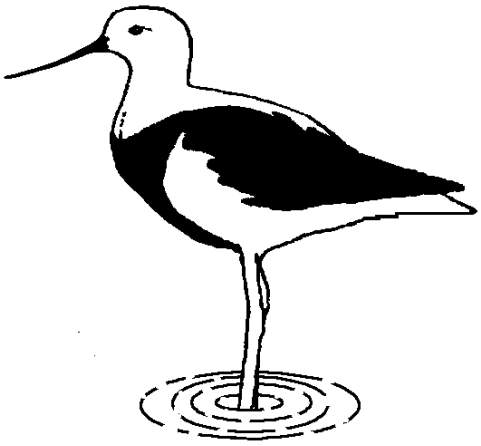
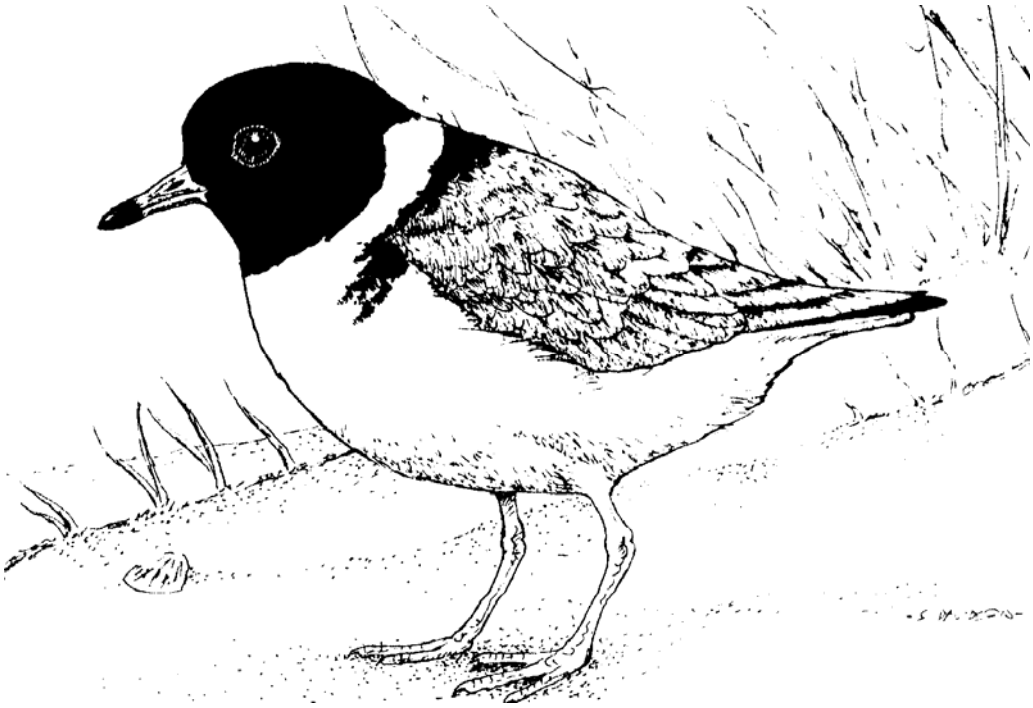
The Stilt



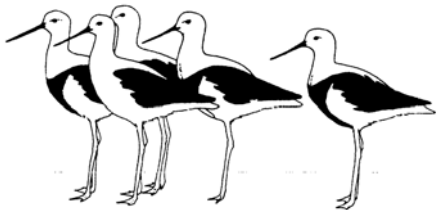
The Bulletin of the East Asian-Australasian Flyway



AWSG Australasian Wader Studies Group

A special interest group of Birds Australia

Number 38
April 2001



The Stilt

ISSN 0726-1888

MISSION STATEMENT

To ensure the future of waders and their habitats in Australia through research and conservation programmes and to encourage and assist similar programmes in the rest of the East Asian-Australasian Flyway.

OBJECTIVES

- To monitor wader populations through a programme of counting and banding in order to collect data on changes on a local, national and international basis.
- To study the migrations of waders through a programme of counting, banding, colour flagging and collection of biometric data.
- To instigate and encourage other scientific studies of waders such as feeding and breeding studies.
- To communicate the results of these studies to a wide audience through the *Stilt*, the *Tattler*, other journals, the internet, the media, conferences and lectures.
- To formulate and promote policies for the conservation of waders and their habitat, and to make available information to local and national governmental conservation bodies and other organisations to encourage and assist them in pursuing this objective.

To encourage and promote the involvement of a large band of amateurs, as well as professionals, to achieve these objectives.

