(9)	2	0
Pacific Golden Plover	0.02	9	(12)	4	0
Common Sandpiper	<0.02	1	(9)	3	0
Common Redshank	<0.02	1	(9)	1	0
Asian Dowitcher	0	()		0	0
Black-fronted Dotterel	0	()		0	0
Snipe spp.	0	()		0	0
Wood Sandpiper	0	()		0	0
Beach Thick-knee	Not calculated	3	(8)	11	68
Pied Oystercatcher	Not calculated	10	(8)^	11	128
Sooty Oystercatcher	Not calculated	3	(3)	1	3

* Greater Sand Plover count based on a small sample count of 2000 mixed Sand Plovers. The highest mixed Sand Plover count (no sample count done) was 2430 (9). There was a relatively high number (33) of mixed Sand Plover records in this survey block.

^ These species had their highest counts made from the air – Black-tailed Godwit 2000 (10), Little Curlew 3000 (10), Whimbrel 200 (9) and Pied Oystercatcher 50 (9).

\# An aerial count of 300 mixed Common Greenshanks and/or Marsh Sandpipers in October may have had more than 200 Common Greenshanks.

Table A 4. Survey Block 4.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	18.77	2500	(11)	45	4
Greater Sand Plover	15.42	400	(8)*	59	0
Bar-tailed Godwit	13.09	750	(9)	46	30
Lesser Sand Plover	8.15	200	(10)*	60	0
Red-necked Stint	7.65	800	(9)	43	3
Grey-tailed Tattler	4.96	400	(9)	42	8
Little Curlew	4.71	440	(10)	20	0
Terek Sandpiper	3.94	300	(8)	37	4
Red Knot	3.50	750	(8)	14	1
Ruddy Turnstone	3.12	300	(9)	45	13
Black-tailed Godwit	3.00	500	(11)	18	5
Whimbrel	2.23	300	(8)	43	74
Grey Plover	2.19	300	(8)	33	6
Sharp-tailed Sandpiper	1.80	200	(12)	33	0
Curlew Sandpiper	1.42	300	(8)	14	0
Common Greenshank	1.26	110	(9)^	56	7
Eastern Curlew	0.97	150	(9)	28	36
Sanderling	0.81	200	(11)	6	0
Marsh Sandpiper	0.75	38	(9)^	46	0
Red-capped Plover	0.57	40	(6)	17	0
Red-kneed Dotterel	0.57	30	(6)	25	0
Oriental Plover	0.29	100	(11)	1	0
Common Sandpiper	0.28	10	(11)	46	1
Pacific Golden Plover	0.25	30	(12)	12	0
Black-fronted Dotterel	0.21	23	(8)	22	0
Wood Sandpiper	0.08	4	(10)	14	0
Snipe spp.	0.02	6	(11)	1	0
Broad-billed Sandpiper	0.01	2	(12)	3	0
Asian Dowitcher	0.01	2	(9)	1	0
Common Redshank	0.00	0		0	0
Beach Thick-knee	Not calculated	5	(8)	24	109
Pied Oystercatcher	Not calculated	15	(9)	29	27
Sooty Oystercatcher	Not calculated	8	(9)	14	4

* The highest mixed Sand Plover count (no sample count done) was a ground count of 1380 done in the month of September. This is likely to have had higher numbers of one or both species than is shown in this table. There was relatively high number (30) of mixed Sand Plover records in this survey block.

^ The highest mixed Common Greenshank and/or Marsh Sandpiper count was 300 done from the air in the month of September. This is likely to have had higher numbers of one or both species than is shown in this table.

Table A 5. Survey Block 5.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Little Curlew	15.38	10000	(10)	14	38
Sharp-tailed Sandpiper	14.53	3000	(5)	38	3
Black-tailed Godwit	12.79	2000	(5&7)	27	14
Marsh Sandpiper	9.14	1600	(4)	39	11
Lesser Sand Plover	7.27	400	(4)*	17	0
Great Knot	6.34	2000	(4&7)	16	4
Red-necked Stint	6.30	850	(9)	24	1
Curlew Sandpiper	6.16	750	(8)	27	1
Terek Sandpiper	5.92	900	(9)	17	1
Greater Sand Plover	3.44	400	(4)*	8	0
Common Greenshank	2.81	450	(9)^	33	14
Bar-tailed Godwit	2.27	400	(12)	25	2
Grey Plover	2.07	750	(8)	17	12
Whimbrel	1.76	1000	(9)	16	46
Eastern Curlew	1.41	500	(9)	14	43
Red-capped Plover	1.03	460	(9)	12	0
Red-kneed Dotterel	0.57	200	(7)	16	4
Red Knot	0.34	200	(7)	7	0
Broad-billed Sandpiper	0.19	100	(7)	7	0
Grey-tailed Tattler	0.10	40	(9)	5	0
Common Redshank	0.10	30	(9)	4	0
Asian Dowitcher	0.03	15	(5)	2	0
Pacific Golden Plover	0.03	20	(4)	2	0
Wood Sandpiper	0.01	8	(10)	4	0
Black-fronted Dotterel	0.01	3	(5)	6	0
Ruddy Turnstone	0.01	5	(9)	2	0
Common Sandpiper	<0.01	1	(8)	1	1
Snipe spp.	0	0		0	0
Oriental Plover	0	0		0	0
Sanderling	0	0		0	0
Beach Thick-knee	Not calculated	1	(1) #	1	15
Pied Oystercatcher	Not calculated	10	(9) #	10	16
Sooty Oystercatcher	Not calculated	0		0	0

* The highest mixed Sand Plover count (no sample count done) was 2430 (9). This would have easily had higher numbers of at least one, probably both, Sand Plovers than are shown in this table. There was relatively high number (33) of mixed Sand Plover records in this survey block.

^ A count of 1500 mixed Common Greenshanks and Marsh Sandpipers in May might have had higher numbers of Common Greenshanks than is recorded in this table.

\# These species had their highest counts made from the air – Beach Thick-knee 4 (12) and Pied Oystercatcher 40 (9).

Table A 6. Survey Block 6.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	29.04	760	(2)*	10	2
Red-necked Stint	16.32	560	(2)	9	0
Greater Sand Plover	15.53	600	(6)^	12	0
Bar-tailed Godwit	11.95	500	(6) #	7	10
Lesser Sand Plover	8.14	200	(9)^	7	0
Black-tailed Godwit	4.66	300	(9)#	3	5
Sharp-tailed Sandpiper	3.57	300	(4)	3	0
Red-capped Plover	2.46	100	(6)	5	0
Grey-tailed Tattler	2.41	150	(6)	7	2
Curlew Sandpiper	1.99	150	(4)	3	0
Red Knot	1.12	40	(2)	6	0
Terek Sandpiper	1.02	40	(6)	5	0
Grey Plover	0.74	40	(4)	5	9
Marsh Sandpiper	0.37	25	(4)	2	0
Common Greenshank	0.21	10	(4)	3	2
Ruddy Turnstone	0.12	5	(9)	3	0
Asian Dowitcher	0.11	10	(2)	1	0
Eastern Curlew	0.11	10	(6)	1	8
Whimbrel	0.09	5	(4)*	3	13
Common Sandpiper	0.02	2	(2)	1	1
Pacific Golden Plover	0.01	1	(9)	1	0
Sanderling	0.01	1	(6)	1	0
Broad-billed Sandpiper	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Snipe spp.	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	3	(2)	7	42
Pied Oystercatcher	Not calculated	3	(6)*	6	59
Sooty Oystercatcher	Not calculated	2	(3)	0	3

* These species had their highest counts made from the air – Great Knot 2000 (10), Whimbrel 50 (10) and Pied Oystercatcher 6 (10).

^ Counts of 750 (6) from the air and 540 (2) from the ground of mixed Lesser and Greater Sand Plovers could have had higher numbers of one or both species than is recorded in this table.

\# A count of 2000 (10) mixed godwits from the air could have had higher numbers of one or both species than is recorded in this table.

Table A 7. Survey Block 7.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	33.74	2000	(4&11)	20	2
Sharp-tailed Sandpiper	13.6	1000	(4)	10	0
Lesser Sand Plover	11.84	500	(4)*	25	0
Red-necked Stint	9.06	800	(10)	13	0
Greater Sand Plover	6.63	400	(4)*	22	0
Black-tailed Godwit	6.6	600	(4)	10	14
Bar-tailed Godwit	6.02	500	(4)	20	16
Terek Sandpiper	2.86	400	(4)	9	0
Curlew Sandpiper	1.76	150	(4)	9	0
Ruddy Turnstone	1.68	200	(10)	12	9
Grey-tailed Tattler	1.63	100	(10)	12	7
Marsh Sandpiper	1.2	150	(4)	7	0
Common Greenshank	1.14	80	(4)	12	1
Grey Plover	1	60	(4)	13	18
Red Knot	0.44	50	(4)	12	0
Whimbrel	0.24	10	(11)^	10	32
Pacific Golden Plover	0.2	20	(10)	5	0
Eastern Curlew	0.12	10	(9)	5	28
Red-capped Plover	0.1	14	(10)	5	0
Red-kneed Dotterel	0.1	20	(4)	1	0
Common Sandpiper	0.03	2	(10)	5	1
Broad-billed Sandpiper	0.02	4	(4)	1	0
Asian Dowitcher	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Snipe spp.	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Sanderling	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	3	(6)^	21	112
Pied Oystercatcher	Not calculated	4	(6)^	7	110
Sooty Oystercatcher	Not calculated	2	(4)	2	9

* A ground count of 1000 (10) mixed Lesser and Greater Sand Plovers could have had higher numbers of one or both species than is recorded in this table.

^ These species had their highest counts made from the air –Whimbrel 20 (11), Beach Thick-knee 5 (11) and Pied Oystercatcher 50 (4).

Table A 8. Survey Block 8.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	41.43	4750	(3)	33	7
Bar-tailed Godwit	15.79	4300	(11)	19	8
Greater Sand Plover	12.21	1000	(6)*	24	0
Black-tailed Godwit	7.03	4900	(3)	16	13
Red-necked Stint	5.59	900	(6)	17	0
Red Knot	5.1	900	(11)	26	1
Terek Sandpiper	2.94	800	(6)	13	0
Grey-tailed Tattler	1.84	550	(7)	15	3
Ruddy Turnstone	1.44	305	(7)	17	3
Eastern Curlew	1.35	400	(7)	13	13
Lesser Sand Plover	1.15	200	(6)*	25	0
Red-capped Plover	1.13	500	(6)	8	0
Common Greenshank	0.96	350	(7)	25	1
Curlew Sandpiper	0.56	150	(7)	8	0
Marsh Sandpiper	0.54	150	(7)	12	0
Grey Plover	0.34	70	(6)^	15	11
Sanderling	0.3	200	(3)	2	0
Whimbrel	0.24	110	(10)	10	7
Red-kneed Dotterel	0.04	20	(7)	3	0
Sharp-tailed Sandpiper	0.01	5	(10)	4	0
Black-fronted Dotterel	<0.01	2	(7)	1	0
Common Sandpiper	<0.01	2	(7)	1	0
Asian Dowitcher	0	0		0	0
Broad-billed Sandpiper	0	0		0	0
Common Redshank	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	5	(11)	17	16
Pied Oystercatcher	Not calculated	320	(11)	16	77
Sooty Oystercatcher	Not calculated	12	(11)^	10	8

* A ground count of 2000 (6) mixed Lesser and Greater Sand Plovers could have had higher numbers of one or both species than is recorded in this table. There were 19 mixed Sand Plover records for this survey block.

^ These species had their highest counts made from the air – Grey Plover 100 (3) and Sooty Oystercatcher 30 (12).

Table A 9. Survey Block 9.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Grey-tailed Tattler	22.1	201	(11)	2	0
Lesser Sand Plover	19.22	100	(11)*	4	0
Great Knot	14.82	135	(11)	2	0
Ruddy Turnstone	13.97	151	(11)	5	6
Red-necked Stint	12.79	150	(11)	2	0
Bar-tailed Godwit	4.83	56	(11)	2	0
Greater Sand Plover	3.81	20	(10)*	2	0
Common Greenshank	3.47	40	(11)	3	1
Terek Sandpiper	2.54	30	(12)	1	0
Common Sandpiper	0.76	5	(12)	5	0
Grey Plover	0.42	3	(11)	2	0
Pacific Golden Plover	0.42	5	(11)	1	0
Red-capped Plover	0.34	4	(10)	1	0
Eastern Curlew	0.17	2	(11)	1	4
Sharp-tailed Sandpiper	0.17	2	(12)	1	0
Whimbrel	0.17	1	(12)	2	5
Snipe spp.	<0.1	1	(11)	0	1
Asian Dowitcher	0	0		0	0
Broad-billed Sandpiper	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Black-tailed Godwit	0	0		0	0
Common Redshank	0	0		0	0
Curlew Sandpiper	0	0		0	0
Little Curlew	0	0		0	0
Marsh Sandpiper	0	0		0	0
Oriental Plover	0	0		0	0
Red Knot	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Sanderling	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	3	(12)	5	30
Pied Oystercatcher	Not calculated	8	(12)	4	12
Sooty Oystercatcher	Not calculated	6	(10)^	3	37

* A ground count of 150 (11) mixed Lesser and Greater Sand Plovers could have had higher numbers of one or both species than is recorded in this table.

^ This species had its highest count made from the air – 10 (11).

Table A 10. Survey Block 10.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Bar-tailed Godwit	21.98	4300	(3)	13	20
Black-tailed Godwit	17.18	4000	(9)*	17	26
Great Knot	14.31	2000	(9)*	30	3
Red-necked Stint	9.2	1200	(7)	21	3
Red Knot	5.58	450	(3)	20	0
Lesser Sand Plover	4.81	750	(11)	18	0
Curlew Sandpiper	3.89	800	(7)	11	1
Greater Sand Plover	3.36	300	(9)	17	0
Little Curlew	3.25	1000	(9)	3	0
Eastern Curlew	2.67	700	(6)	14	26
Marsh Sandpiper	2.25	450	(7)	12	3
Red-capped Plover	2.2	400	(7)	13	0
Grey-tailed Tattler	2.07	600	(11)	11	3
Sharp-tailed Sandpiper	1.86	250	(9)	7	2
Ruddy Turnstone	1.09	210	(11)	15	11
Common Greenshank	0.95	60	(11)*	19	5
Terek Sandpiper	0.81	210	(11)	4	1
Whimbrel	0.81	100	(6)	8	27
Red-kneed Dotterel	0.72	200	(7)	4	1
Grey Plover	0.63	80	(9)	8	6
Broad-billed Sandpiper	0.33	100	(7)	2	0
Common Sandpiper	0.02	1	(9)	3	2
Asian Dowitcher	0.01	5	(7)	1	0
Wood Sandpiper	0.01	2	(9)	1	0
Common Redshank	<0.01	1	(11)	1	0
Black-fronted Dotterel	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Oriental Plover	0	0		0	0
Sanderling	0	0		0	0
Beach Thick-knee	Not calculated	3	(5)*	28	112
Pied Oystercatcher	Not calculated	75	(9)*	19	109
Sooty Oystercatcher	Not calculated	15	(10)	14	26

* These species had their highest counts made from the air – Black-tailed Godwit 5000 (3), Great Knot 5000 (3), Common Greenshank 100 (4), Beach Thick-knee 5 (3) and Pied Oystercatcher 100 (3,4,7,11).

Table A 11. Survey Block 11.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Lesser Sand Plover	34.58	50	(12)	5	0
Bar-tailed Godwit	10.51	30	(12)	2	4
Red-necked Stint	9.49	17	(10)	4	0
Grey-tailed Tattler	8.81	15	(12)	2	2
Curlew Sandpiper	8.47	25	(12)	1	1
Sanderling	6.78	20	(12)	1	0
Ruddy Turnstone	6.44	16	(10)	4	3
Red-capped Plover	3.39	10	(12)	1	0
Red-kneed Dotterel	3.39	10	(10)	0	1
Grey Plover	2.37	7	(12)	1	3
Terek Sandpiper	2.03	6	(12)	1	0
Common Greenshank	1.02	1	(12)	3	0
Whimbrel	1.02	2	(10)	2	9
Common Sandpiper	0.68	1	(10)	2	0
Eastern Curlew	0.68	2	(12)	1	6
Great Knot	0.34	1	(2)	0	1
Asian Dowitcher	0	0		0	0
Broad-billed Sandpiper	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Black-tailed Godwit	0	0		0	0
Common Redshank	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Greater Sand Plover	0	0		0	0
Marsh Sandpiper	0	0		0	0
Oriental Plover	0	0		0	0
Red Knot	0	0		0	0
Sharp-tailed Sandpiper	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	2	(5)	6	34
Pied Oystercatcher	Not calculated	2	(9)*	2	34
Sooty Oystercatcher	Not calculated	2	(10)	1	4

* This species had its highest count made from the air – 5 (11).

Table A 12. Survey Block 12.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Lesser Sand Plover	41.33	600	(10)	4	0
Red-necked Stint	13.44	400	(9)	3	0
Curlew Sandpiper	9.1	200	(10)	3	0
Grey-tailed Tattler	7.28	200	(8)	2	0
Black-tailed Godwit	5.91	260	(9)	3	25
Marsh Sandpiper	5.6	200	(10)	1	0
Great Knot	4.76	150	(9)	2	0
Sharp-tailed Sandpiper	3.36	100	(9)	2	0
Grey Plover	2.8	50	(10)	3	4
Greater Sand Plover	1.99	25	(9)	4	0
Bar-tailed Godwit	1.57	50	(10)	3	10
Common Greenshank	1.32	40	(10)	3	0
Red Knot	0.56	20	(9)	1	0
Red-capped Plover	0.39	14	(10)	1	0
Eastern Curlew	0.28	9	(10)	2	5
Whimbrel	0.22	15	(10)	1	4
Ruddy Turnstone	0.08	3	(10)	1	0
Asian Dowitcher	0	0		0	0
Broad-billed Sandpiper	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Common Sandpiper	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Sanderling	0	0		0	0
Terek Sandpiper	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	2	(10)	1	11
Pied Oystercatcher	Not calculated	6	(10)*	2	38
Sooty Oystercatcher	Not calculated	4	(10)	1	2

* This species had its highest count made from the air – 32 (7).

Table A 13. Survey Block 13.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Red Knot	26.22	1500	(10)	3	0
Great Knot	17.87	750	(7)	5	2
Red-necked Stint	15.31	580	(10)	6	1
Red-capped Plover	9.1	330	(7)	6	0
Lesser Sand Plover	7.2	280	(10)	7	0
Curlew Sandpiper	5.6	300	(7)	6	0
Greater Sand Plover	5.03	250	(10)	6	0
Broad-billed Sandpiper	3.05	200	(7)	3	0
Eastern Curlew	2.61	150	(7)	4	5
Grey-tailed Tattler	2.13	120	(7)	5	0
Black-tailed Godwit	2.1	100	(2)	0	10
Bar-tailed Godwit	1.74	50	(7)	5	13
Whimbrel	1.16	60	(7)	5	7
Common Greenshank	0.27	11	(7)	4	0
Grey Plover	0.21	5	(10)*	3	9
Ruddy Turnstone	0.16	10	(10)	2	0
Marsh Sandpiper	0.09	5	(10)	2	0
Sharp-tailed Sandpiper	0.09	6	(10)	2	1
Terek Sandpiper	0.07	8	(10)	2	0
Wood Sandpiper	0.01	1	(7)	1	0
Asian Dowitcher	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Common Sandpiper	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Sanderling	0	0		0	0
Beach Thick-knee	Not calculated	Nil	*	0	12
Pied Oystercatcher	Not calculated	6	(7)*	5	50
Sooty Oystercatcher	Not calculated	2	(10)*	1	12

* These species had their highest counts made from the air – Grey Plover 50 (11), Beach Thick-knee 4 (12), Pied Oystercatcher 50 (7) and Sooty Oystercatcher 4 (3).

Table A 14. Survey Block 14.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Great Knot	22.21	380	(5)*	7	1
Grey-tailed Tattler	16.89	500	(7)	5	1
Greater Sand Plover	11.67	200	(7)	6	0
Lesser Sand Plover	11.61	150	(9)	4	0
Red-necked Stint	9.71	150	(9)	4	1
Common Greenshank	6.32	153	(7)	8	2
Black-tailed Godwit	6.11	200	(7)	1	4
Red-capped Plover	5.1	80	(9)	7	2
Eastern Curlew	2.78	50	(5)	3	9
Bar-tailed Godwit	1.86	50	(7)	3	11
Curlew Sandpiper	1.53	30	(7)	2	1
Ruddy Turnstone	1.53	35	(9)	3	2
Red Knot	1.1	20	(5)	4	0
Marsh Sandpiper	1.04	27	(7)	3	1
Sharp-tailed Sandpiper	0.31	7	(9)	2	0
Grey Plover	0.09	4	(9)	2	6
Terek Sandpiper	0.06	2	(5)	1	0
Whimbrel	0.06	2	(7)*	5	0
Broad-billed Sandpiper	0.03	1	(7)	1	0
Asian Dowitcher	0	0		0	0
Black-fronted Dotterel	0	0		0	0
Common Redshank	0	0		0	0
Common Sandpiper	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Red-kneed Dotterel	0	0		0	0
Sanderling	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	Nil	*	0	18
Pied Oystercatcher	Not calculated	70	(5)	8	40
Sooty Oystercatcher	Not calculated	Nil	*	0	1

* These species had their highest counts made from the air – Great Knot 2000 (9), Whimbrel 25 (9), Beach Thick-knee 2 (5,7,9) and Sooty Oystercatcher 4 (10).

Table A 15. Survey Block 15.

Species	Average% abundance from all ground surveys	Highest single site ground count (month)		No. of ground records	No. of aerial records
Black-tailed Godwit	14.88	1730	(10)	9	11
Great Knot	13.4	1600	(10)	18	2
Red-necked Stint	10.43	1000	(7)	22	4
Curlew Sandpiper	10.04	1300	(9)	19	0
Bar-tailed Godwit	9.99	2400	(10)	10	6
Grey-tailed Tattler	9.77	1000	(10)	19	7
Lesser Sand Plover	5.98	550	(10)	26	0
Common Greenshank	4.91	500	(10)	16	2
Marsh Sandpiper	4.56	640	(10)	13	0
Sharp-tailed Sandpiper	3.96	600	(10)	10	0
Whimbrel	2.95	350	(10)	12	19
Eastern Curlew	2.5	407	(7)	13	12
Red-capped Plover	2.22	300	(7)	16	5
Red Knot	1.65	200	(10)	13	0
Grey Plover	0.85	100	(10)	10	6
Greater Sand Plover	0.72	50	(10)	10	0
Terek Sandpiper	0.3	40	(10)	8	0
Asian Dowitcher	0.27	70	(7)	2	0
Ruddy Turnstone	0.27	20	(9)*	15	10
Broad-billed Sandpiper	0.2	20	(10)	4	0
Red-kneed Dotterel	0.08	15	(5)	3	0
Black-fronted Dotterel	0.07	15	(5)	3	0
Common Sandpiper	<0.01	1	(5)	1	0
Common Redshank	0	0		0	0
Snipe spp.	0	0		0	0
Pacific Golden Plover	0	0		0	0
Little Curlew	0	0		0	0
Oriental Plover	0	0		0	0
Sanderling	0	0		0	0
Wood Sandpiper	0	0		0	0
Beach Thick-knee	Not calculated	3	(9)	9	37
Pied Oystercatcher	Not calculated	30	(11)*	13	70
Sooty Oystercatcher	Not calculated	4	(7)	4	8

* These species had their highest counts made from the air – Ruddy Turnstone 150 (9) and Pied Oystercatcher 50 (5).

APPENDIX B
SUMMARY OF INDIVIDUAL SPECIES BY SURVEY BLOCK

Table B 1. *Snipe spp.*

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	6	41.10	1	0
2	0	0.00	0	0
3	0	0.00	0	0
4	6	38.36	1	0
5	0	0.00	0	0
6	0	0.00	0	0
7	0	0.00	0	0
8	0	0.00	0	0
9	3	20.55	0	1
10	0	0.00	0	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	15	100	2	1

Table B 2. Black-tailed Godwit

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	1	0.00	0	1
2	2146	4.92	4	4
3	3796	8.71	22	38
4	840	1.93	18	5
5	7162	16.43	27	14
6	1864	4.28	3	5
7	2970	6.81	10	14
8	4640	10.64	16	13
9	0	0.00	0	0
10	11597	26.60	17	26
11	0	0.00	0	0
12	709	1.63	3	25
13	798	1.83	0	10
14	672	1.54	1	4
15	6398	14.68	9	11
Total	43593	100	130	170

Table B 3. Bar-tailed Godwit

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	960	1.81	5	4
2	1340	2.52	4	4
3	7462	14.04	47	24
4	3665	6.90	46	30
5	1271	2.39	25	2
6	4780	8.99	7	10
7	2709	5.10	20	16
8	10421	19.61	19	8
9	145	0.27	2	0
10	14837	27.91	13	20
11	210	0.40	2	4
12	188	0.35	3	10
13	661	1.24	5	14
14	205	0.38	3	11
15	4296	8.08	10	6
Total	53150	100	211	163

Table B 4. Little Curlew.

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	0	0.00	0	0
3	221	1.79	1	1
4	1319	10.68	20	0
5	8613	69.76	14	38
6	0	0.00	0	0
7	0	0.00	0	0
8	0	0.00	0	0
9	0	0.00	0	0
10	2194	17.77	3	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	12346	100	38	39

Table B 5. Whimbrel

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	110	2.15	5	10
2	306	5.99	5	6
3	462	9.04	30	14
4	624	12.23	43	74
5	986	19.31	16	46
6	36	0.71	3	13
7	108	2.12	10	32
8	158	3.10	10	7
9	5	0.10	2	5
10	547	10.71	8	27
11	20	0.40	2	9
12	26	0.52	1	4
13	441	8.64	5	7
14	7	0.13	5	0
15	1269	24.85	12	19
Total	5104	100	157	273

Table B 6. Eastern Curlew

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	6	0.09	3	9
2	90	1.33	3	3
3	403	5.95	23	13
4	272	4.01	28	36
5	790	11.65	14	43
6	44	0.65	1	8
7	54	0.80	5	28
8	891	13.15	13	13
9	5	0.08	1	4
10	1802	26.60	14	26
11	14	0.20	1	6
12	34	0.50	2	5
13	992	14.64	4	5
14	306	4.51	3	9
15	1075	15.86	13	12
Total	6776	100	128	220

Table B 7. Common Redshank

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	0	0.00	0	0
3	13	17.16	1	0
4	0	0.00	0	0
5	56	73.93	4	0
6	0	0.00	0	0
7	0	0.00	0	0
8	0	0.00	0	0
9	0	0.00	0	0
10	7	8.91	1	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	76	100	6	0

Table B 8. Marsh Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	6	0.05	1	0
3	1417	11.71	11	1
4	210	1.74	46	0
5	5118	42.31	39	11
6	148	1.22	2	0
7	540	4.46	7	0
8	356	2.95	12	0
9	0	0.00	0	0
10	1519	12.56	12	3
11	0	0.00	0	0
12	672	5.56	1	0
13	34	0.28	2	0
14	114	0.95	3	1
15	1961	16.21	13	0
Total	12096	100	149	16

Table B 9. Common Greenshank

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	49	0.64	7	4
2	120	1.57	1	3
3	468	6.14	29	9
4	353	4.63	56	7
5	1574	20.63	33	14
6	84	1.10	3	2
7	513	6.73	12	1
8	634	8.31	25	1
9	104	1.36	3	1
10	641	8.41	19	5
11	20	0.27	3	0
12	158	2.08	3	0
13	103	1.35	4	0
14	695	9.11	8	2
15	2111	27.68	16	2
Total	7627	100	222	51

Table B 10. Wood Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	0	0.00	0	0
3	0	0.00	0	0
4	22	58.11	14	0
5	6	14.53	4	0
6	0	0.00	0	0
7	0	0.00	0	0
8	0	0.00	0	0
9	0	0.00	0	0
10	7	17.51	1	0
11	0	0.00	0	0
12	0	0.00	0	0
13	4	9.86	1	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	39	100	20	0

Table B 11. Terek Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	3389	21.38	6	0
2	446	2.81	2	0
3	3140	19.80	36	6
4	1103	6.96	37	4
5	3315	20.91	17	1
6	408	2.57	5	0
7	1287	8.12	9	0
8	1940	12.24	13	0
9	76	0.48	1	0
10	547	3.45	4	1
11	41	0.26	1	0
12	0	0.00	0	0
13	27	0.17	2	0
14	7	0.04	1	0
15	129	0.81	8	0
Total	15854	100	142	12

Table B 12. Common Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	0	0.00	0	0
3	13	7.25	3	0
4	78	43.73	46	1
5	6	3.12	1	1
6	8	4.46	1	1
7	14	7.53	5	1
8	7	3.68	1	0
9	23	12.72	5	0
10	14	7.53	3	2
11	14	7.59	2	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	4	2.40	1	0
Total	179	100	68	6

Table B 13. Grey-tailed Tattler

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	228	1.42	6	0
2	1042	6.51	3	0
3	397	2.48	29	6
4	1389	8.68	42	8
5	56	0.35	5	0
6	964	6.02	7	2
7	734	4.58	12	7
8	1214	7.59	15	3
9	663	4.14	2	0
10	1397	8.73	11	3
11	176	1.10	2	2
12	874	5.46	2	0
13	809	5.06	5	0
14	1858	11.61	5	1
15	4201	26.25	19	7
Total	16002	100	165	39

Table B 14. Ruddy Turnstone

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	354	7.08	2	0
2	182	3.64	3	0
3	189	3.77	20	7
4	874	17.48	45	13
5	6	0.11	2	0
6	48	0.96	3	0
7	756	15.13	12	9
8	950	19.02	17	3
9	419	8.39	5	6
10	736	14.73	15	11
11	129	2.58	4	3
12	10	0.19	1	0
13	61	1.22	2	0
14	168	3.37	3	2
15	116	2.32	15	10
Total	4997	100	149	64

Table B 15. Asian Dowitcher

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	5	2.61	1	0
2	0	0.00	0	0
3	0	0.00	0	0
4	3	1.46	1	0
5	17	8.78	2	0
6	44	22.98	1	0
7	0	0.00	0	0
8	0	0.00	0	0
9	0	0.00	0	0
10	7	3.53	1	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	116	60.64	2	0
Total	191	100	8	0

Table B 16. Great Knot

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	539	0.44	2	0
2	10552	8.65	10	0
3	22302	18.28	62	12
4	5256	4.31	45	4
5	3550	2.91	16	4
6	11616	9.52	10	2
7	15183	12.44	20	2
8	27344	22.41	33	7
9	445	0.36	2	0
10	9659	7.92	13	3
11	7	0.01	0	1
12	571	0.47	2	0
13	6791	5.57	5	2
14	2443	2.00	7	1
15	5762	4.72	18	2
Total	122019	100	245	40

Table B 17. Red Knot

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	15	0.06	1	0
2	626	2.58	9	0
3	3790	15.63	28	4
4	980	4.04	14	1
5	190	0.79	7	0
6	448	1.85	6	0
7	198	0.82	12	0
8	3366	13.89	26	1
9	0	0.00	0	0
10	3767	15.54	20	0
11	0	0.00	0	0
12	67	0.28	1	0
13	9964	41.10	3	0
14	121	0.50	4	0
15	710	2.93	13	0
Total	24241	100	144	6

Table B 18. Sanderling

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	254	28.49	3	0
2	8	0.90	1	0
3	65	7.29	7	2
4	227	25.44	6	0
5	0	0.00	0	0
6	4	0.45	1	0
7	0	0.00	0	0
8	198	22.21	2	0
9	0	0.00	0	0
10	0	0.00	0	0
11	136	15.21	1	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	891	100	21	2

Table B 19. Red-necked Stint.

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	709	1.60	7	0
2	32	0.07	2	0
3	3881	8.75	35	4
4	2142	4.83	43	3
5	3528	7.95	24	1
6	6528	14.72	9	0
7	4077	9.19	13	0
8	3689	8.32	17	0
9	384	0.87	2	0
10	6210	14.00	21	3
11	190	0.43	4	0
12	1613	3.64	3	0
13	5818	13.12	6	1
14	1068	2.41	4	1
15	4485	10.11	22	4
Total	44353	100	212	17

Table B 20. Sharp-Tailed Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	62	0.30	2	0
2	224	1.07	1	0
3	1014	4.84	15	3
4	504	2.41	33	0
5	8137	38.88	38	3
6	1428	6.82	3	0
7	6120	29.24	10	0
8	7	0.03	4	0
9	5	0.02	1	0
10	1256	6.00	7	2
11	0	0.00	0	0
12	403	1.93	2	0
13	34	0.16	2	1
14	34	0.16	2	0
15	1703	8.14	10	0
Total	20930	100	130	9

Table B 21. Curlew Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	5	0.03	2	1
2	0	0.00	0	0
3	1482	8.33	19	2
4	398	2.23	14	0
5	3450	19.39	27	1
6	796	4.47	3	0
7	792	4.45	9	0
8	370	2.08	8	0
9	0	0.00	0	0
10	2626	14.76	11	1
11	169	0.95	1	1
12	1092	6.14	3	0
13	2128	11.96	6	0
14	168	0.95	2	1
15	4317	24.26	19	0
Total	17792	100	124	7

Table B 22. Broad-Billed Sandpiper

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	334	16.69	4	0
2	0	0.00	0	0
3	78	3.90	4	0
4	3	0.14	3	0
5	106	5.32	7	0
6	0	0.00	0	0
7	9	0.45	1	0
8	0	0.00	0	0
9	0	0.00	0	0
10	223	11.13	2	0
11	0	0.00	0	0
12	0	0.00	0	0
13	1159	57.91	3	0
14	3	0.16	1	0
15	86	4.30	4	0
Total	2001	100	29	0

Table B 23. Pacific Golden Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	0	0.00	0	0
3	13	6.30	4	0
4	70	33.91	12	0
5	17	8.14	2	0
6	4	1.94	1	0
7	90	43.60	5	0
8	0	0.00	0	0
9	13	6.10	1	0
10	0	0.00	0	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	206	100	25	0

Table B 24. Grey Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	46	0.85	2	6
2	166	3.08	4	12
3	1151	21.38	38	11
4	613	11.39	33	6
5	1159	21.54	17	12
6	296	5.50	5	9
7	450	8.36	13	18
8	224	4.17	15	11
9	13	0.23	2	0
10	425	7.90	8	6
11	47	0.88	1	3
12	336	6.24	3	4
13	80	1.48	3	9
14	10	0.18	2	6
15	366	6.79	10	6
Total	5382	100	156	119

Table B 25. Red-capped Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	88	0.89	4	0
2	280	2.83	6	0
3	416	4.21	18	0
4	160	1.62	17	0
5	577	5.84	12	0
6	984	9.96	5	0
7	45	0.46	5	0
8	746	7.55	8	0
9	10	0.10	1	0
10	1485	15.03	13	0
11	68	0.69	1	1
12	47	0.47	1	0
13	3458	35.00	6	0
14	561	5.68	7	2
15	955	9.66	16	5
Total	9879	100	120	8

Table B 26. Lesser Sand Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	478	1.23	2	0
2	1430	3.67	8	0
3	5298	13.60	50	0
4	2282	5.86	60	0
5	4071	10.45	17	0
6	3256	8.36	7	0
7	5328	13.68	25	0
8	759	1.95	25	0
9	577	1.48	4	0
10	3247	8.33	18	0
11	692	1.78	5	0
12	4960	12.73	4	0
13	2736	7.02	7	0
14	1277	3.28	4	0
15	2571	6.60	26	0
Total	38961	100	262	0

Table B 27. Greater Sand Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	2265	5.62	5	0
2	986	2.44	8	0
3	7462	18.50	52	0
4	4318	10.70	59	0
5	1926	4.78	8	0
6	6212	15.40	12	0
7	2984	7.40	22	0
8	8059	19.98	24	0
9	114	0.28	2	0
10	2268	5.62	17	0
11	0	0.00	0	0
12	239	0.59	4	0
13	1911	4.74	6	0
14	1284	3.18	6	0
15	310	0.77	10	0
Total	40337	100	235	0

Table B 28. Oriental Plover

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.00	0	0
2	18	13.67	1	0
3	33	24.68	2	0
4	81	61.66	1	0
5	0	0.00	0	0
6	0	0.00	0	0
7	0	0.00	0	0
8	0	0.00	0	0
9	0	0.00	0	0
10	0	0.00	0	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	0	0.00	0	0
Total	132	100	4	0

Table B 29. Black-fronted Dotterel

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	9	8.17	1	0
2	0	0.00	0	0
3	0	0.00	0	0
4	59	53.41	22	0
5	6	5.09	6	0
6	0	0.00	0	0
7	0	0.00	0	0
8	7	5.99	1	0
9	0	0.00	0	0
10	0	0.00	0	0
11	0	0.00	0	0
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	30	27.34	3	0
Total	110	100	33	0

Table B 30. Red-kneed Dotterel

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	92	7.03	2	0
2	0	0.00	0	0
3	78	5.96	2	0
4	160	12.20	25	0
5	319	24.40	16	4
6	0	0.00	0	0
7	45	3.44	1	0
8	26	2.02	3	0
9	0	0.00	0	0
10	486	37.14	4	1
11	68	5.18	0	1
12	0	0.00	0	0
13	0	0.00	0	0
14	0	0.00	0	0
15	34	2.63	3	0
Total	1308	100	56	6

Table B 31. Beach Thick-knee

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	20	2.9	9	13
2	20	2.9	4	19
3	48	6.9	11	68
4	70	10.0	24	109
5	16	2.3	1	15
6	52	7.4	7	42
7	114	16.3	21	112
8	40	5.7	17	16
9	32	4.6	5	30
10	144	20.6	28	112
11	52	7.4	2	34
12	10	1.4	1	11
13	20	2.9	0	12
14	14	2.0	0	18
15	48	6.9	9	37
Total	700	100.0	139	648

Table B 32. Pied Oystercatcher

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	20	1.2	5	9
2	20	1.2	4	19
3	70	4.1	11	128
4	40	2.3	29	27
5	50	2.9	10	16
6	32	1.9	6	59
7	150	8.7	7	110
8	600	35.0	16	77
9	18	1.0	4	18
10	300	17.5	19	109
11	30	1.7	2	34
12	70	4.1	2	3
13	76	4.4	5	50
14	142	8.3	8	40
15	98	5.7	13	70
Total	1716	100.0	141	769

Table B 33. Sooty Oystercatcher

Survey block	Peak no. estimate per block	Percentage of total in block	No. of ground records	No. of aerial records
1	0	0.0	0	0
2	0	0.0	0	0
3	10	4.2	1	3
4	25	10.5	15	4
5	0	0.0	0	0
6	10	4.2	3	6
7	21	8.9	2	9
8	52	21.9	10	8
9	71	30.0	3	43
10	18	7.6	14	26
11	4	1.7	1	4
12	4	1.7	1	2
13	12	5.1	1	12
14	4	1.7	0	1
15	6	2.5	4	8
Total	237	100.0	55	126

APPENDIX C
NUMBERS AND RECORDS BY MONTH BY SURVEY BLOCK

BLACK-TAILED GODWIT

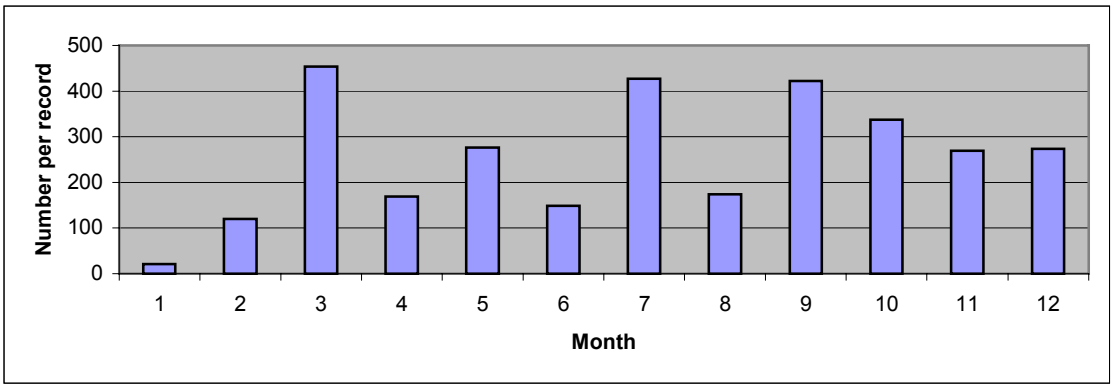

Figure C1. Average number of Black-tailed Godwits per record by month.