MEMBERSHIP OF THE AUSTRALASIAN WADER STUDIES GROUP

Membership of the AWSG is open to anyone interested in the conservation and research of waders (shorebirds) in the East Asian-Australasian Flyway. Members receive the twice yearly bulletin *The Stilt*, and the quarterly newsletter *The Tattler*. Please direct all membership enquiries to the Membership Manager at Birds Australia (RAOU) National Office, 415 Riversdale Rd, East Hawthorn, 3122. Vic., AUSTRALIA.
Ph: 03-9882 2622, fax: 03-9882 2677.
Email: membership@raou.com.au

Annual Subscriptions:	Australia	A$30.00
	New Zealand	A$30.00
	Overseas	A$35.00
	Institutions	A$40.00

Cover Illustration: Stephen Davidson

EDITORIAL

I am pleased to see an increasing range of articles in this issue from new authors and the trend is very encouraging. I think that it is one of the most diverse issues in the last few years, with articles from China and Papua New Guinea as well as several from Australia. This year looks bright for *Stilt* as we have so many articles that we have decided to print an extra issue that will be come out with the July *Tattler*. I thank authors who have chosen to send their articles to *Stilt* and this can only increase its value as a means of disseminating important information on the status and conservation of waders throughout the flyway. It looks like we will have three bumper issues this year and the July issue is already full.

Following a suggestion from Phil Straw, editor of *Tattler*, we have the first of what is hoped will be a series of articles on important wader sites in the East Asian-Australasian Flyway. Richard Loyn bravely agreed to write the first article on Westernport in southern Victoria. This is probably the most well studied wader site in Australia and waders have been systematically counted here since the early 1970s. This depth of knowledge is reflected in the breadth of this article and I hope that readers enjoy it and are stimulated to write about important wader sites in their area. Phil and I have developed a template for these articles and intending authors should contact either of us for details of the sections we would like to see included.

It is also encouraging to see the fifth in the series of occasional counts of waders at sites visited irregularly. Since Jim Wilson kicked this series off, was have had a steady flow of articles. I hope the interest in documenting unusually large counts in out of the way places or counts of rare species will increase. Increasingly, governments will only respond on environmental issues when confronted with written evidence of the importance of areas to wildlife. I hope we publish more of these occasional counts and they prove of value for conservation in the future.

David Milton

THE ANNUAL REPORT FOR 2000 FROM THE AUSTRALASIAN WADER STUDIES GROUP

This was a year of exciting developments for the AWSG.

In January and February, a wader survey of the coasts of South Australia was carried out. This was supported by funds from the Natural Heritage Trust. The Coorong, Gulf St Vincent, Spencer Gulf and West Eyre Peninsula were covered. The survey was highly successful and counts were made at many sites that have not been visited since the early 1980s. New sites of international importance for waders were discovered, and the bays and islands around Ceduna, most of which have either never, or only been counted once before, were recommended for further investigation and possible Ramsar nomination. A report has been published and a copy is deposited in the Birds Australia library.

In May, Clive Minton took a team cannon netting in N.W. Australia to cover a period of the year when we are lacking information from there. Much valuable research was done on the moult of immature waders and collected evidence that some immatures are moving north of Australia in the winter.

Meanwhile Mark Barter went to China again. He covered four sites, including the now famous Yalu Jiang that the AWSG discovered in 1999. He also located the first large flocks of Red Knots and Curlew Sandpipers in the Yellow Sea at Tianjin, a site not previously visited.

In early July, the AWSG held their third conference, this time in conjunction with the Southern Hemisphere Ornithological Congress at Griffith University. There were many interesting talks, but the lack of participation from overseas (apart from New Zealand) was disappointing.

In August, George McKay delivered his report to Environment Australia on population monitoring trials. The AWSG did not agree with everything in the report. We have decided that our Population Monitoring Project, which has been running for 20 years has to be reinvigorated, but we will mostly keep the methods we have always used with some modifications to make the counts more consistent (see the paper in this *Stilt*).

In September, the AWSG was represented at the International Wader Study Group conference in

England by Clive Minton and Jim Wilson, both of whom gave talks on Australian waders. At the same time, Phil Straw was representing the AWSG in Taiwan at an International Wetlands Management Conference sponsored by the Wild Bird Society of Taipei.

In November Mike Weston ran the biennial Hooded Plover survey,

Two copies of Stilt and four copies of Tattler were published.

However, the most exciting development has been taking place quietly in the background of all the field and conference activities. The AWSG have been awarded a contract by Environment Australia to develop a new database for wader counts. We have entered an agreement that this data can be used to help enforce the intentions of the Biodiversity Act. This means that wader counts will be used for the practical conservation of waders. It has also become obvious that we need a new counting program, and that sites in the future will need to be registered in much more detail. It is probable that the AWSG will considerably expand the count programs in the future.

Another exciting project is the development of a web site, which is now well in hand. It is hoped that this will develop into the wader web site for the whole Flyway.

At the end of the year, we heard that the NHT would support the AWSG in a total count of waders in Victoria. Following on our suggestion from the 2000 South Australia surveys that the Coorong should be monitored annually, Mount Gambier office of the Department of Environment and Heritage also awarded us funds to do another count in February 2001. At the time of writing, the Coorong survey is complete and the Victorian survey is well in hand. There are good indications of future support for further counts of the Coorong.

It is obvious that the AWSG is not going to realise its full potential without paid staff. The lack of staff has been the achilles heel of the Population Monitoring Project. We are therefore looking at ways to get finances for a part or full time position to be set up within the Birds Australia organisation. We believe that the implications of the Biodiversity Act, the need to constantly update the new database and organise more counting, and the increasing need for the Population Monitoring will force the position into existence. The AWSG and other wader groups also need help with the running of the wader-flagging program. The undreamed of success in tracking the movements of waders throughout the Flyway is bogging us (Clive Minton) down in paperwork. At the time of writing, we are negotiating with Environment Australia for a possible project to develop a flagging database, an electronic reporting form, and to spread more information about the flagging through the Flyway.

June will bring to an end my period in Australia and the end of my three years as the Chair of the AWSG. Ros Jessop has been co-opted as chair by the committee until the biennial elections take place. I take the opportunity to thank all within and outside Birds Australia for the tremendous support and enthusiasm that they have given me and the AWSG over the last three years. Especially I would like to thank the whole committee and other members who beaver away busily behind the scenes to keep things moving forward. The willingness to cooperate, share data and work together that exists in Australia is hard to better anywhere else in the world. The AWSG is in a good financial position, its repute is high and increasing, and hopefully it is now set to continue on a course of providing good solid information and scientific data through its publications, the web and new databases.

Jim Wilson
February 2001.

TREASURER'S REPORT FOR 2000

The Consolidated Accounts provided below show that income exceeded payments by $23,158.82, however this includes commitments for expenditure on contracts (see Chair's Report) yet to be paid of $17,500. In addition, Environment Australia have paid in advance for the provision of our publications and other services to nominated recipients in the Flyway. A surplus arising from the Brisbane Conference is included.

The overall result, excluding one off contracts, is in accordance with the budget and is a pleasing start to the new millennium.

Research Fund

The Research Fund comprises Specific Donations and is included in the statement of accounts. In

accordance with our Rules the following is a Report for the Fund as at 31 December 2000.

Brought forward from 31/12/99 $5,048 $8,320

Donations 2000

Less Contribution to Lake Eyre Expedition $8,000

Total Research Fund 31/12/00 $5,368

Membership Statistics for 2000

The membership as at the end of 2000 was:

Australia/ New Zealand	197
Overseas (excl. NZ)	30
Institutions	17
EA Funded	93
TOTAL	330

I would like to express my thanks to the staff at Birds Australia who provide us with such excellent service in processing accounts and memberships.

Ken Gosbell, Secretary/ Treasurer

Australian Wader Studies Group
Consolidated Accounts
Statement of Receipts and Payments
1 January 2000 - 31 December 2000

RECEIPTS			**PAYMENTS**		
Item	**2000**	**1999** $	**Item**	**2000**	**1999** $
Balance B/f	23,982.61	19,195.30	Stationary/Printing	5,749.24	6,400.98
			Photocopying	15.75	33.75
Subscriptions	4,299.65	7,345.77	Insurance	350.00	285.00
E.A. Contract	6,000	7,318.00	Postage/Courier	2,379.45	2,185.21
Contracts - Federal Govt	16,140.00		Consultants	1,305.00	
Contracts - State Govts	3,978.00		Field Expenses	8,520.04	
Contracts - Other	500				
Sales	762.78	82.00	Phone/Fax	439.58	3.50
Specific Donations	8,320.00	645.00	Subscriptions		193.62
Conference	4,520.43	6478.50	Conference	1,389.55	6,286.90
			Admin Fee (BA)	1,000.00	1,000.00
			Depreciation	485.00	693.00
TOTAL INCOME	**44,790.43**	21,869.27	**TOTAL EXPENSES**	**21,633.61**	17,081.96
BALANCE AT 31/12/00	**47,139.43**				

THE IMPORTANCE OF INLAND CLAYPANS FOR WADERS IN ROEBUCK BAY, BROOME, NW AUSTRALIA

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ABSTRACT

Birds have often been observed flying over the mangroves into the areas of claypans behind Roebuck Bay. It has been surmised that these areas are used by the migratory waders as a roost during high tides over 8.5m. This paper gives the result of a count conducted on the 4 May 2000 at a claypan (17º 59' S, 122º 23' E) two kilometres behind the mangroves at Roebuck Bay, Broome, northwestern Australia.