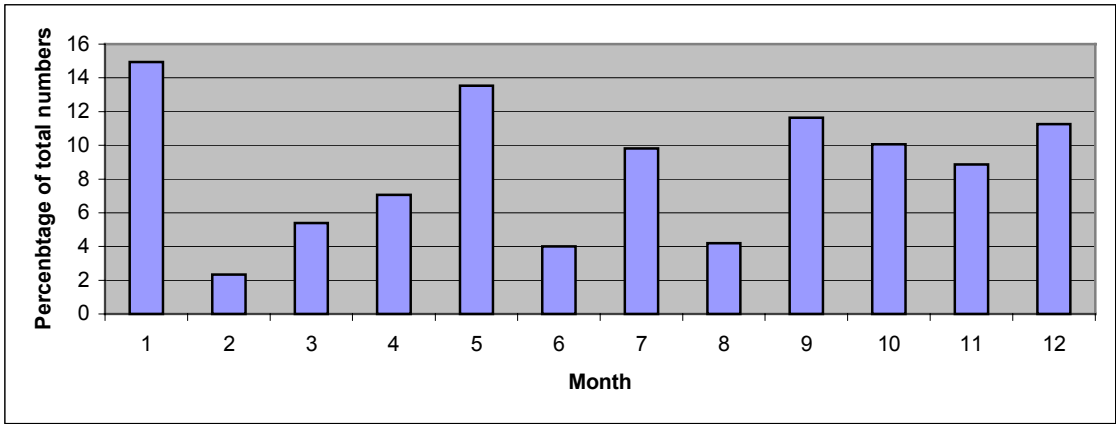

Figure C2. Average numbers of Black-tailed Godwits as a percentage of the total number of all group 1 species combined by month.

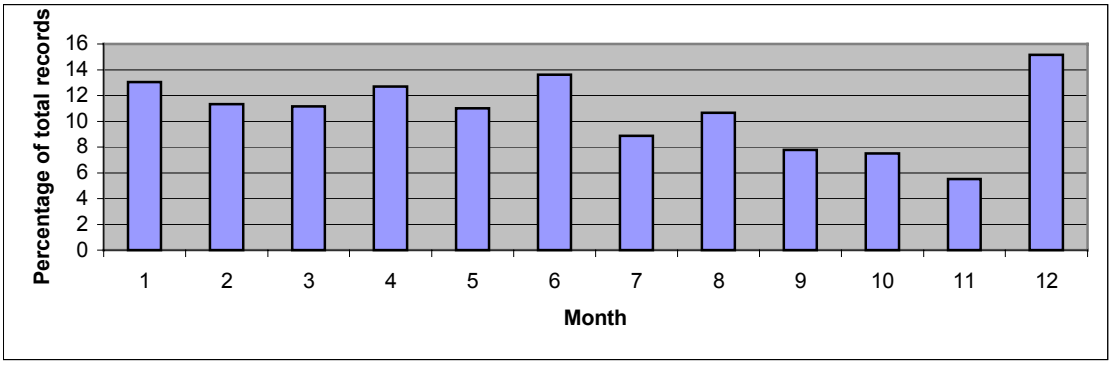

Figure C3. Average number of Black-tailed Godwit records as a percentage of the total number of all group 1 species records combined by month.

BAR-TAILED GODWIT

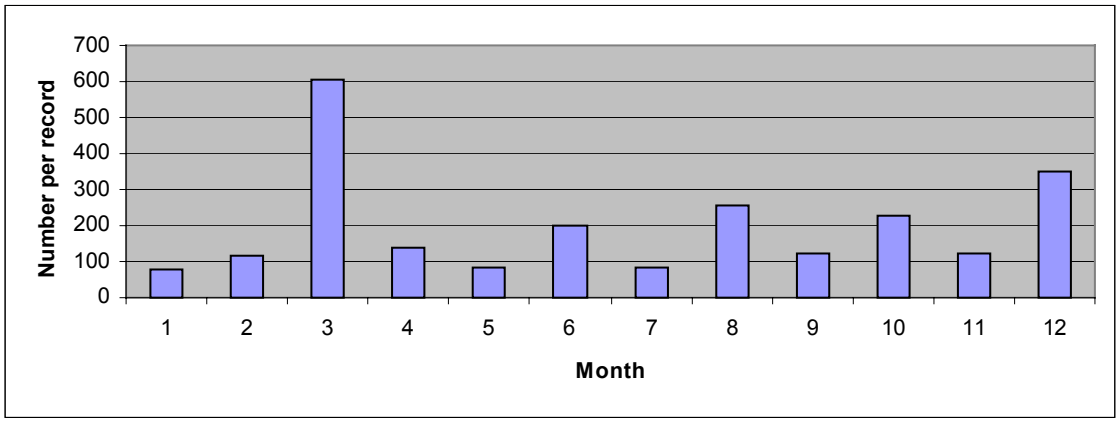

Figure C4. Average number of Bar-tailed Godwits per record by month.

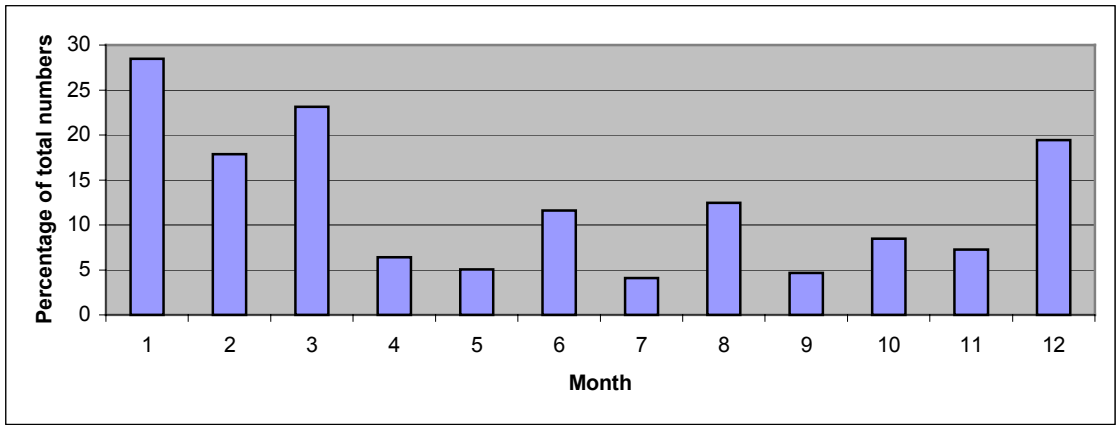

Figure C5. Average number of Bar-tailed Godwits as a percentage of the total number of all group 1 species combined by month.

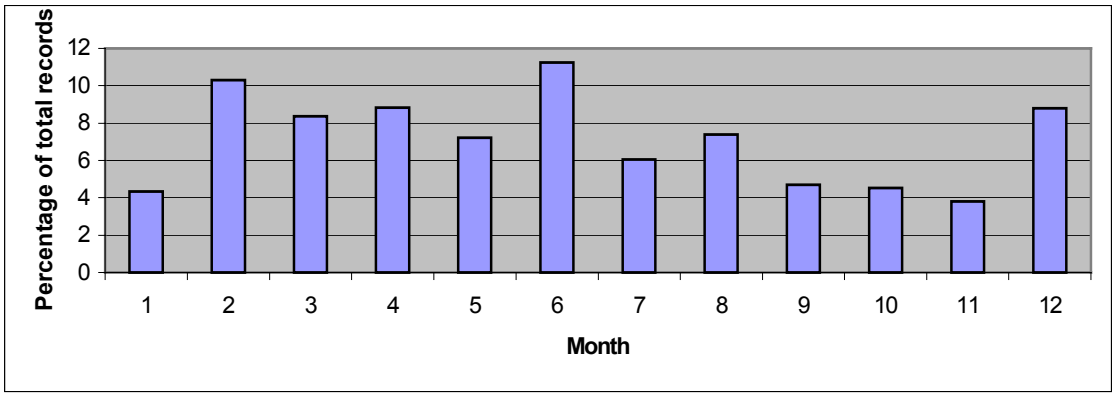

Figure C6. Average number of Bar-tailed Godwit records as a percentage of the total number of all group 1 species records combined by month.

LITTLE CURLEW

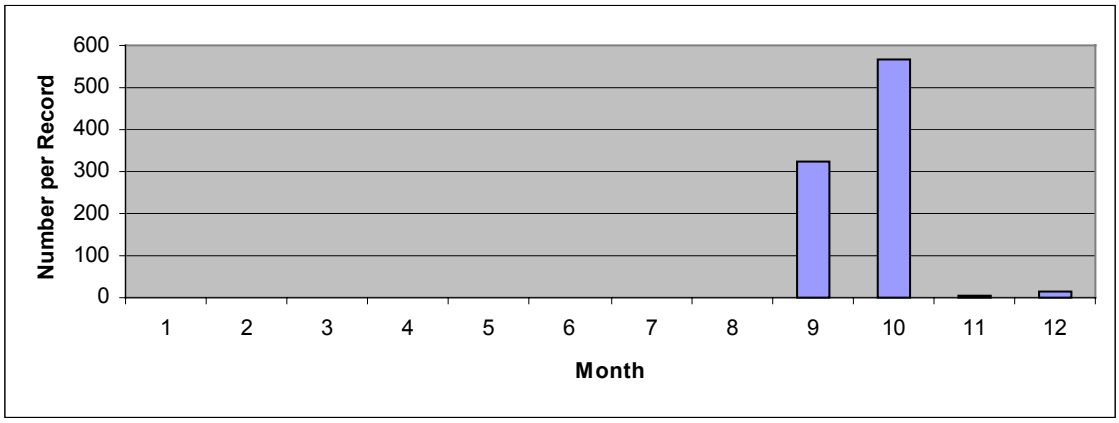

Figure C7. Average number of Little Curlews per record by month.

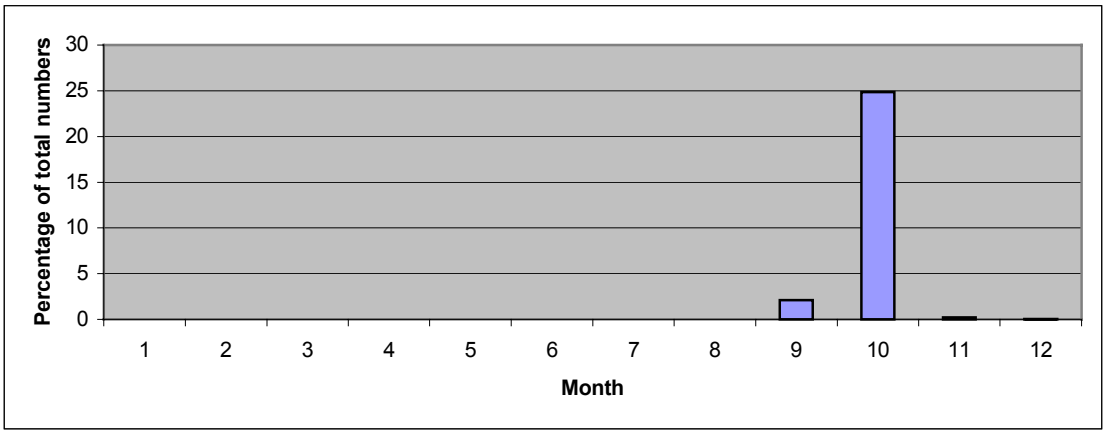

Figure C8. Average number of Little Curlews as a percentage of the total number of all group 1 species combined by month.

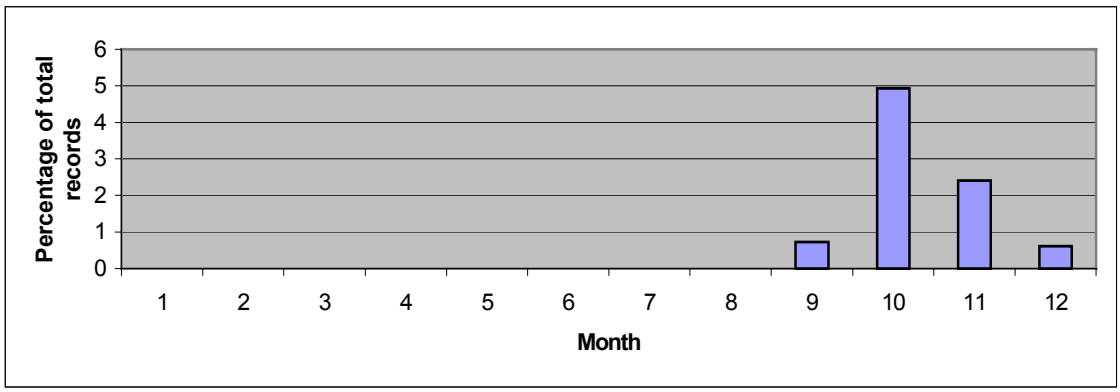

Figure C9. Average number of Little Curlew records as a percentage of the total number of all group 1 species records combined by month.

WHIMBREL

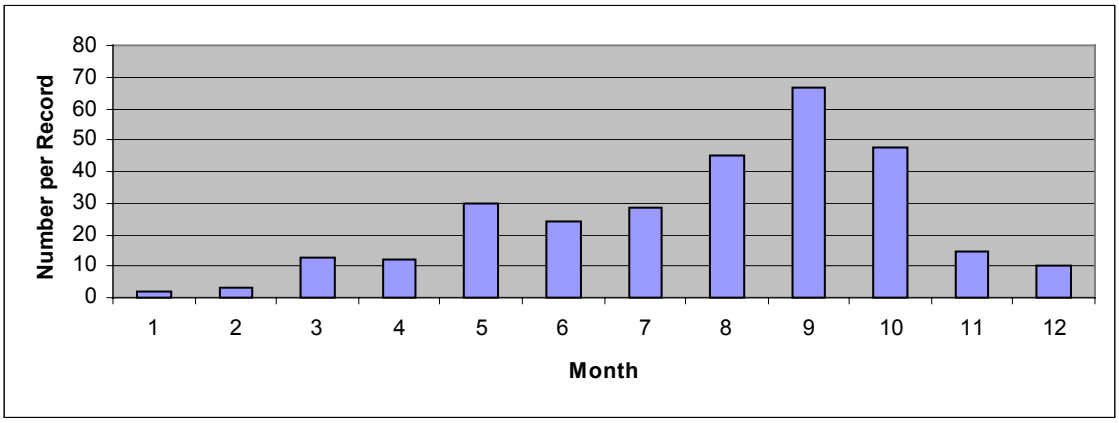

Figure C10. Average number of Whimbrels per record by month.

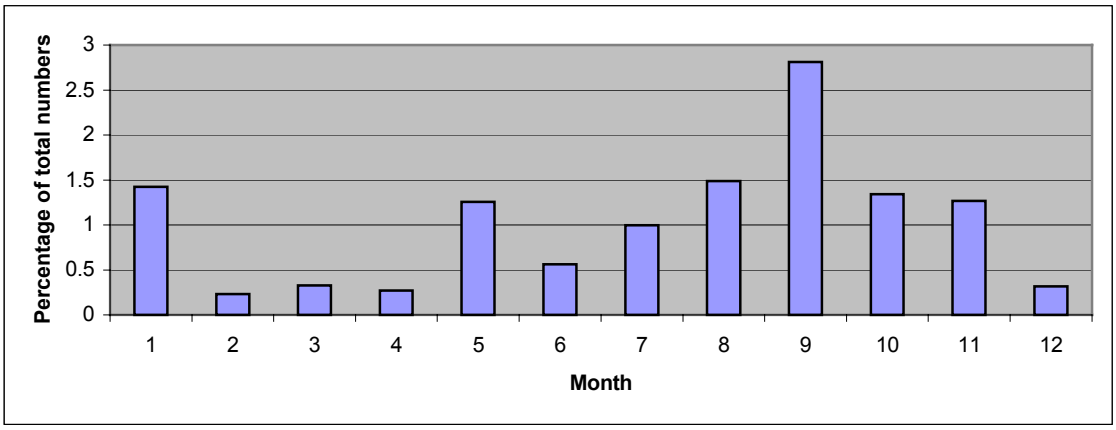

Figure C11. Average number of Whimbrels as a percentage of the total number of all group 1 species combined by month.

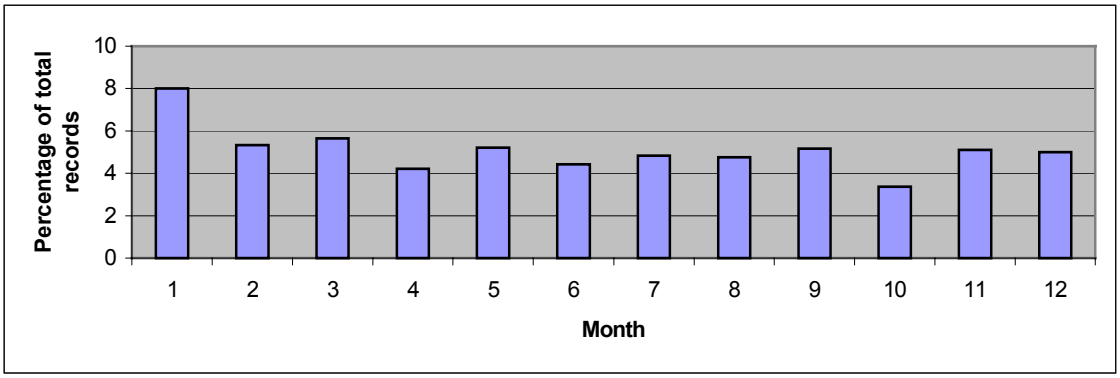

Figure C12. Average number of Whimbrel records as a percentage of the total number of all group 1 species records combined by month.

EASTERN CURLEW

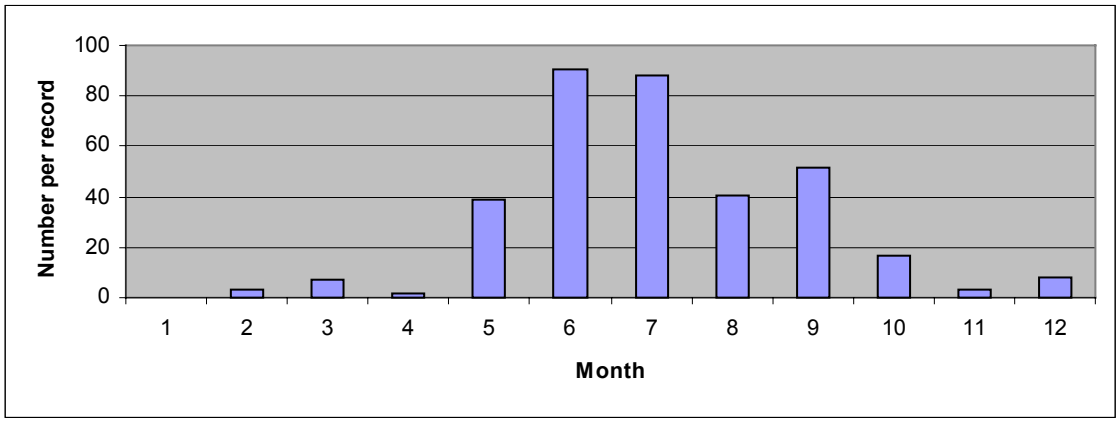

Figure C13. Average number of Eastern Curlews per record by month.

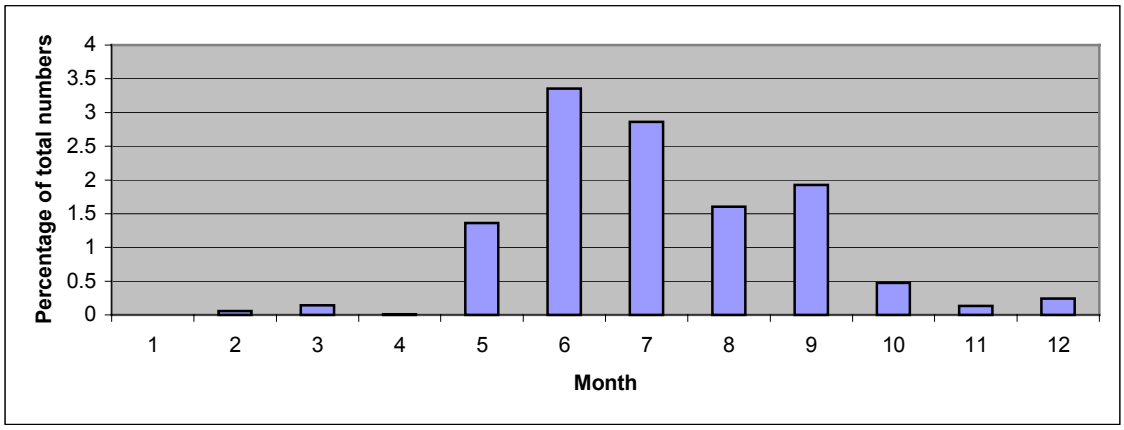

Figure C14. Average number of Eastern Curlews as a percentage of the total number of all group 1 species combined by month.