INTRODUCTION

In the dry season (May to August) the numbers of waders using the Roebuck Bay high tide roosts on the northern shores is much lower than in the wet season owing to the migration of large numbers of adult birds to their breeding grounds in the northern hemisphere. The counts of waders at this time of year in the bay vary between 25 and 30,000 birds (Watkins 1993). The counts of the northern shores, that is those shores that are easily accessed by road, normally show much lower numbers. Therefore a special count was arranged by the Australasian Wader Studies Group (AWSG) to explore the possibility that large numbers of waders were utilising areas behind the mangroves at Roebuck Bay.

The movement of large numbers of waders into the hinterland of Roebuck Bay is a well-known phenomenon that has been observed for many years. Recently interest has been centred on the claypans that fill on high tides and ephemeral wetland that fill infrequently depending on the quantity of rain during the previous wet season. One such claypan has been named Kidney Bean from its distinctive shape and has been the centre for several land-based excursions and counts (Rogers *et al* this issue). Moderate numbers of waders were found roosting and feeding there on several occasions.

METHODS

On 4 May 2000, two observers (PC and AB) were airlifted by small helicopter, three hours before high tide to a site two kilometres behind the mangroves at Roebuck Bay, Broome, North West Australia (17º 59' S, 122º 23' E) (Figure 1). This location, behind the mangroves at Little Crab Creek, had previously been identified to be near a major wader roost. Detailed notes on bird numbers and species arriving at the claypan were taken at intervals of fifteen minutes. Flocks of waders seen flying over the mangroves further away were also noted and numbers and species, were recorded, if possible.

Figure 1. Flocks of waders on the claypan, behind the mangroves at Little Crab Creek, Broome, WA.

RESULTS

The vegetation around the margins of the claypan was dominated by Samphire *Halosarcia* sp. and other plants belonging to the family Chenopodiacea. The lack of vegetation within the claypan indicated that the area retains saline water from high tides for considerable periods. As the tide came in, water covered bare areas where Red-necked Stints *Calidris ruficollis* and Curlew Sandpipers *Calidris ferruginea* had been feeding. The depth of water

and area of the claypan filled on this height of tide could not be determined as the observers left before high tide. However, previous experience in the area indicated that it would be no more than a few centimetres deep in the middle and would barely reach the vegetated edges on 8 - 8.5 metre high tides. Presumably this area had also been inundated by rainwater from the previous, exceptional wet season (January to April 2000).

Large numbers of avian footprints ranging in size from small, similar to those made by Red-necked Stints, to medium, similar to those made by Great Knot *Calidris tenuirostris*, were seen in the soft mud in the area where the observers landed by helicopter. Thus, it appeared that the area had been used as a roosting site on previous high tides. The only large avian prints were presumably those of Black-necked Stork *Ephippiorrhynchus asiaticus*.

Birds already present in the area when the observers arrived were Red-necked Stint (135) and Grey Plover *Pluvialis squatarola* (6). Observations commenced at 08.00 and during the first thirty minutes nearly 3,000 waders (Figure 2) mostly Red-necked Stints, flew into the area (Table 1). In the period 08.30 to 08.45 nearly 17,000 waders arrived, from 08.45 to 9.00, about 900 birds, 09.00 to 09.15, about 1,700 and 09.15 to 09.30, 250. No birds arrived after 9.30 even although high tide was not until 11.00.

Birds arrived from all areas of Roebuck Bay, generally from the west and south west, at a height of two - three metres, sometimes directly over the observers heads. A small flock of Red-necked Stint and Curlew Sandpiper arrived from the south east followed by smaller number of the same species presumably from freshwater wetlands where they had been feeding. One flock, of approximately 1,000 Great Knot were first observed several kilometres away and followed all the way into the claypan. These birds followed a looping flight path to the area and did not approach directly. This observation may account for previous descriptions of birds going into different areas behind the mangroves as this flock flew close to the ground and could easily have been lost to observers on the coast. All flocks that were seen from the claypan ultimately ended up there though it is possible that small flocks of Curlew Sandpiper and Red-necked Stint were overlooked.

Local movement of birds had to be taken into consideration when estimating the number of birds arriving to ensure none were counted twice eg. a large flock of 2,000 Red-necked Stints were observed arriving from the south but a count of Red-necked Stints on the ground indicated this was a local movement from within the claypan.

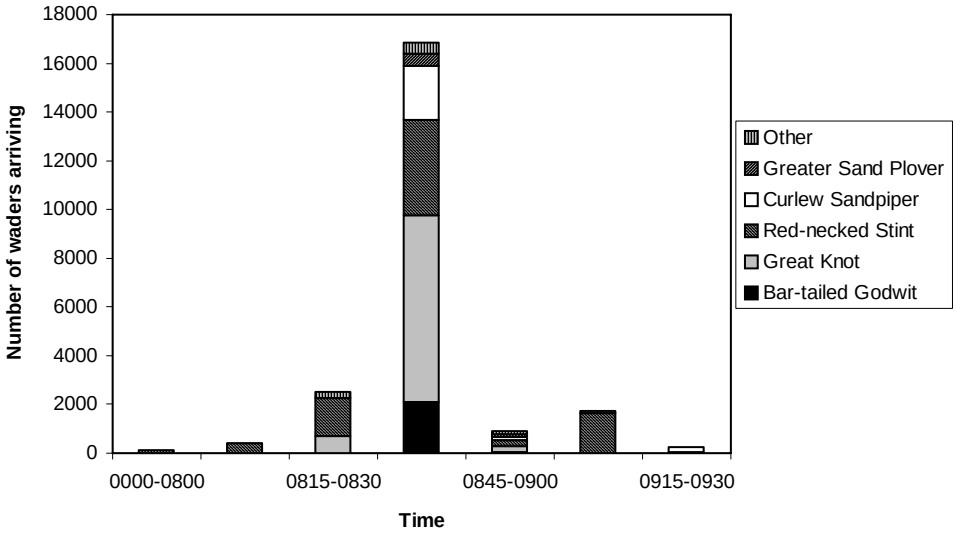

Figure 2. The number of waders arriving to roost on a claypan behind the mangroves near Little Crab Creek, Roebuck Bay, Broome, WA on 4 May, 2000.

Table 1. The number of waders arriving each 15 minutes to roost on a claypan behind the mangroves near Little Crab Creek, Roebuck Bay, Broome, WA 08.00 to 09.30 on 4 May 2000.

Species	**Observation period**							
	Pre - 08.00	0.800-08.15	08.00-08.30	08.30-08.45	08.45-09.00	09.00-09.15	09.15-09.30	Total
Black-tailed Godwit			130	80				210
Bar-tailed Godwit				2111	30			2141
Whimbrel				1				1
Eastern Curlew				13	24			37
Common Greenshank	3				4			7
Grey-tailed Tattler			30	46				76
Ruddy Turnstone			20	85	10			115
Red Knot			20	200	76			296
Great Knot			680	7667	260	3		8610
Red-necked Stint	135		2000	3902	250	1630	50	7967
Curlew Sandpiper				2220	113	100	200	2633
Grey Plover	6		50	37				93
Greater Sand Plover				500	130			630
TOTAL	144		2930	16862	897	1733	250	22816

Although several species were present that were not observed in arriving flocks. However, subsequent ground counts revealed their presence (Table 2). Notable amongst these was the number of Asian Dowitcher *Limnodromus semipalmatus* and Broad-billed Sandpipers *Limicola falcinellus.* Also present in small numbers were Lesser Sand Plover *Charadrius mongolus*, Grey-tailed Tattler *Heteroscelus brevipes*, Whimbrel *Numenius phaeopus* and Ruddy Turnstone *Arenaria interpres*.

Although Black-tailed Godwit *Limosa limosa* and Grey Plover were not reported from beach counts conducted on 3 and 4 May 2000, their presence in the claypan indicate that they may be utilising this area exclusively as a roost during the non-breeding

Table 2. Wader species only observed from counts of flocks roosting on a claypan behind the mangroves near Little Crab Creek, Roebuck Bay, Broome, WA on 4 May 2000.

Species	**Time**
	09.15-09.30
Asian Dowitcher	30
Terek Sandpiper	2
Broad-billed Sandpiper	104
Red-capped Plover	30
Lesser Sand Plover	20
Australian Pratincole	2

Red-capped Plover *Charadrius ruficapillus* were not observed prior to the commencement of the count but it seems likely that this species uses the area on a more permanent basis and the birds counted resulted from local tide induced movements.

Two Australian Pratincole *Stiltia isabella* were observed flying over the site but did not stop at the clay pan.

The majority of Black-tailed Godwit and Grey Plover arrived in the 15 minutes prior to the majority of birds (Table 3). This suggests that they leave directly from the mudflats. Red-necked Stints were the first species to arrive at the claypan and had the greatest range of arrival times. The majority of birds arrived in the period 08.30 to 08.45 (Table 3). This was the same time as the majority of all waders (74 %) arrived (Table 3).

At 08.00, Red-necked Stints were observed actively feeding along the edges of the claypan but by 08.30, most were roosting. Curlew Sandpipers, Broad-billed Sandpiper and Asian Dowitcher were also observed feeding. On arrival at the claypans the majority of bird species roosted immediately with only a very small number bathing and preening.