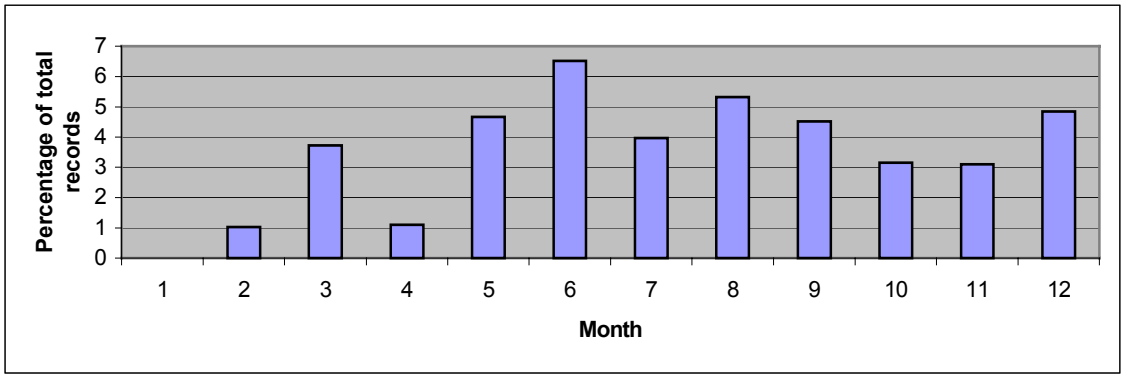

Figure C15. Average number of Eastern Curlew records as a percentage of the total number of all group 1 species records combined by month.

MARSH SANDPIPER

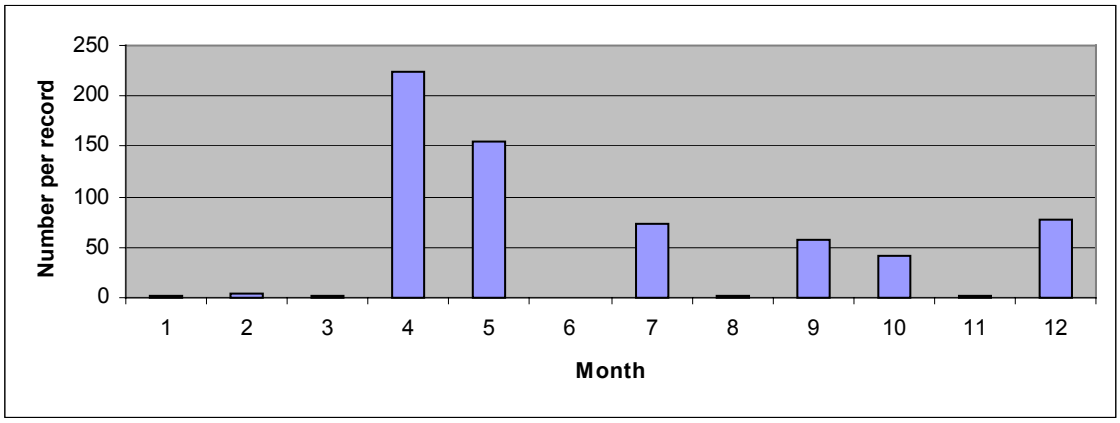

Figure C16. Average number of Marsh Sandpipers per record by month.

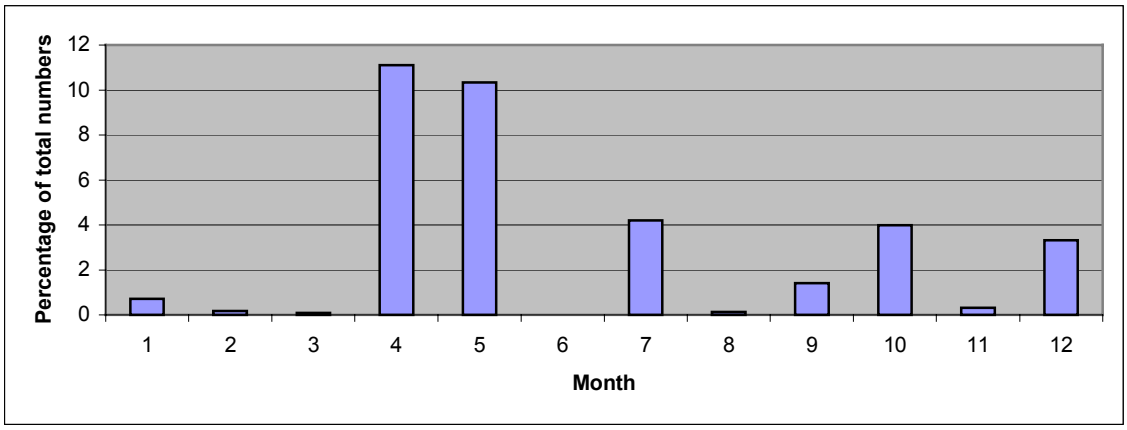

Figure C17. Average number of Marsh Sandpipers as a percentage of the total number of all group 1 species combined by month.

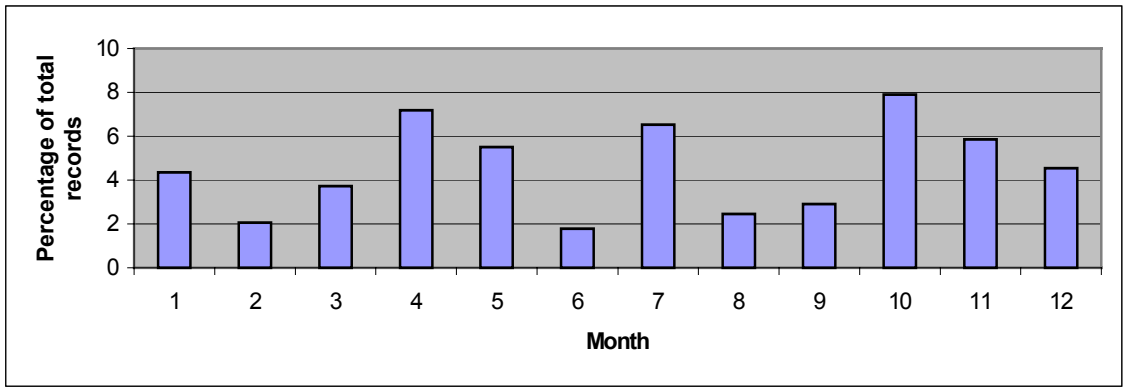

Figure C18. Average number of Marsh Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

COMMON GREENSHANK

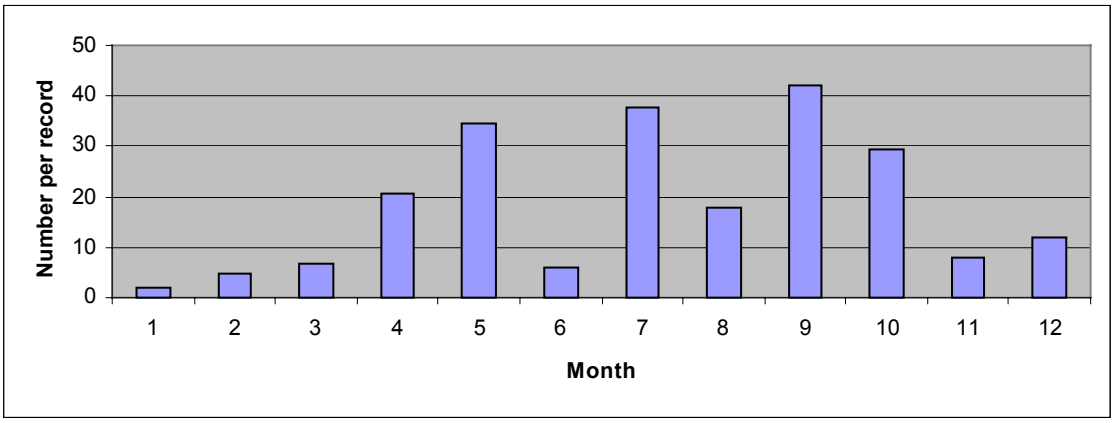

Figure C19. Average number of Common Greenshanks per record by month.

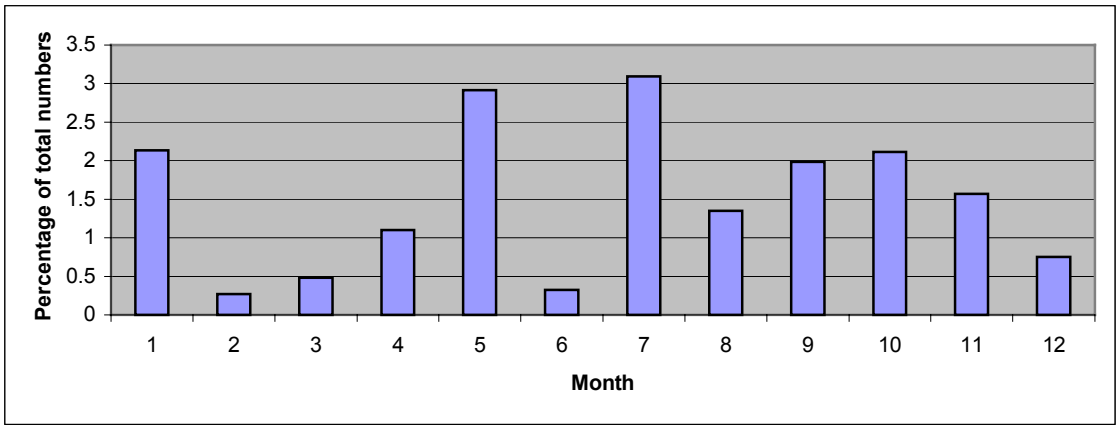

Figure C20. Average number of Common Greenshanks as a percentage of the total number of all group 1 species combined by month.

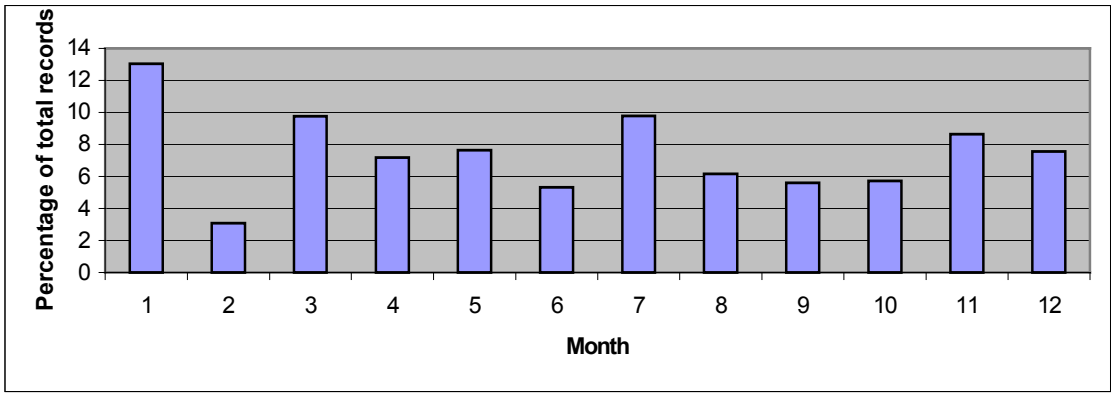

Figure C21. Average number of Common Greenshank records as a percentage of the total number of all group 1 species records combined by month.

TEREK SANDPIPER

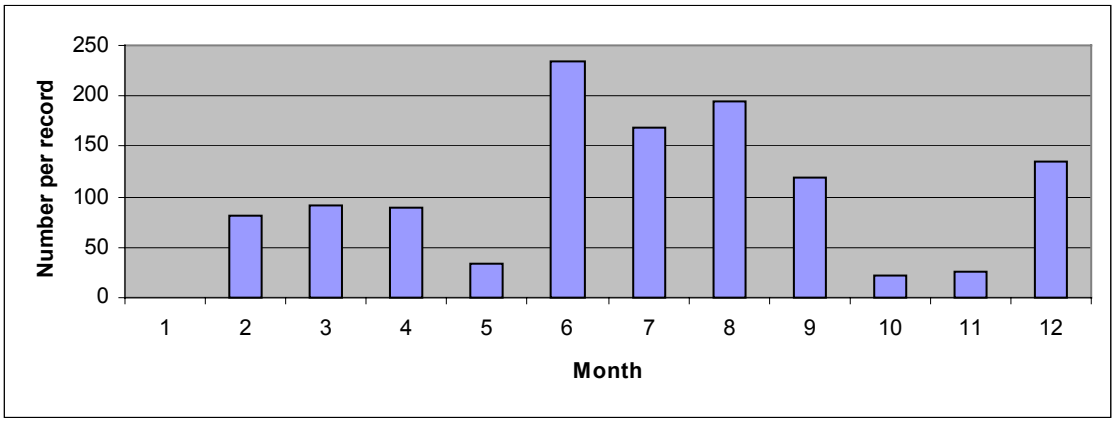

Figure C22. Average number of Terek Sandpipers per record by month.

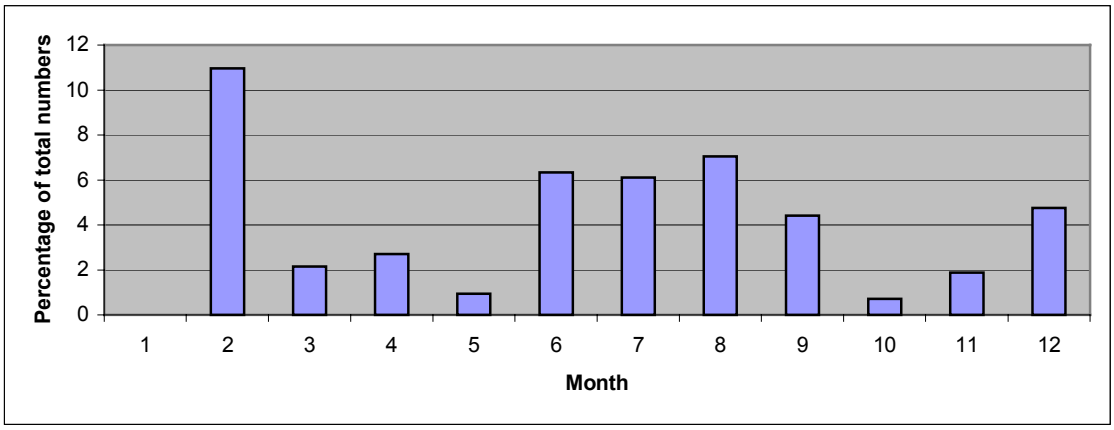

Figure C23. Average number of Terek Sandpipers as a percentage of the total number of all group 1 species combined by month.

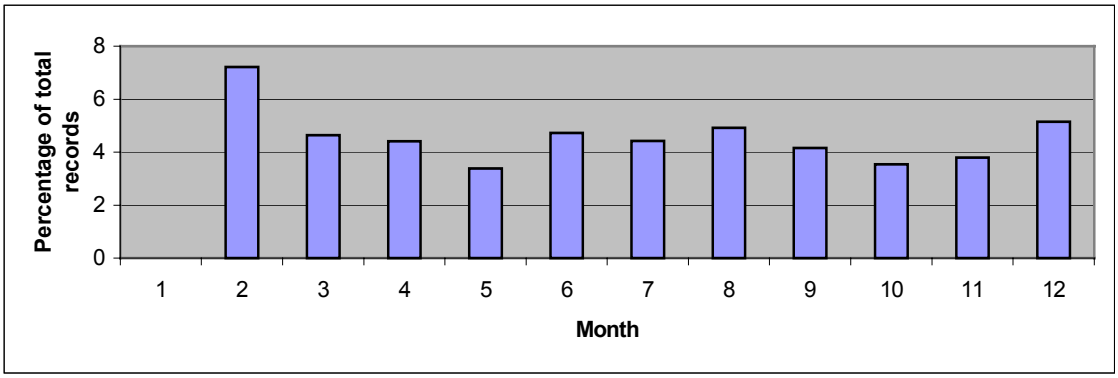

Figure C24. Average number of Terek Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

COMMON SANDPIPER

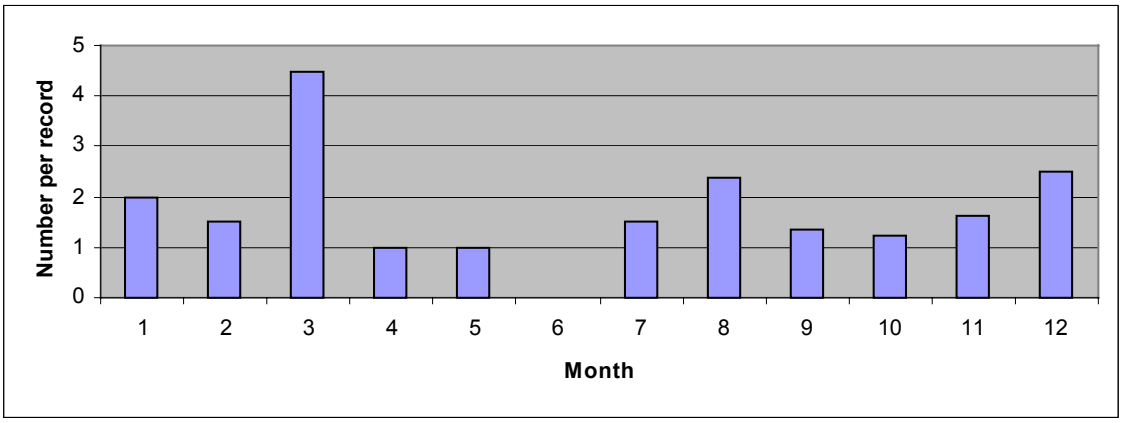

Figure C25. Average number of Common Sandpipers per record by month.

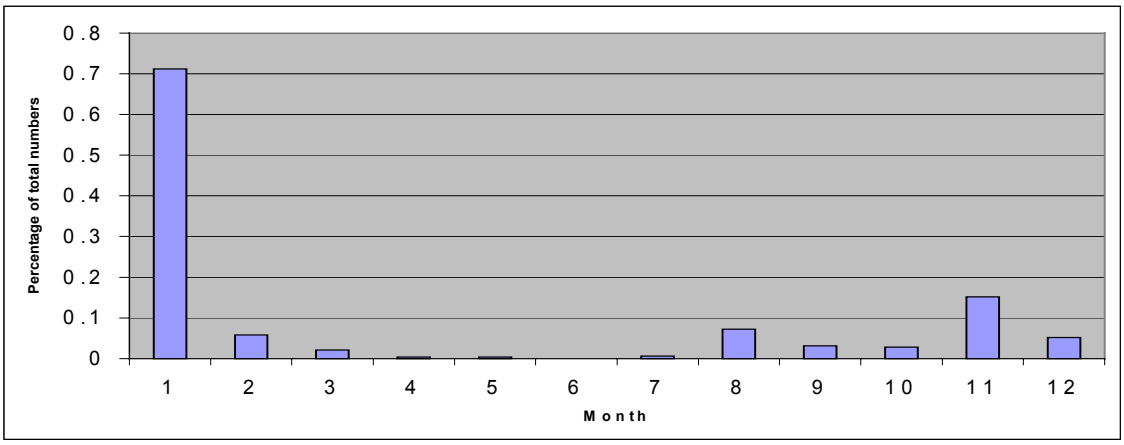

Figure C26. Average number of Common Sandpipers as a percentage of the total number of all group 1 species combined by month.

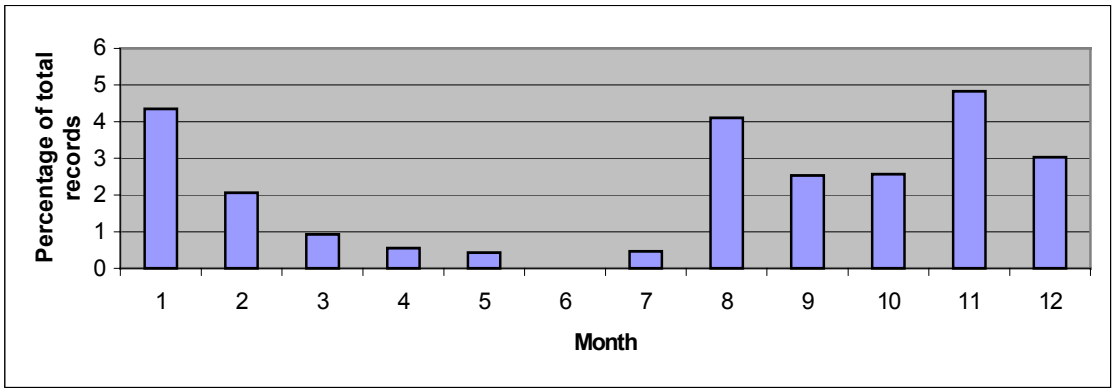

Figure C27. Average number of Common Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

GREY-TAILED TATTLER

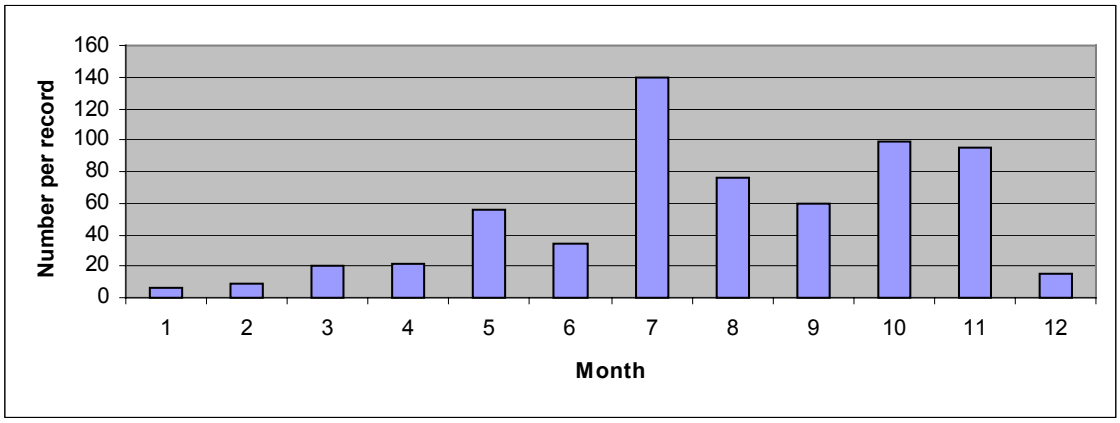

Figure C28. Average number of Grey-tailed Tattlers per record by month.

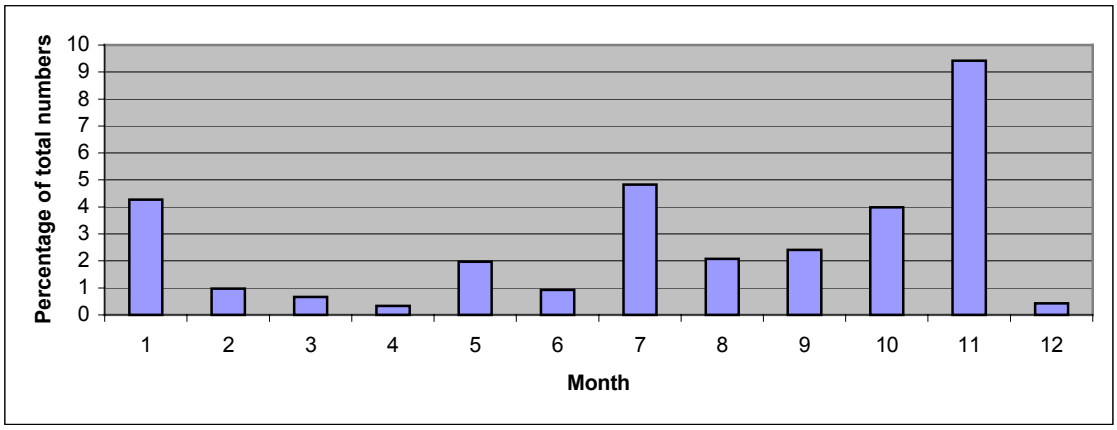

Figure C29. Average number of Grey-tailed Tattlers as a percentage of the total number of all group 1 species combined by month.

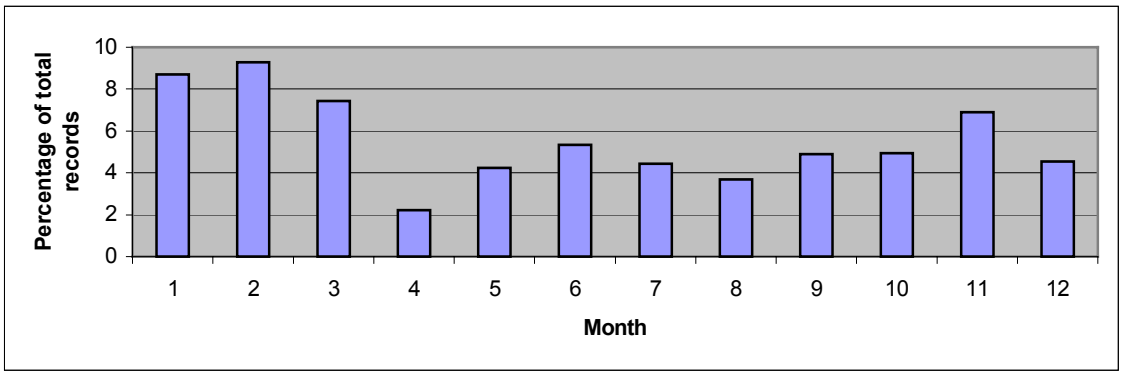

Figure C30. Average number of Grey-tailed Tattler records as a percentage of the total number of all group 1 species records combined by month.

RUDDY TURNSTONE

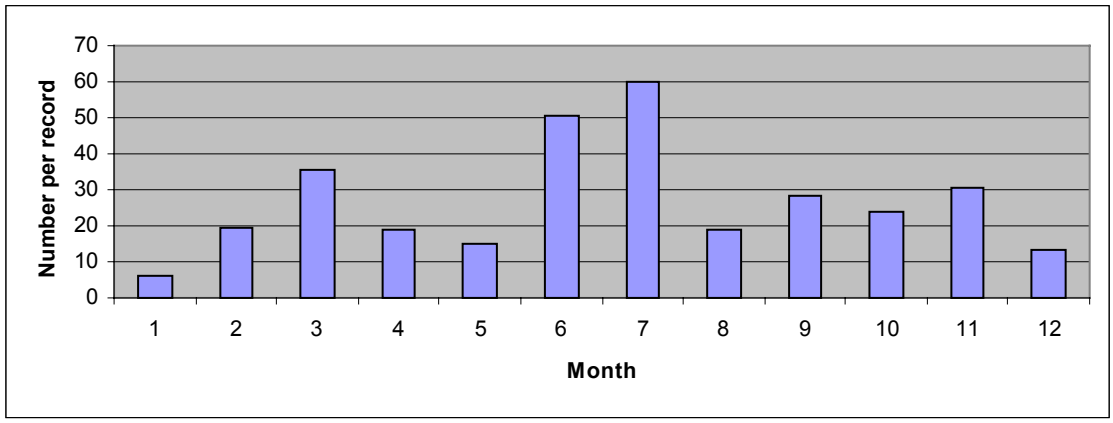

Figure C31. Average number of Ruddy Turnstones per record by month.

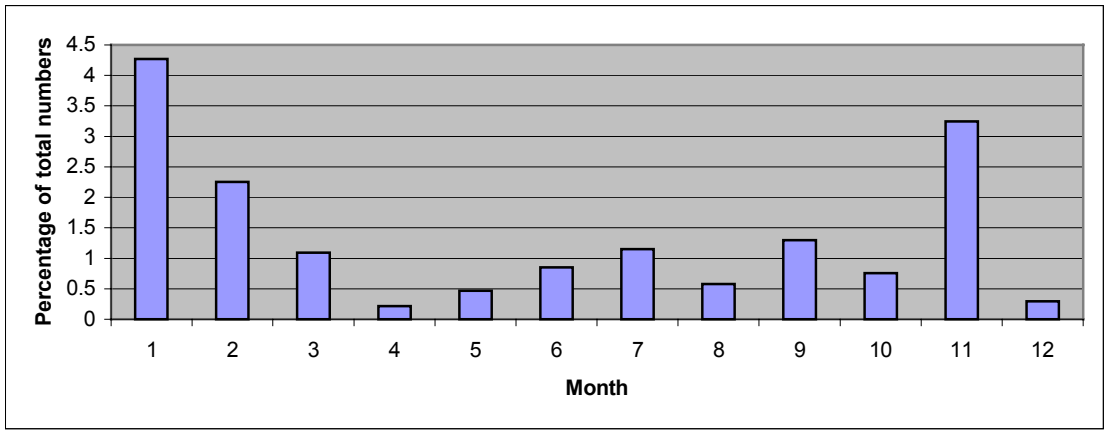

Figure C32. Average number of Ruddy Turnstones as a percentage of the total number of all group 1 species combined by month.

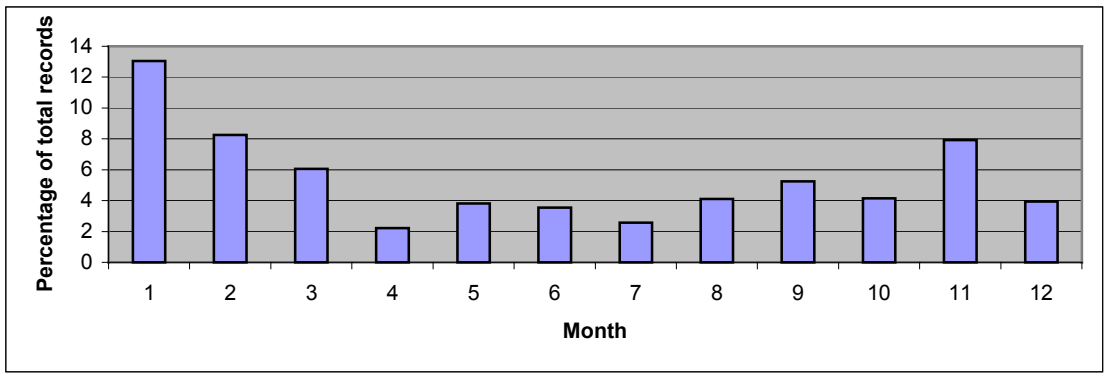

Figure C33. Average number of Ruddy Turnstone records as a percentage of the total number of all group 1 species records combined by month.

GREAT KNOT

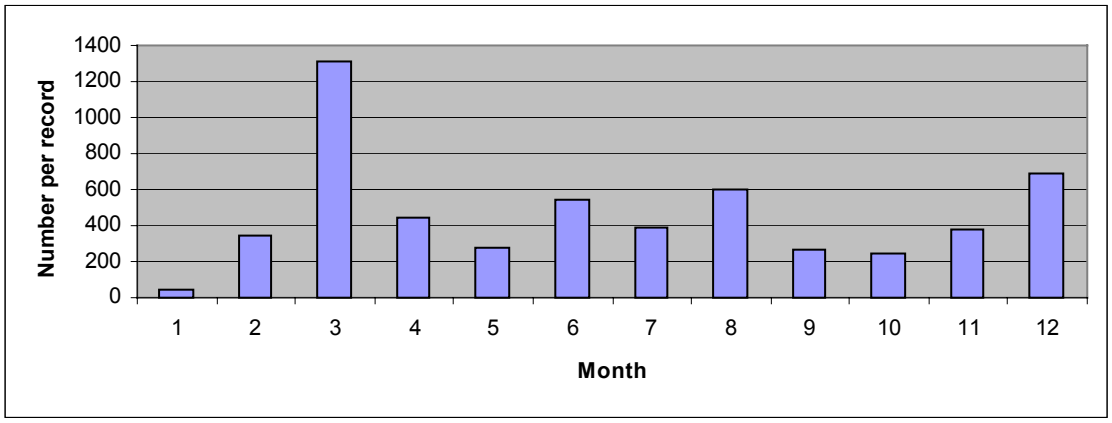

Figure C34. Average number of Great Knots per record by month.

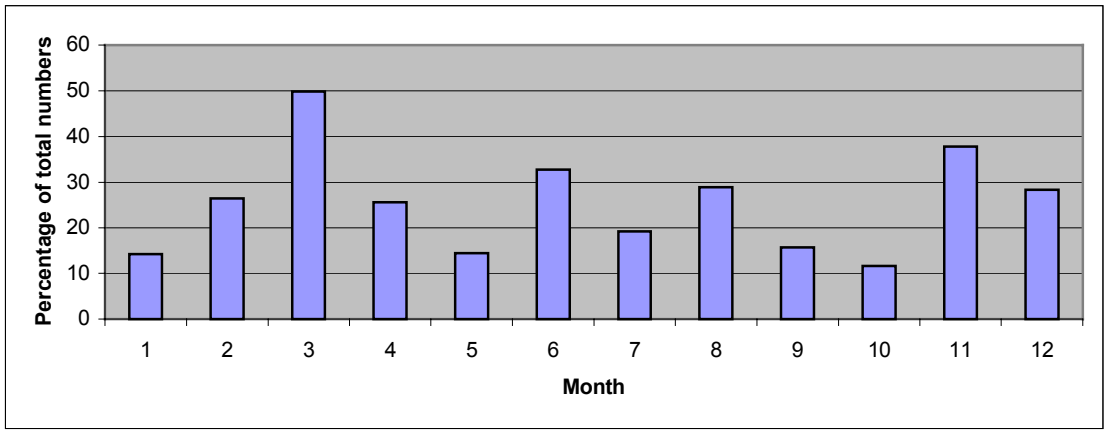

Figure C35. Average number of Great Knots as a percentage of the total number of all group 1 species combined by month.

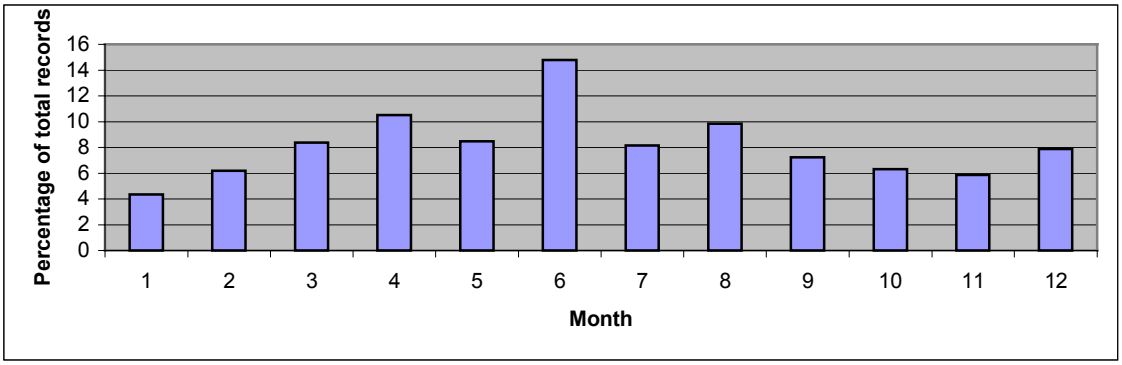

Figure C36. Average number of Great Knot records as a percentage of the total number of all group 1 species records combined by month.

RED KNOT

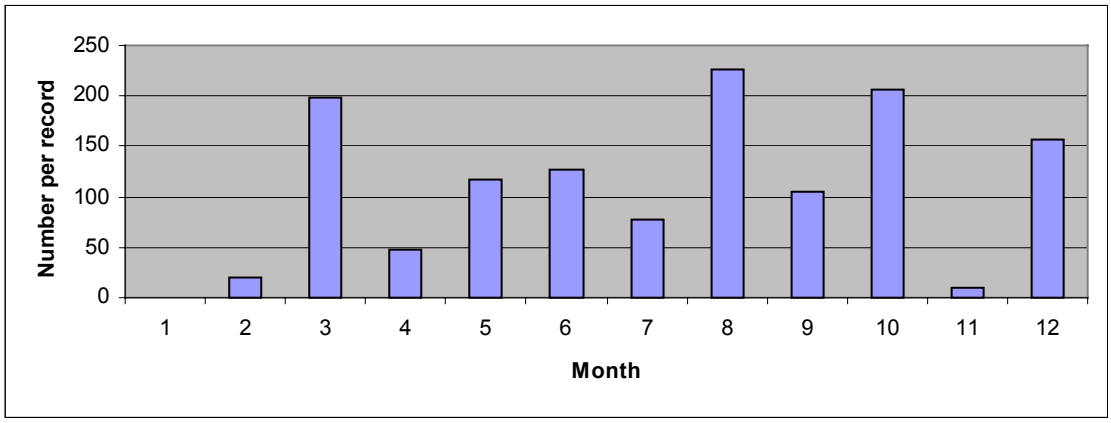

Figure C37. Average number of Red Knots per record by month.

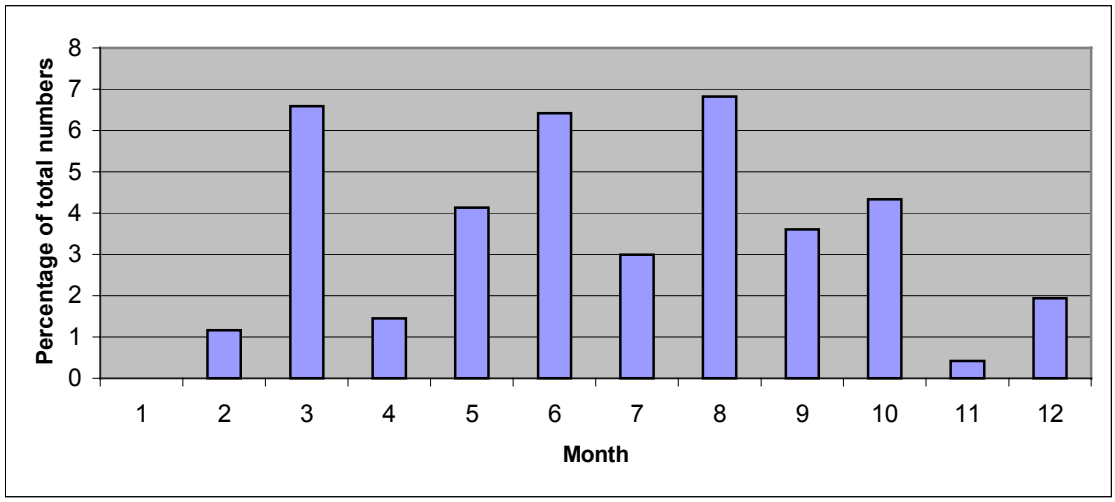

Figure C38. Average number of Red Knots as a percentage of the total number of all group 1 species combined by month.

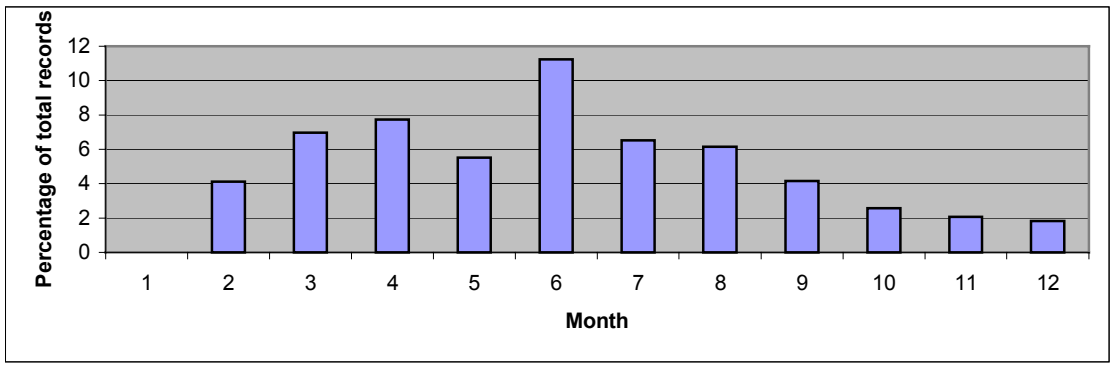

Figure C39. Average number of Red Knot records as a percentage of the total number of all group 1 species records combined by month.

SANDERLING

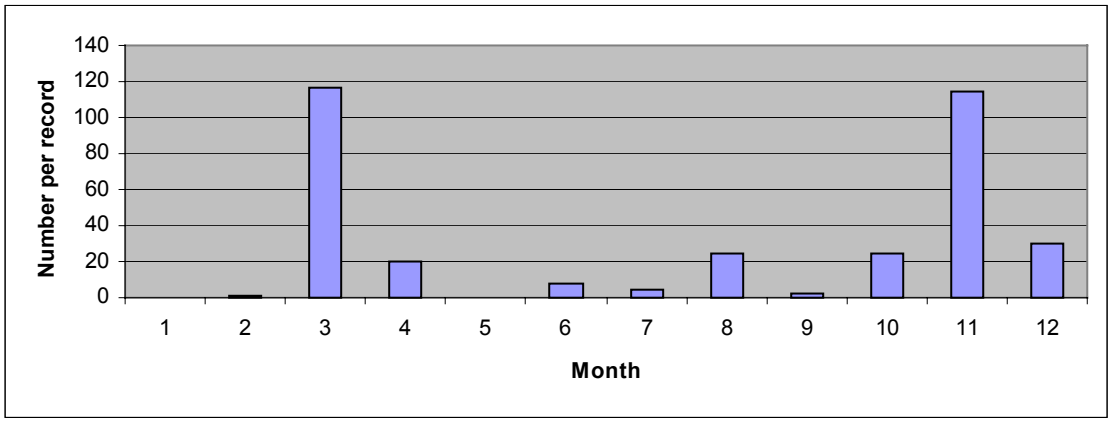

Figure C40. Average number of Sanderlings per record by month.