Table 3. The percentage of each wader species arriving each 15 minutes to roost on a claypan behind the mangroves near Little Crab Creek, Roebuck Bay, Broome, WA 08.00 to 09.30 on 4 May 2000.

Species	**Observation period**							
	Pre-08.00	08.00-08.15	08.15-08.30	08.30-08.45	08.45-09.00	09.00-09.15	09.15-09.30	Total %
Black-tailed Godwit			61.9	38.1				100
Bar-tailed Godwit				98.6	1.4			100
Whimbrel				100				100
Eastern Curlew				35.1	64.9			100
Common Greenshank	42.9				57.1			100
Grey-tailed Tattler			39.5	60.5				100
Ruddy Turnstone			17.4	73.9	8.7			100
Red Knot			6.8	67.6	25.7			100
Great Knot			7.9	89.0	3.0			100
Red-necked Stint	1.7	5.0	20.1	49.0	3.1	20.5	0.6	100
Curlew Sandpiper				84.3	4.3	3.8	7.6	100
Grey Plover	6		53.8	39.8				100
Greater Sand Plover				79.4	20.6			100
TOTAL (%)	0.6	1.8	11.1	73.9	3.9	7.6	1.1	100

DISCUSSION

The utilisation of claypans that are either rarely or regularly filled with salt, brackish or fresh water behind the Crab Creek Mangroves in Roebuck Bay has long been speculated. Jessop & Collins (2000) reported the use of these areas by waders during extreme weather conditions. It is also not uncommon for waders to roost in similar areas within the flyway. Two of the authors (PC and RJ) have witnessed large numbers of Great Knot, Red Knot and Dunlin utilising salt and brackish waters behind a sea wall for roosting in Korea. What is problematical up until recent times is where the majority of birds are going. Some birds have been found in a variety of places that are suitable for apparently short periods of time, however it is not known if these areas remain suitable and for how long. The discovery of this area that appears to be regularly inundated by tides of 8 metres and over would indicate that this could be a regular area for roosting. It may also be a regular feeding area for small waders.

It may be that the heavy rains in the previous months increased the attractiveness of this area for waders and that the use of these claypans is unusual. At Anna Plains/80 Mile Beach, where large numbers of waders were also seen leaving the shore before high tide to areas of flooded plain inland, this is almost certainly the case. This phenomena has not been previously recorded . An aerial survey of this area did not reveal any large numbers of waders inland but the area was very large and flocks of waders would be easily overlooked. It is obvious from this study that waders of a several species will leave their normal roost site on ocean beaches and use inland sites for roosting or feeding.

The question remains as to why these birds roost, and in some cases, feed in these areas when the beaches around the northern shores of Roebuck Bay are suitable for roosting on normal daytime tides. Certain species, such as Red-necked Stint and Curlew Sandpiper regularly use fresh and brackish water for feeding and the presence of four Curlew Sandpiper juveniles with orange leg flags on may indicate that this type of area is favoured by young birds from the south. The reason why larger species, that are normally associated with coastal roost sites, choose this area is more difficult to explain. Several theories have been suggested: the most popular being the safety factor either from the increased disturbance by tourists during the dry season or from the many species of avian raptor that patrol the beaches. It may be that this type of roost site is the most favoured and that beaches are a secondary choice. If this is the case, presumably adult birds returning from the north would favour these sites and displace the non-breeding birds during the Austral summer. If this is true, this finding could have implications for the accuracy of count and age structure data. A very useful exercise would be to count this area again on southward migration and during January/February when all the adults should have returned. If this area is unfavourable, an aerial survey to find suitable areas should be undertaken.

ACKNOWLEDGEMENTS

The authors would like to thank members of the AWSG June 2000 Wader Expedition who provided funds for the hire of the helicopter and Pat of Fitzroy Helicopters.

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THE LOW TIDE DISTRIBUTION OF EASTERN CURLEW ON FEEDING GROUNDS IN MORETON BAY, QUEENSLAND

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ABSTRACT

We assessed the broadscale distribution of Eastern Curlew among tidal flats within Moreton Bay in order to identify important intertidal feeding habitat. Low tide surveys were conducted with the help of 60 volunteers who counted at 160 sites during summer 1998-99 and winter 1999. A site typically comprised a section of tidal flat from high water to low water, or a sandbank or banks. Sites varied in size (0.68 - 474 ha), substrate, topography, and other features, and covered approximately 41.3% (9,500 ha) of the intertidal habitat within Moreton Bay.

There was a high and significant correlation (P<0.0005), between the site counts on different days within a month and different months within a season, across all sites. Winter count numbers totalled about 25% of summer counts, and the pattern of variation in numbers across sites was generally similar to that seen in summer. The within-season constancy of Eastern Curlew numbers across sites suggests that short surveys can give reliable results. Eastern Curlew densities (numbers.ha^{-1}.site^{-1}) also showed a strong correlation between summer and winter counts, and sites supporting high abundances of Eastern Curlew also frequently supported high densities. Key areas in terms of Eastern Curlew abundance and density were Lota, North Stradbroke Island, Moreton Island, Fisherman Islands, Hays Inlet, Deception Bay, and Pumicestone Passage.

INTRODUCTION

The conservation of shorebirds whose populations are declining, depends on developing an adequate understanding of what types of intertidal environment are utilised by the birds on their feeding grounds (Watkins 1993). To date, most shorebird surveys in Australia have focussed on counts of roost sites (Close & Jaensch 1981; Thompson 1989; Houston & Mitchell 1997; Wilson 2000). A few studies have counted shorebirds in their intertidal feeding grounds (Garnett 1986; Thompson 1990a&b; Driscoll 1993; Congdon & Catterall 1994; Gill & Crawford 1999).

The Eastern Curlew, *Numenius madagascariensis*, has declined in numbers in Australia over recent decades (Close & Newman 1984) and is a species of particular concern (Garnett 1992; Watkins 1993). Many Eastern Curlew spend their non-breeding season on feeding grounds in eastern Australia (Driscoll, 1997). Moreton Bay is a Ramsar site in eastern Australia that supports over 15 percent of the world's population of Eastern Curlew (estimated at 31,000) during the summer months and is therefore of international importance for the species (Watkins 1993; Thompson 1993a; Driscoll 1997). Juvenile Eastern Curlew require three years to mature and some individuals may use feeding grounds in Moreton Bay year round during this period (Driscoll & RAOU 1993; Wilson 2000). Moreton Bay is also the centre of Australia's fastest growing region for human population and there is some evidence that foreshore conditions are impacting on the local distribution of shorebirds in the Bay (Thompson 1993b). It is therefore particularly important to develop an understanding of which areas are the main feeding grounds of Eastern Curlew and what factors affect their quality and use by the birds.

The aim of the present study was to assess the broad scale distribution of Eastern Curlew among tidal flats within Moreton Bay, and to evaluate the difference in low tide count numbers across different days, months and seasons.

METHODS

Moreton Bay extends north east and south east of the city of Brisbane, in south east Queensland (27° 20' 01" S, 153° 17' 35" E). At 300,177 ha, it is one of the largest estuarine bays in Australia, enclosed on its western side by the mainland and on its eastern side by two of the largest sand islands in the world (Moreton and North Stradbroke Islands)

(Blackman & Craven 1999) (Fig. 1). Moreton Bay extends approximately 132 km along the coast in a north-south direction and reaches a maximum width and depth of 40 km and 40 m respectively (Blackman & Craven 1999). Salinity is highest on the eastern side of the Bay because the western side receives an input of freshwater from coastal drainage (Young 1978). The majority of this drainage comes from the Coomera, Logan, Brisbane, Pine and Caboolture rivers (Blackman & Craven 1999). Moreton Bay contains a complex system of intertidal flats totaling 23,000 ha at low tide (Blackman & Craven 1999). Substrate types within the bay are diverse and have been broadly categorised into sand, coral, sandy mud, and mud (Young 1978). Moreton Bay supports eight mangrove species and extensive seagrass meadows in certain areas (Hyland *et al.*. 1989; Blackman & Craven 1999).

The Eastern Curlews' use of feeding grounds in Moreton Bay was assessed during a series of low tide surveys covering 160 intertidal flats (sites). Sites spanned a north-south distance of approximately 115 km, from the northern end of Pumicestone Passage to the southern Moreton Bay islands, and the sites varied in area from 0.68 to 474 ha. Individual sites typically comprised a section of intertidal flat from high water to low water, or a sandbank or collection of banks at low tide. Sites were defined on the basis of convenience of access and survey logistics. Site locations were predetermined to achieve maximum coverage of intertidal flats with varying characteristics (size, substrate and topography). An effort was made to delineate sites based on natural disjunctions. On the western side of the Bay, observers using cars and gaining access from the shore, covered the majority of sites, many of which were small in area. On the eastern and southern islands, along inlets, creeks, and rivers, and in Pumicestone Passage, the majority of sites were surveyed by boat and some sites covered very large areas.

A total of approximately 9,500 ha or 41.3% of the intertidal habitat within Moreton Bay was surveyed. The intertidal area covered within major sections of the bay were: the north west (37%)(western bay sites from Pumicestone Passage to the Brisbane River), the south west (35%) (western bay sites from The Brisbane River to Redland Bay), the east islands (25%) and the south islands (3%) respectively. In the western section of the Bay, where intertidal habitat coverage was the greatest, sites formed an almost continuous length of coastline. The main gaps in coverage were confined to the eastern and southern bay islands and the northern half of Pumicestone Passage.