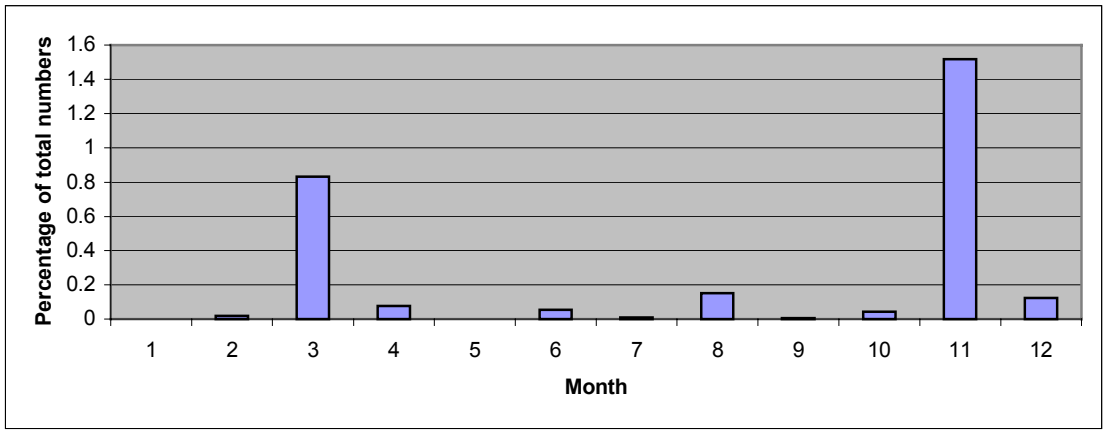

Figure C41. Average number of Sanderlings as a percentage of the total number of all group 1 species combined by month.

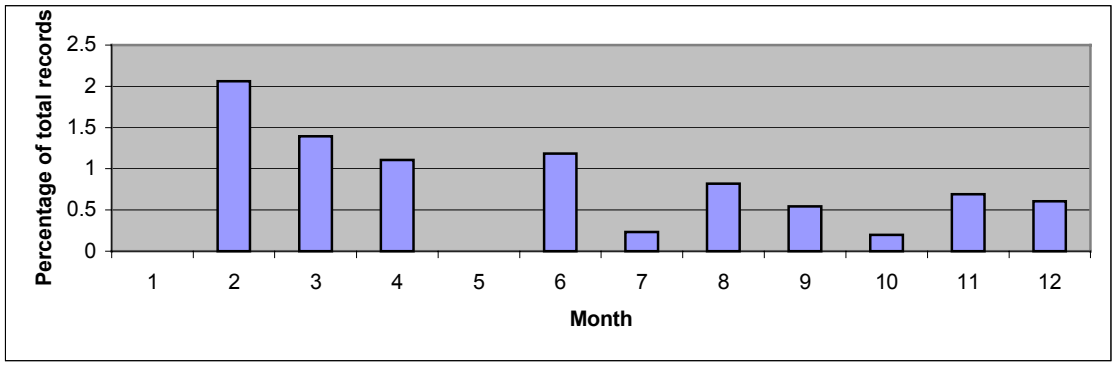

Figure C42. Average number of Sanderling records as a percentage of the total number of all group 1 species records combined by month.

RED-NECKED STINT

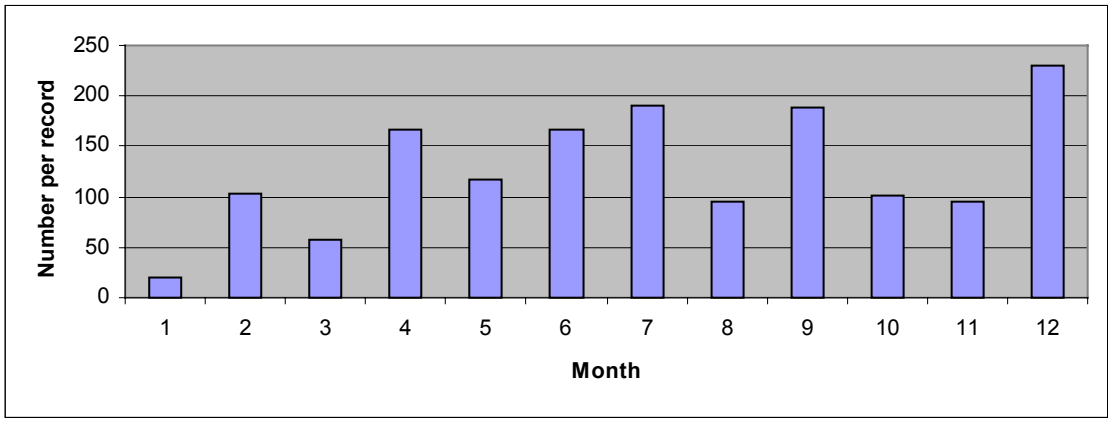

Figure C43. Average number of Red-necked Stints per record by month.

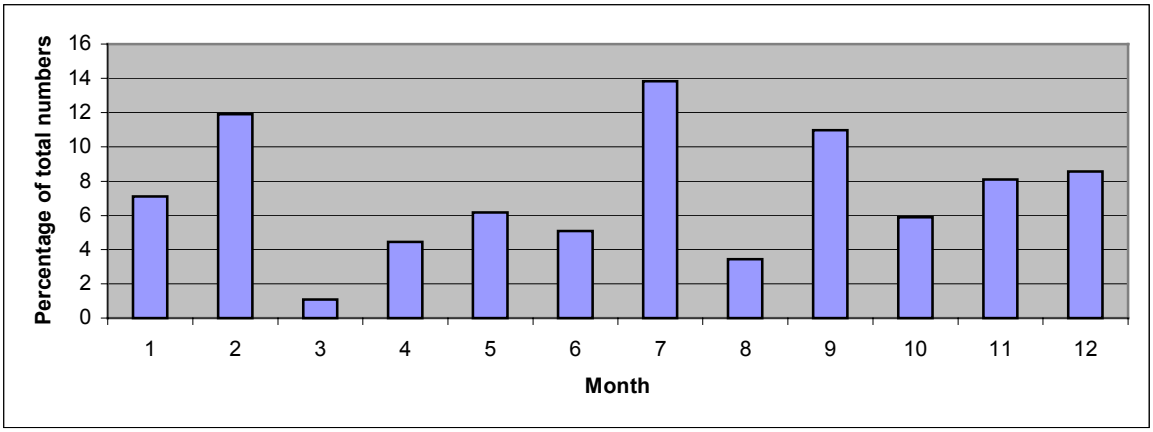

Figure C44. Average number of Red-necked Stints as a percentage of the total number of all group 1 species combined by month.

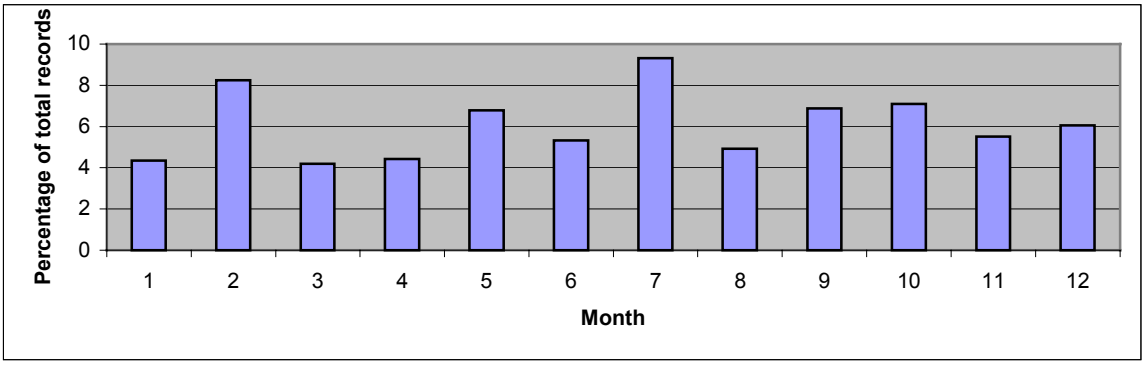

Figure C45. Average number of Red-necked Stint records as a percentage of the total number of all group 1 species records combined by month.

SHARP-TAILED SANDPIPER

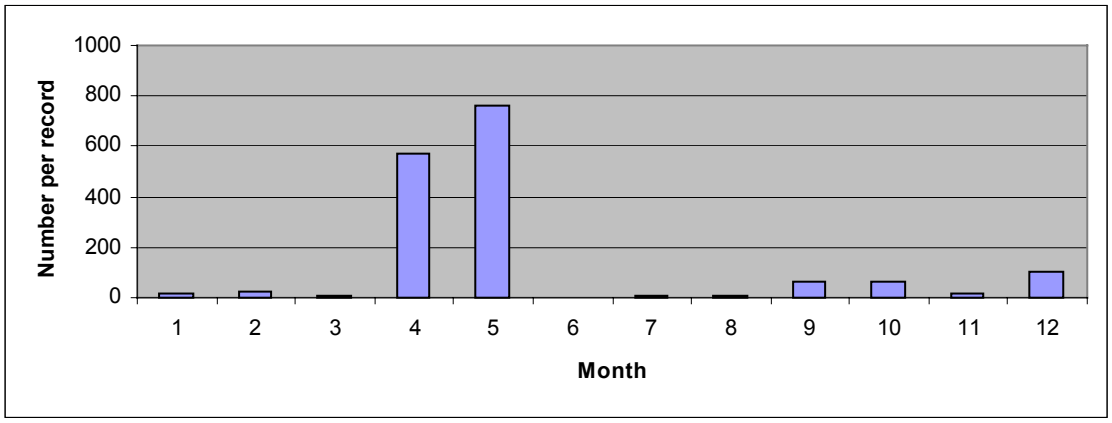

Figure C46. Average number of Sharp-tailed Sandpipers per record by month.

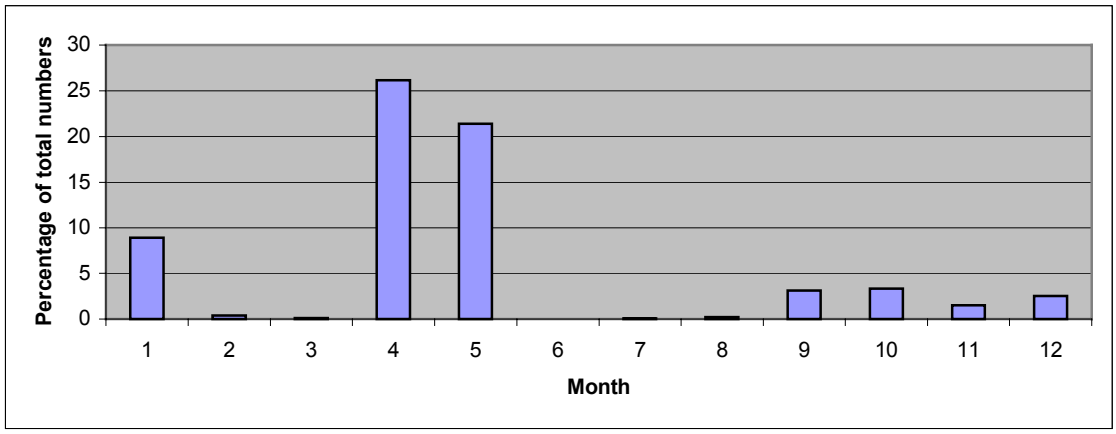

Figure C47. Average number of Sharp-tailed Sandpipers as a percentage of the total number of all group 1 species combined by month.

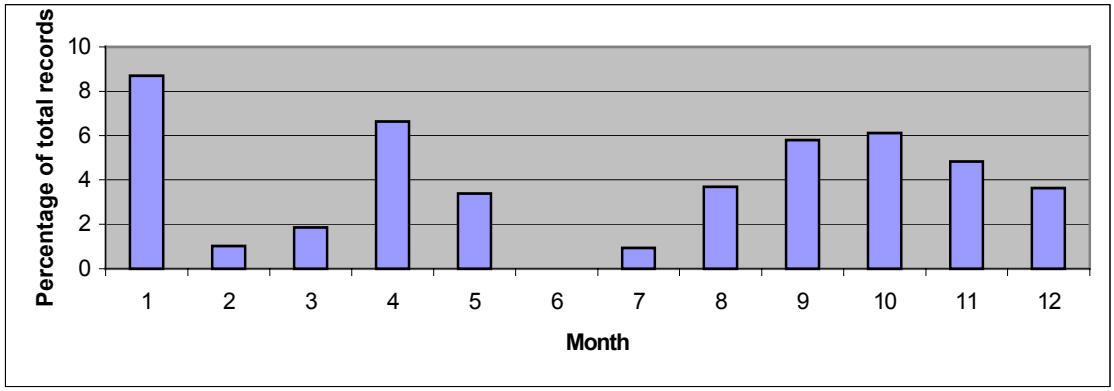

Figure C.48. Average number of Sharp-tailed Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

CURLEW SANDPIPER

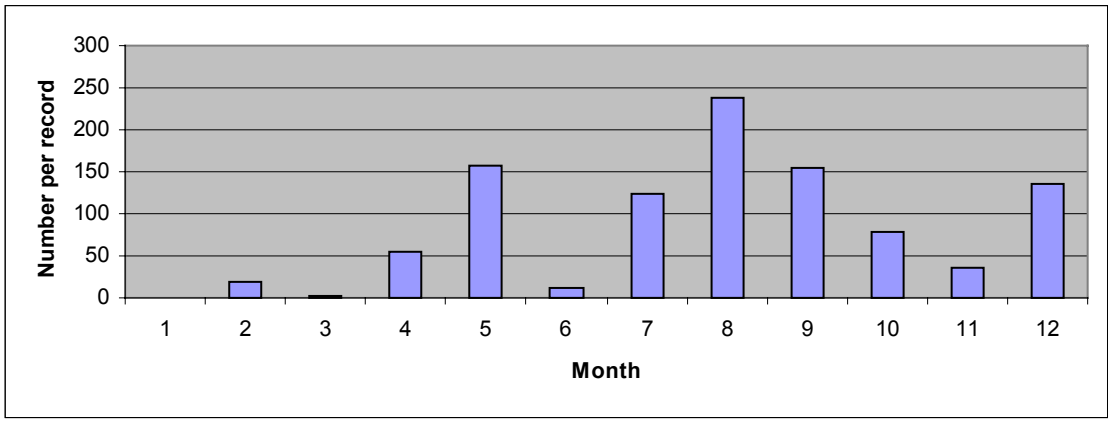

Figure C49. Average number of Curlew Sandpipers per record by month.

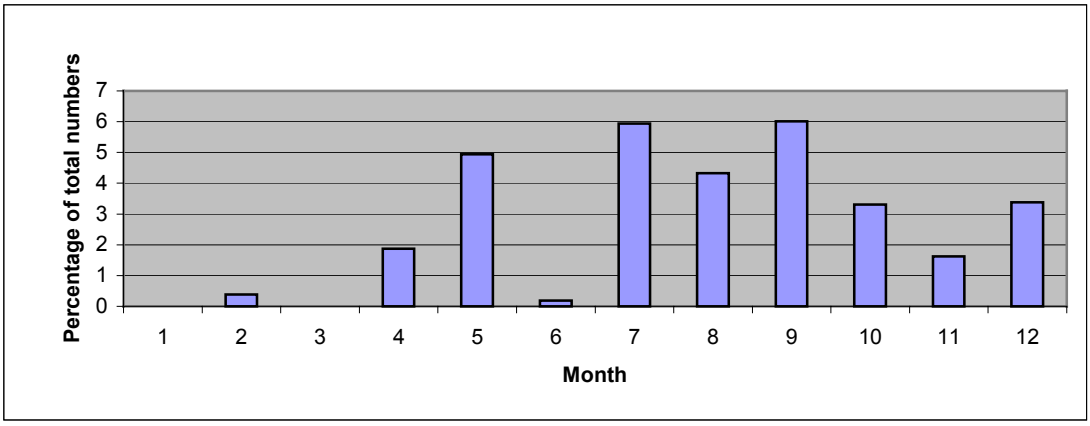

Figure C50. Average number of Curlew Sandpipers as a percentage of the total number of all group 1 species combined by month.

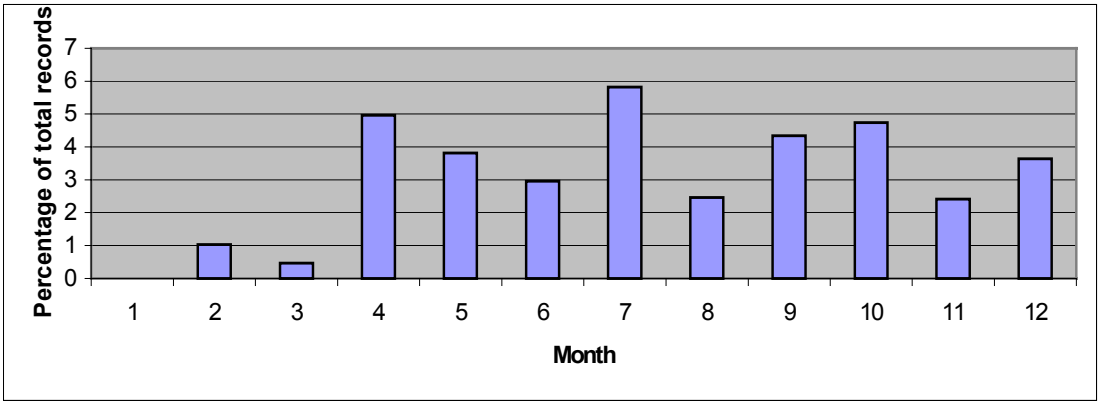

Figure C51. Average number of Curlew Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

BROAD-BILLED SANDPIPER

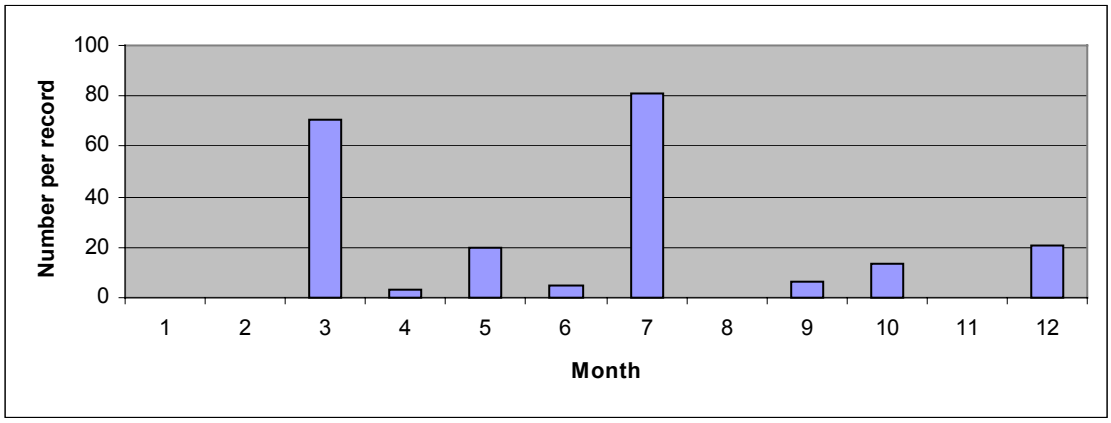

Figure C52. Average number of Broad-billed Sandpipers per record by month.

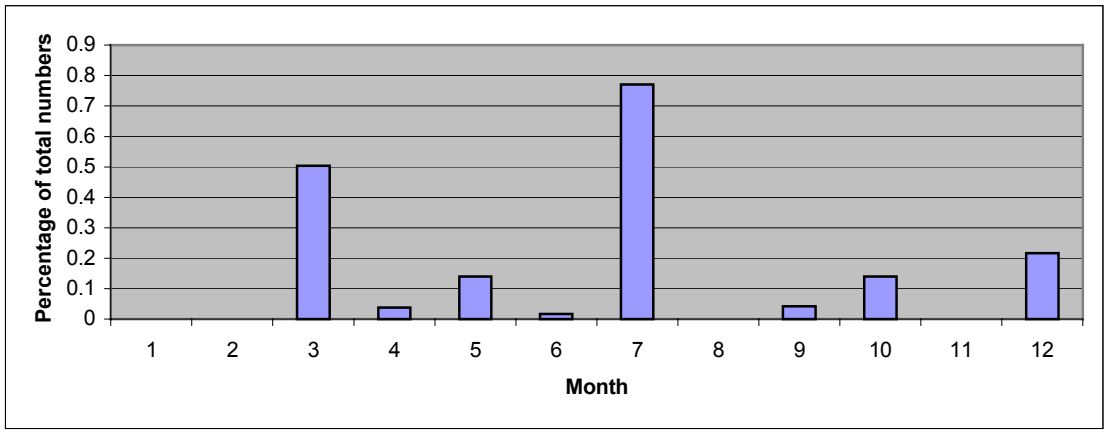

Figure C53. Average number of Broad-billed Sandpipers as a percentage of the total number of all group 1 species combined by month.

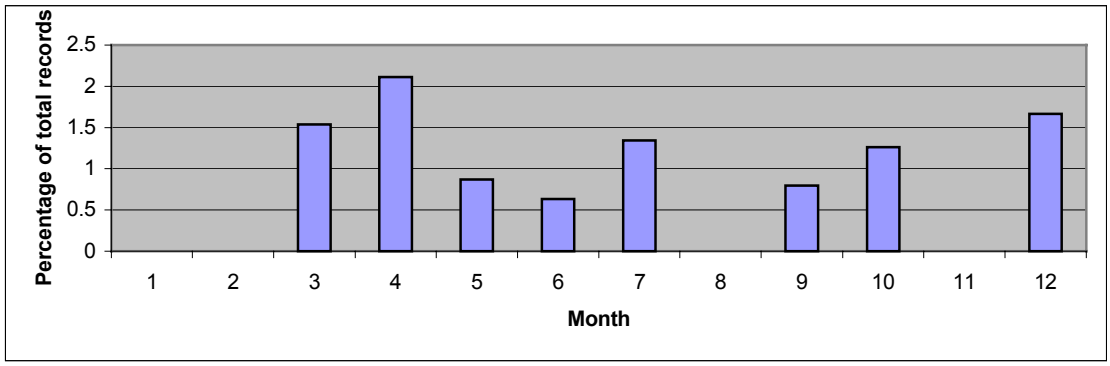

Figure C54. Average number of Broad-billed Sandpiper records as a percentage of the total number of all group 1 species records combined by month.

PACIFIC GOLDEN PLOVER

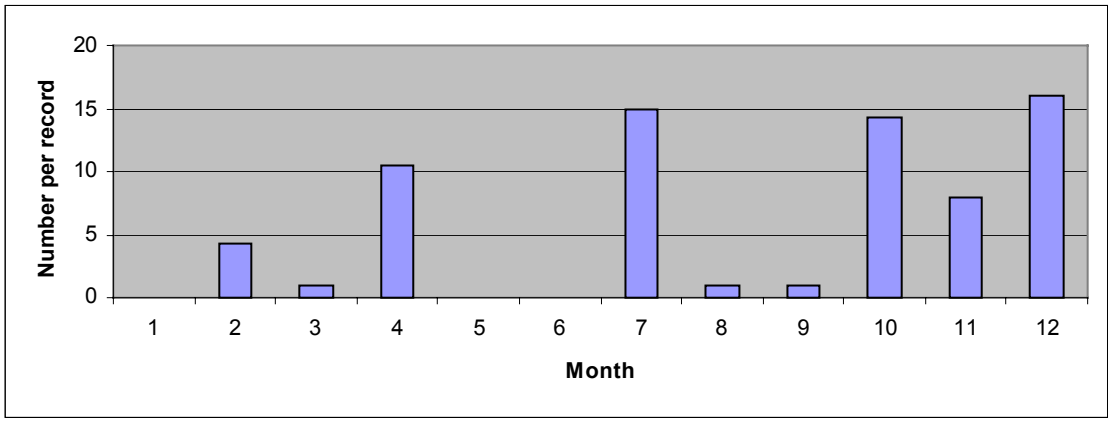

Figure C55. Average number of Pacific Golden Plover per record by month.

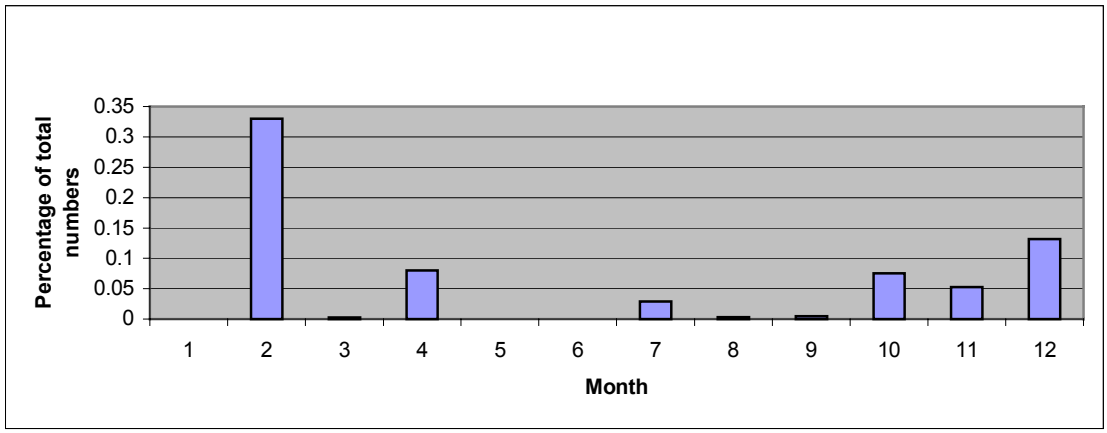

Figure C56. Average number of Pacific Golden Plovers as a percentage of the total number of all group 1 species combined by month.

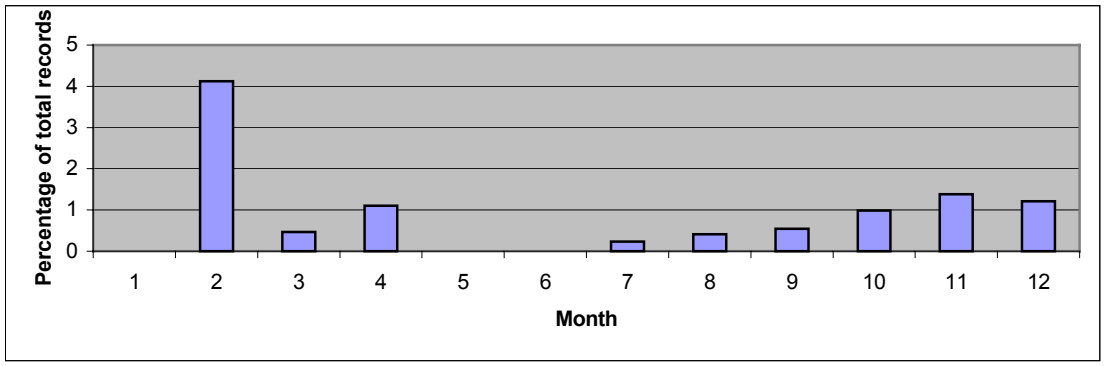

Figure C57. Average number of Pacific Golden Plover records as a percentage of the total number of all group 1 species records combined by month.

GREY PLOVER

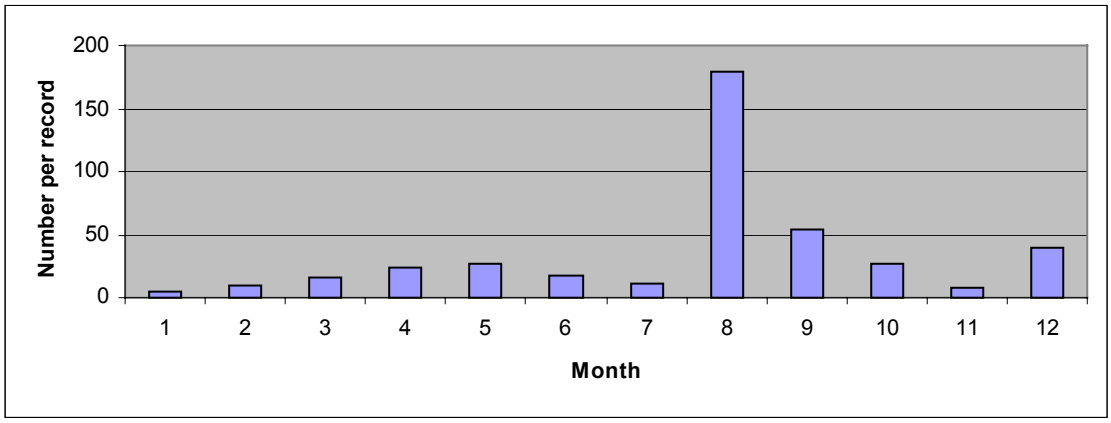

Figure C58. Average number of Grey Plovers per record by month.

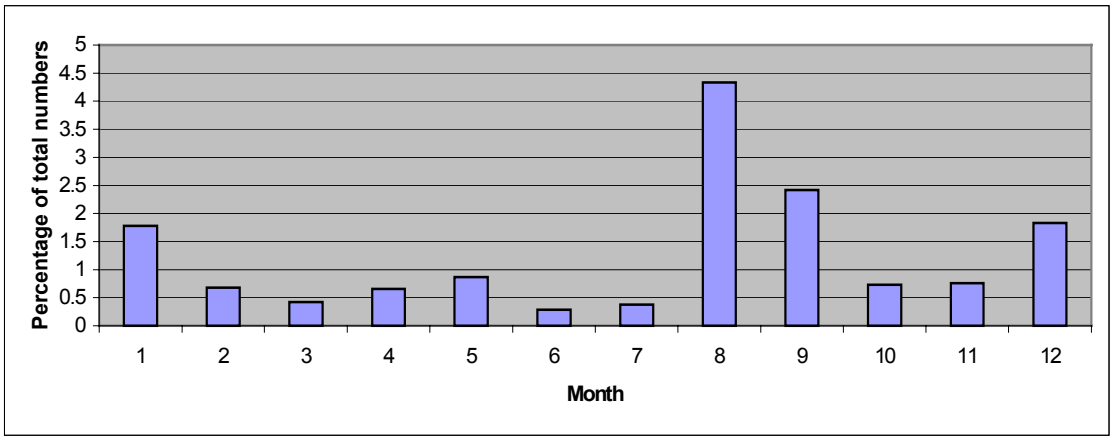

Figure C59. Average number of Grey Plovers as a percentage of the total number of all group 1 species combined by month.

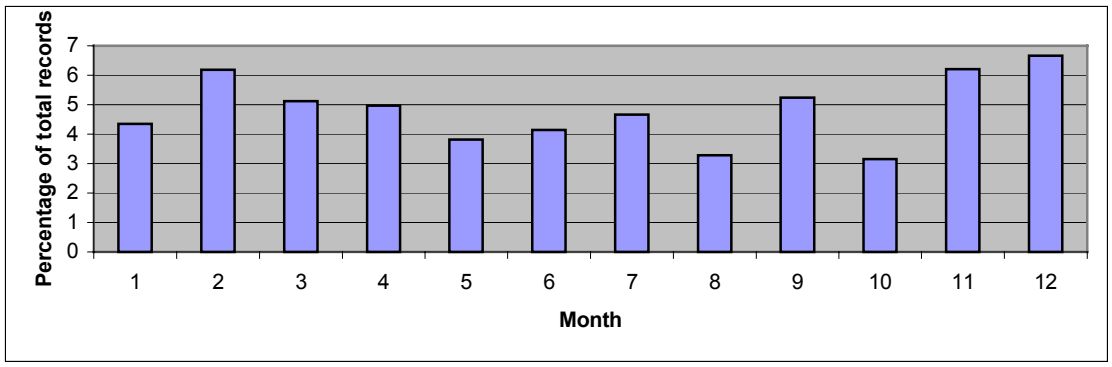

Figure C60. Average number of Grey Plover records as a percentage of the total number of all group 1 species records combined by month.

RED-CAPPED PLOVER

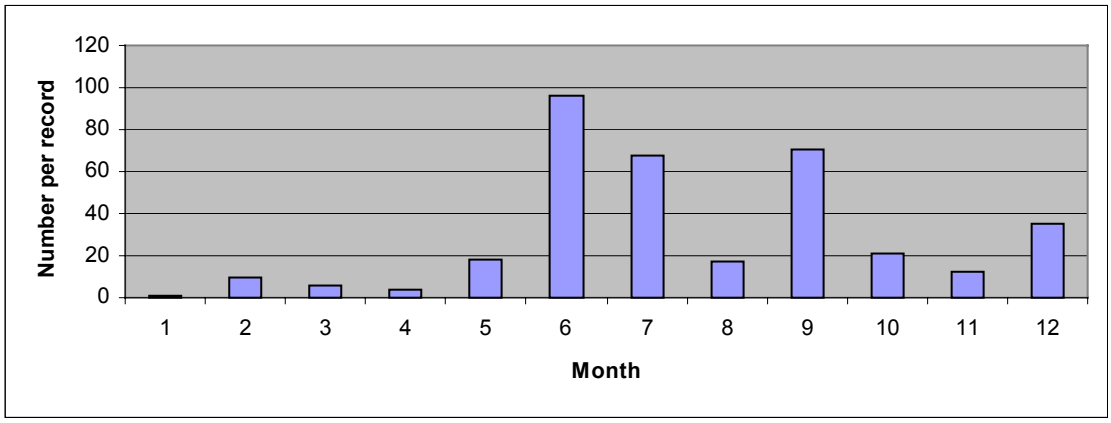

Figure C61. Average number of Red-capped Plovers per record by month.

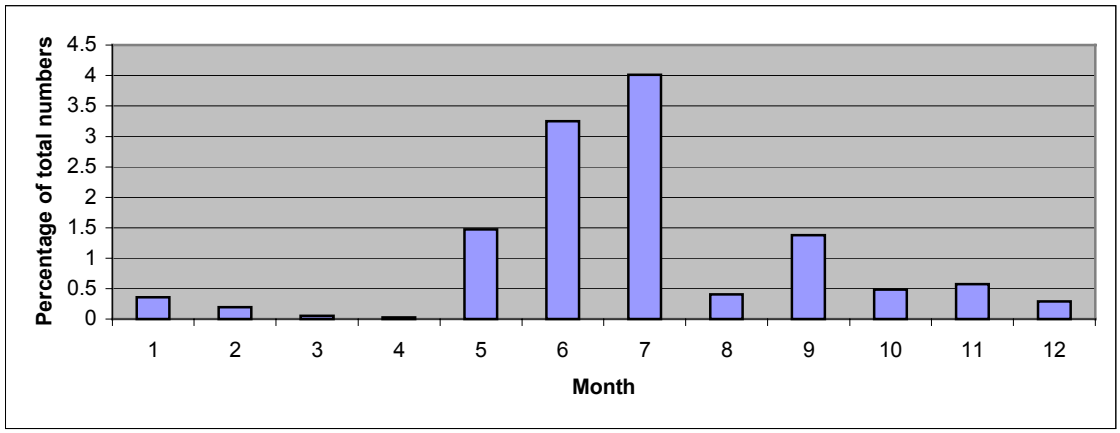

Figure C62. Average number of Red-capped Plovers as a percentage of the total number of all group 1 species combined by month.

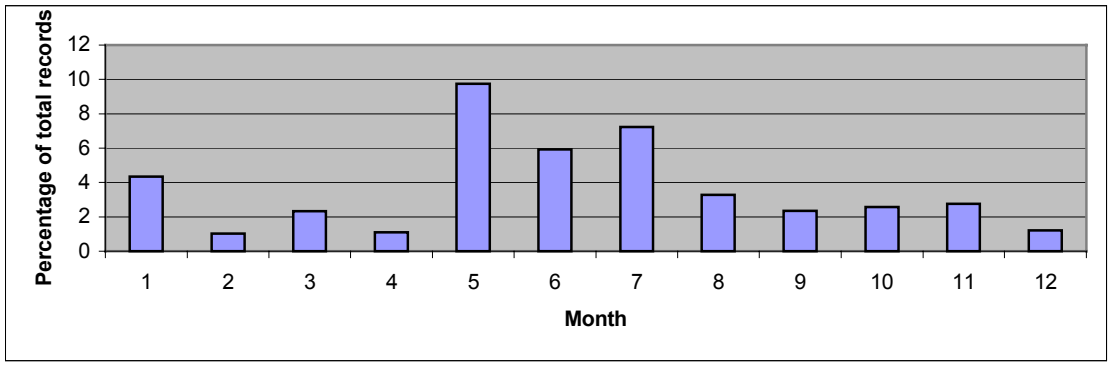

Figure C63. Average number of Red-capped Plover records as a percentage of the total number of all group 1 species records combined by month.

LESSER SAND PLOVER

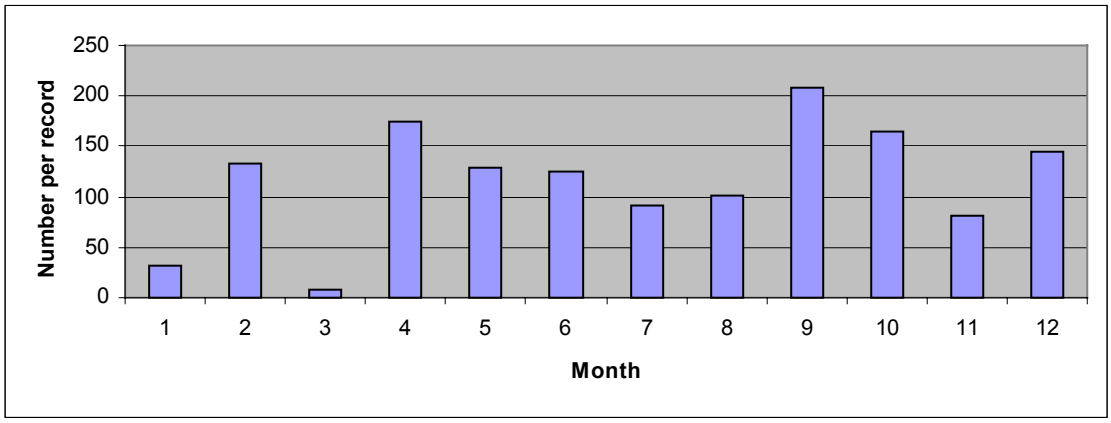

Figure C64. Average number of Lesser Sand Plovers per record by month.

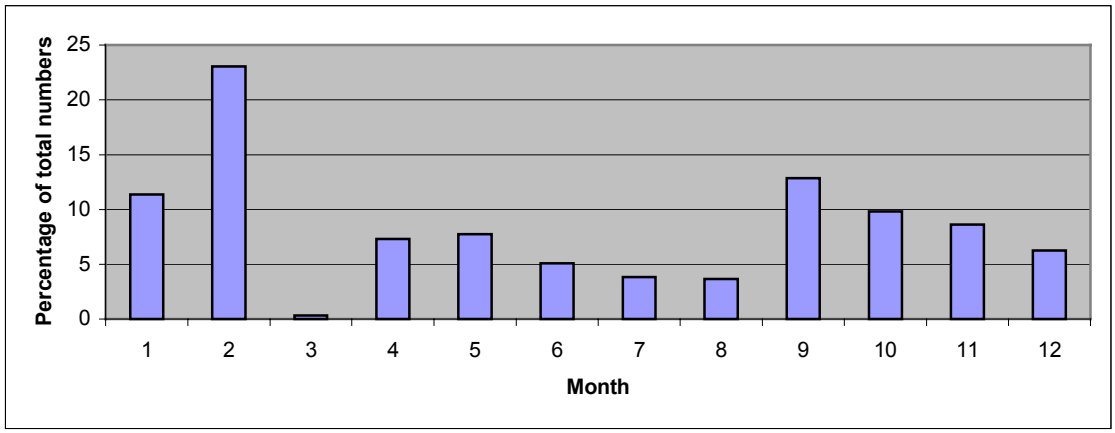

Figure C65. Average number of Lesser Sand Plovers as a percentage of the total number of all group 1 species combined by month.

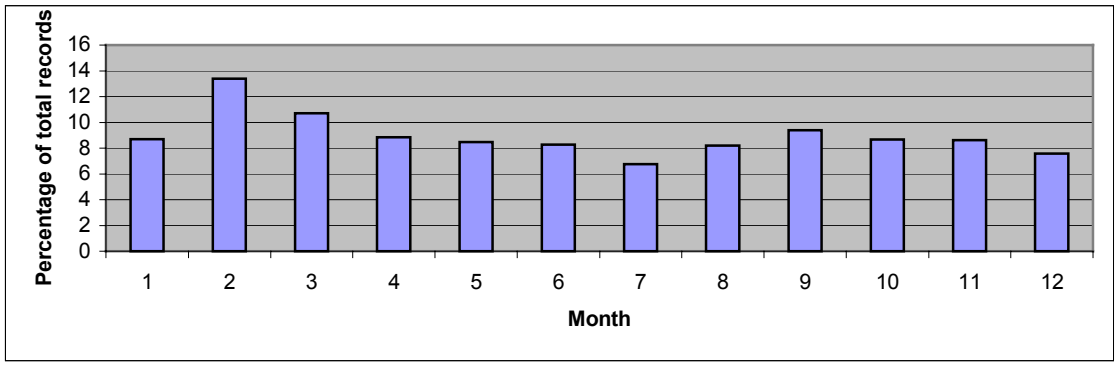

Figure C66. Average number of Lesser Sand Plover records as a percentage of the total number of all group 1 species records combined by month.

GREATER SAND PLOVER

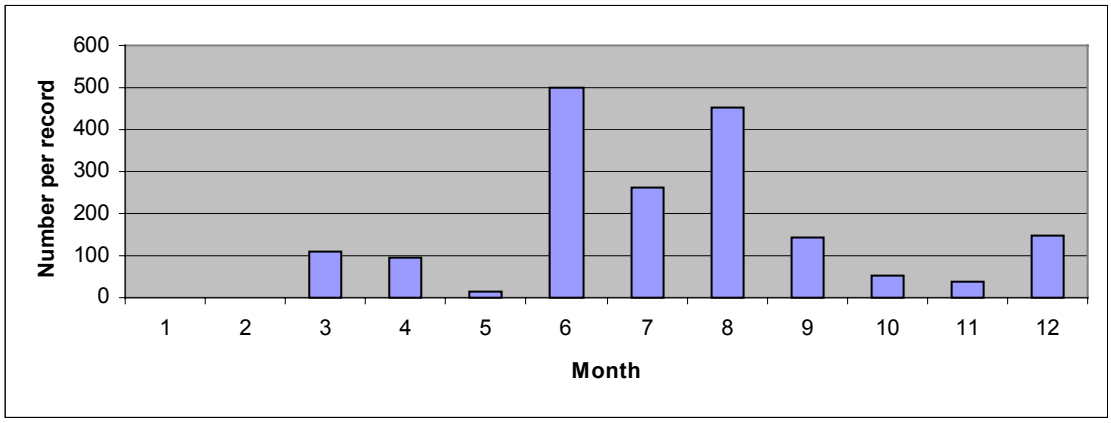

Figure C67. Average number of Greater Sand Plovers per record by month.

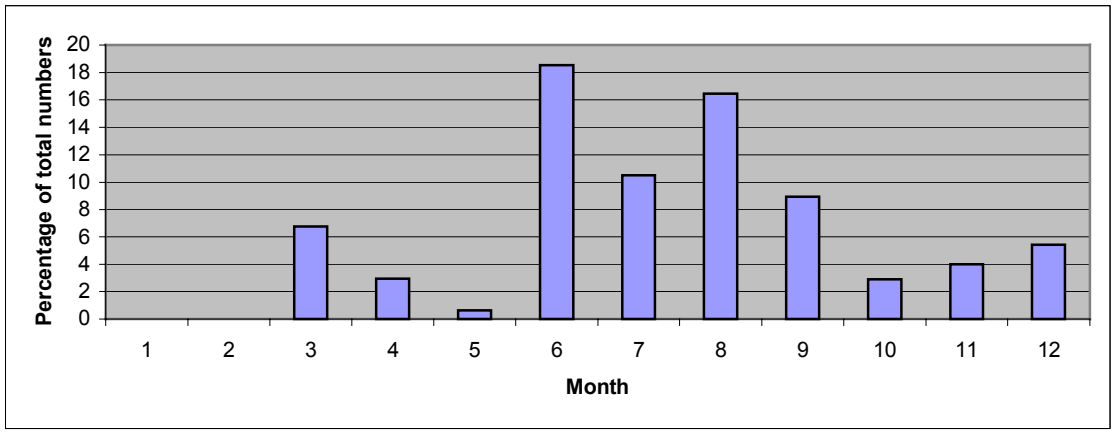

Figure C68. Average number of Greater Sand Plovers as a percentage of the total number of all group 1 species combined by month.

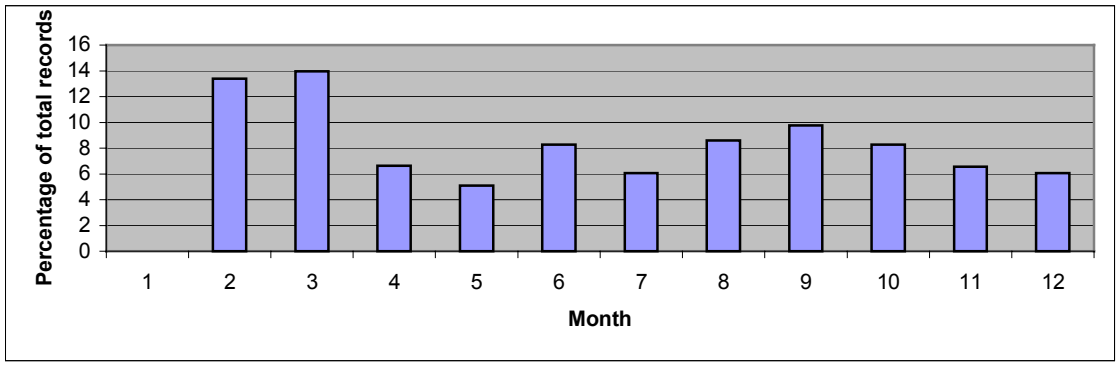

Figure C69. Average number of Greater Sand Plover records as a percentage of the total number of all group 1 species records combined by month.

LESSER, GREATER AND COMBINED SAND PLOVER

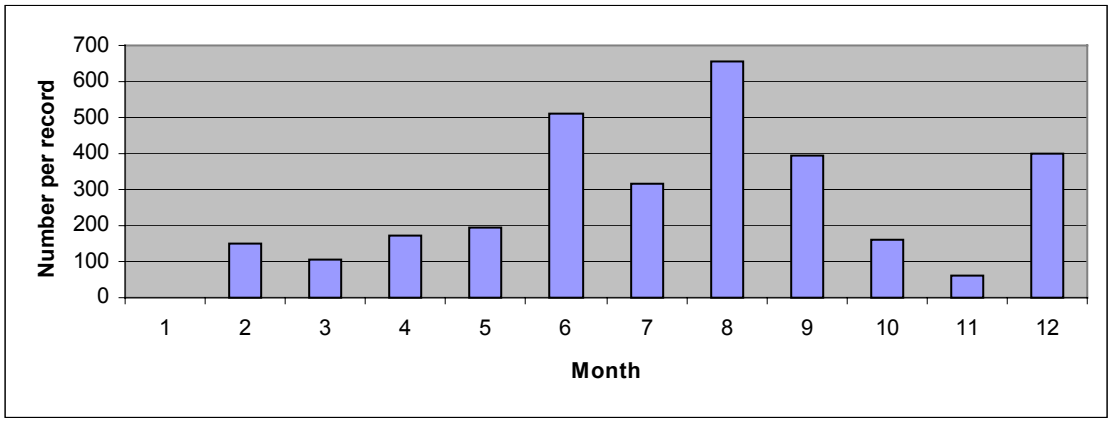

Figure C70. Average number of Lesser, Greater and combined sand plovers per record by month.

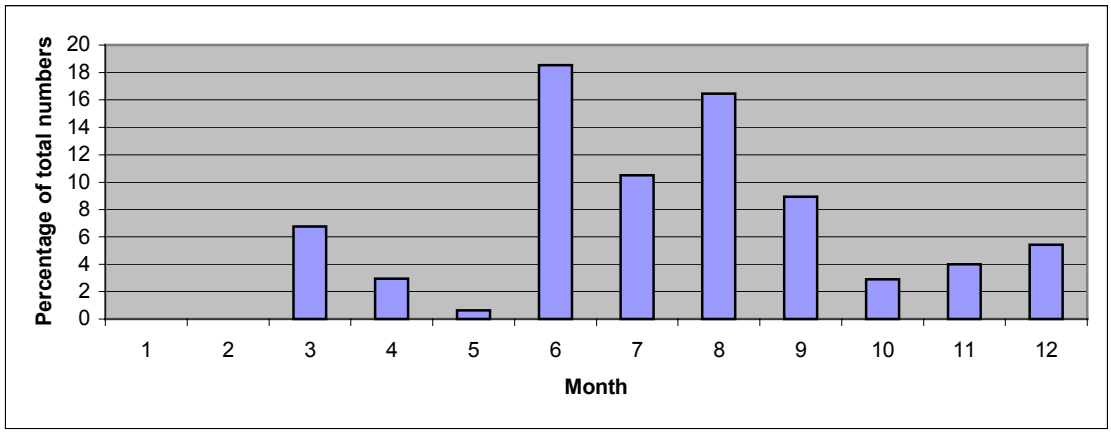

Figure C71. Average number of Lesser, Greater and combined sand plovers as a percentage of the total number of all group 1 species combined by month.

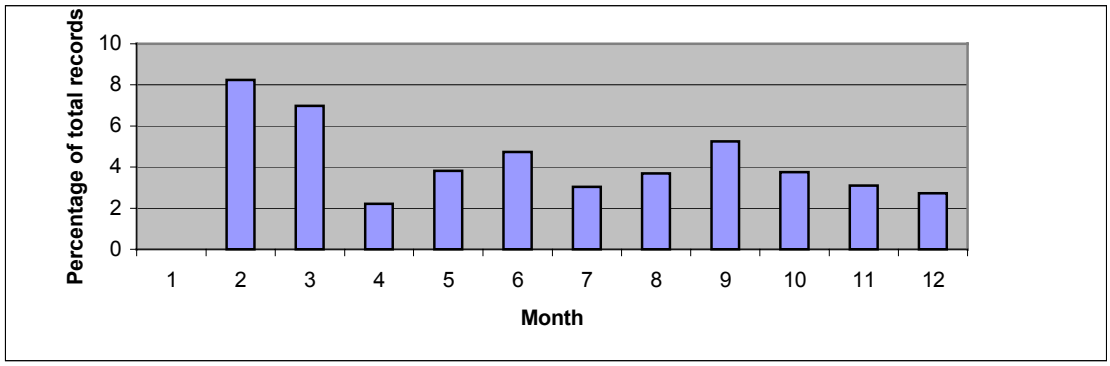

Figure C72. Average number of Lesser, Greater and combined sand plover records as a percentage of the total number of all group 1 species records combined by month.

BLACK-FRONTED DOTTEREL

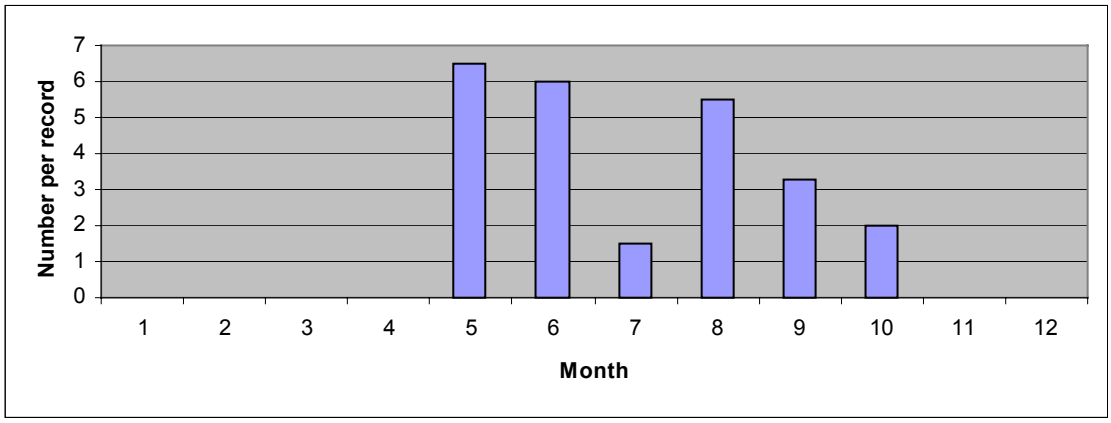

Figure C73. Average number of Black-fronted Dotterels record by month.

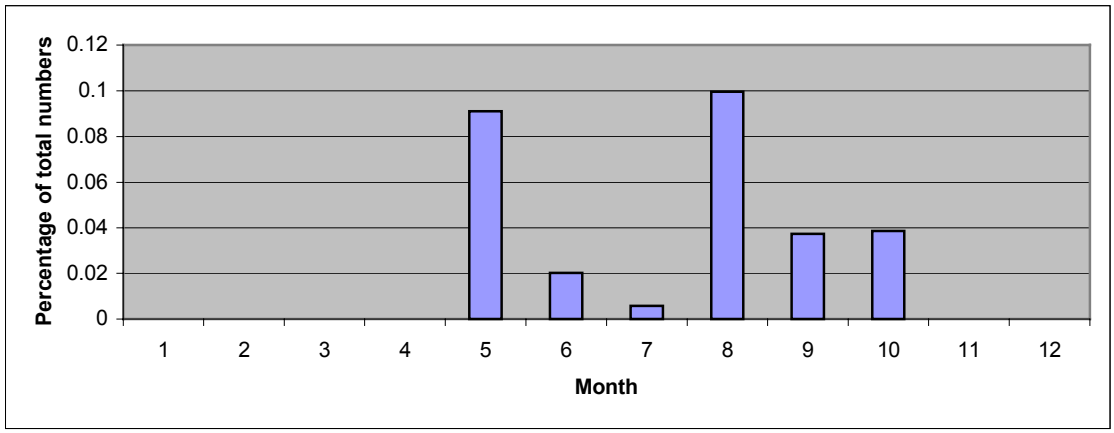

Figure C74. Average number of Black-fronted Dotterels as a percentage of the total number of all group 1 species combined by month.

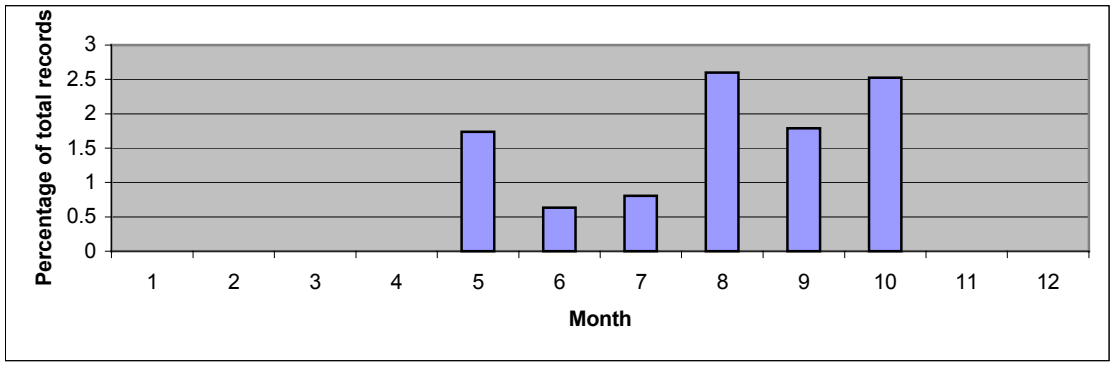

Figure C75. Average number of Black-fronted Dotterel records as a percentage of the total number of all group 1 species records combined by month.

RED-KNEED DOTTEREL

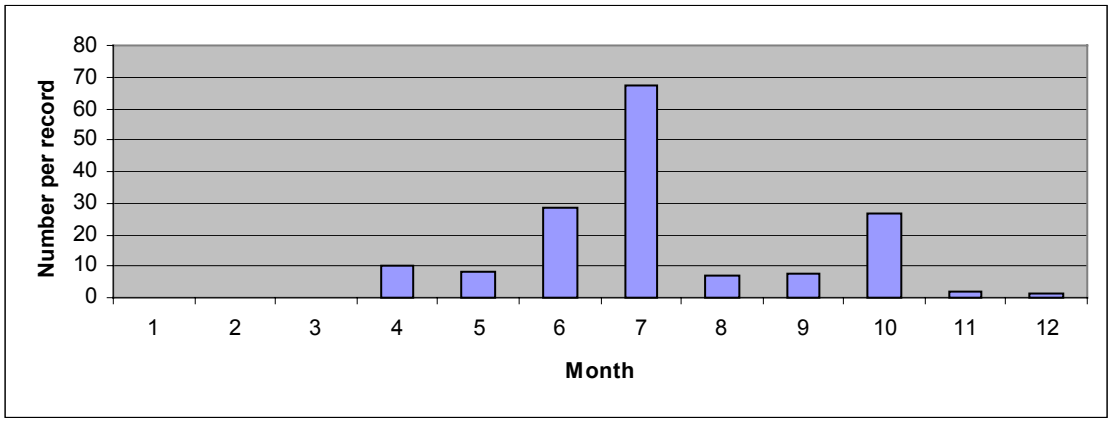

Figure C76. Average number of Red-kneed Dotterels per record by month.

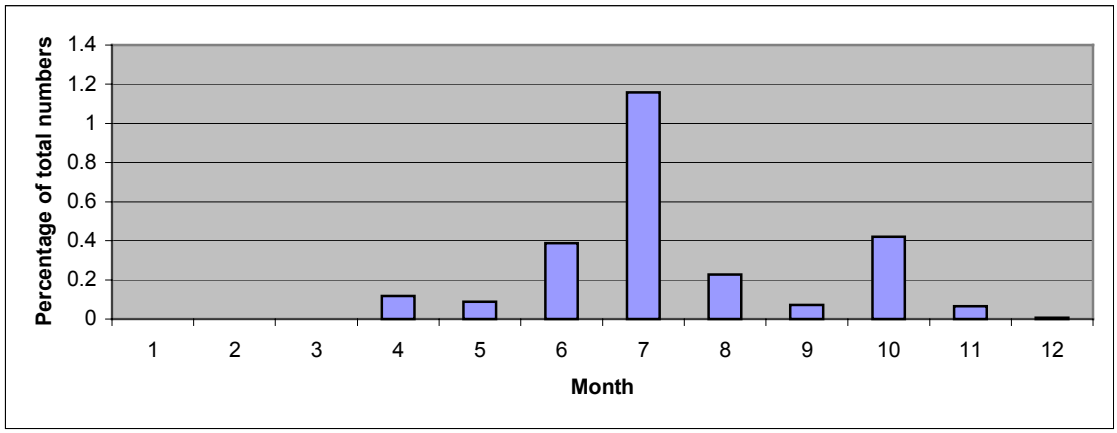

Figure C77. Average number of Red-kneed Dotterels as a percentage of the total number of all group 1 species combined by month.

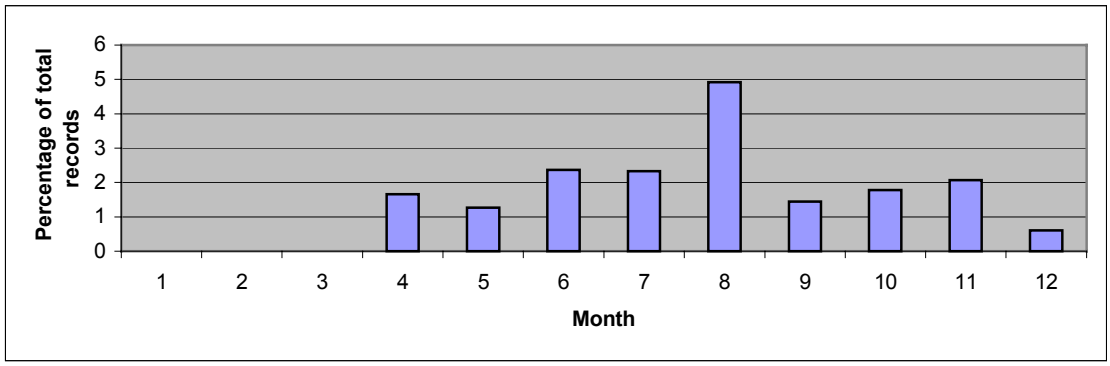

Figure C78. Average number of Red-kneed Dotterel records as a percentage of the total number of all group 1 species records combined by month.

PIED OYSTERCATCHER

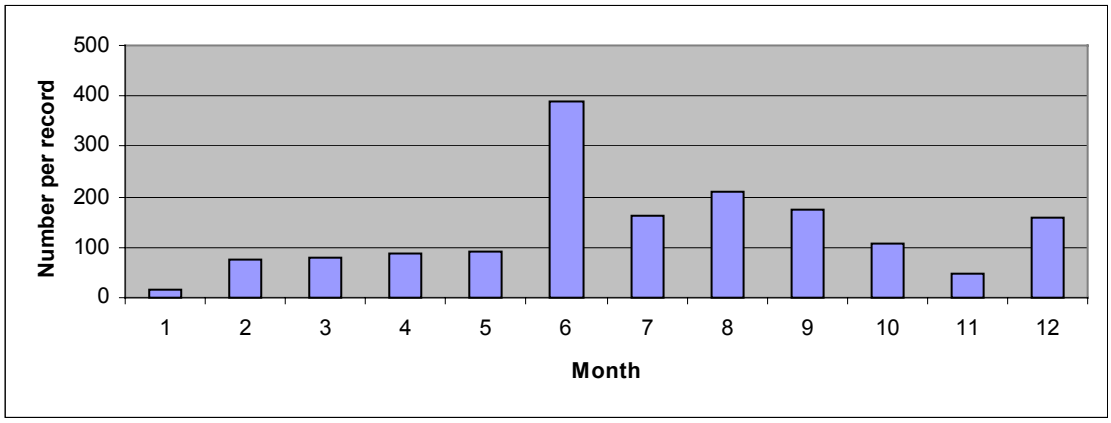

Figure C79. Average number of Pied Oystercatchers per record by month.