Counts of Eastern Curlew were conducted on eight days, four in each of summer and winter. Summer counts took place during one weekend in November 1998 (28 & 29) and one in January 1999 (30 & 31). Winter counts were also on two weekends: 26 & 27 June and 24 & 25 July 1999. For various reasons some sites could not be surveyed on the allocated count days. These sites restricted to four areas: Pumicestone Passage, Peel Island, Moreton Island, and North Stradbroke Island and were surveyed as close as possible to the allocated days. During summer and winter respectively, 125 and 108 of the 160 sites were surveyed on the allocated count days. Data were collected by 60 experienced volunteers. Counts were made using spotting scopes, of at least 20x magnification.

Eastern Curlew densities (number of birds.ha^{-1} of feeding ground) were calculated for most sites (128 of 160). A digital map, in the form of a raster image, was obtained from the Australian Hydrographic Office of the Royal Australian Navy. This map was set up as a base layer within a GIS with MapInfo. Hard copy maps showing the boundaries of the sites surveyed in this study were then used to digitise the site areas on screen. The intertidal area was defined at its potential maximum, from highest water to zero datum.

RESULTS

During summer, over 2000 Eastern Curlew were counted on each of the four days, compared with an average of 600 in winter (Table 1). Eastern Curlew numbers at individual sites in summer varied from zero to 160, with differences in flat area accounting for some of this variation.

Figure 1 shows the relationship between counts on different days and different months using a logarithmic scale to separate the large number of low counts (on smaller flats). The relative numbers of Eastern Curlew on consecutive days corresponded closely ($r = 0.89$-0.95; $P<0.0005$ for all; Figure 1A-D). There was also a high and significant correlation ($r^2 = 0.87$ and 0.92; $P<0.0005$), between counts in different months within both seasons (Figure 1e,f).

Table 1. The total number of Eastern Curlew counted each day during the low tide survey of feeding grounds in Moreton Bay.

Summer survey		WINTER SURVEY	
Date of count	Number of Curlew	**DATE OF COUNT**	Number of Curlew
28/11/1998	2388	26/06/1999	528
29/11/1998	2357	27/06/1999	550
30/01/1999	2221	24/07/1999	661
31/01/1999	2080	25/07/1999	679
Summer mean	2261	Winter mean	604

The average summer count was also highly correlated with the average winter count (r = 0.79; $P<0.0005$). Approximately one quarter of the summer population occurred in Moreton Bay during the winter (Table 1) but there were some sites where the numbers of Eastern Curlew remained similar in summer and winter (Fig. 2). Table 2 shows the location, area and abundance for the 30 sites that supported the lowest and highest Eastern Curlew counts. Those sites where the count was low were generally relatively small in area when compared with those sites where the count was high (Table 2).

Calculations of the Eastern Curlew density (number of birds.ha^{-1} of tidal flat) provide some control over the effects of variation in site area. Winter and summer densities were significantly correlated ($P<0.0005$) although the relationship was weaker (r = 0.45) than the correlation in the counts. The Eastern Curlew density also decreased from summer to winter across the majority of sites, although there were some sites where it remained similar between the seasons (Fig. 3). There was one relatively small (16 ha) site, situated at Deception Bay, where the winter density was almost four times greater than the summer density (Fig. 3). With this site removed from the analysis the strength of the correlation between winter and summer densities was greater ($r^2 = 0.34$).

Table 3 lists the 30 sites that supported the lowest and highest Eastern Curlew densities in summer. Of the 30 sites that had the lowest Eastern Curlew count (Table 2), 21 also appeared in the 30 sites that had the lowest densities (Table 3). Locations that supported both low counts and densities included Redland Bay, Victoria Point, Cleveland, Wynnum, Brisbane Airport, Shorncliffe, and Redcliffe. In comparison, 17 of the 30 sites that supported the highest counts (Table 2) also appeared in the 30 sites that supported the highest densities (Table 3). Locations that supported both high counts and densities included Lota, North Stradbroke Island, Moreton Island, Fisherman Islands, Hays Inlet, Deception Bay, and Pumicestone Passage.

DISCUSSION

Distribution of Eastern Curlew among intertidal feeding flats in Moreton Bay.

Almost half of the total Eastern Curlew population of south east Queensland, estimated at approximately 5,000 (Driscoll 1997), were counted during each of the low tide surveys. The constancy of Eastern Curlew numbers across sites suggests that short surveys (such as one count per season instead of four) can give useful results. Some tidal areas supported considerably higher counts and densities of Eastern Curlew than others, and the fact that a substantial proportion of the sites with high counts also had high densities (and likewise for low counts) indicates that the variation in Eastern Curlew numbers across sites was not due only to the effect of flat size.

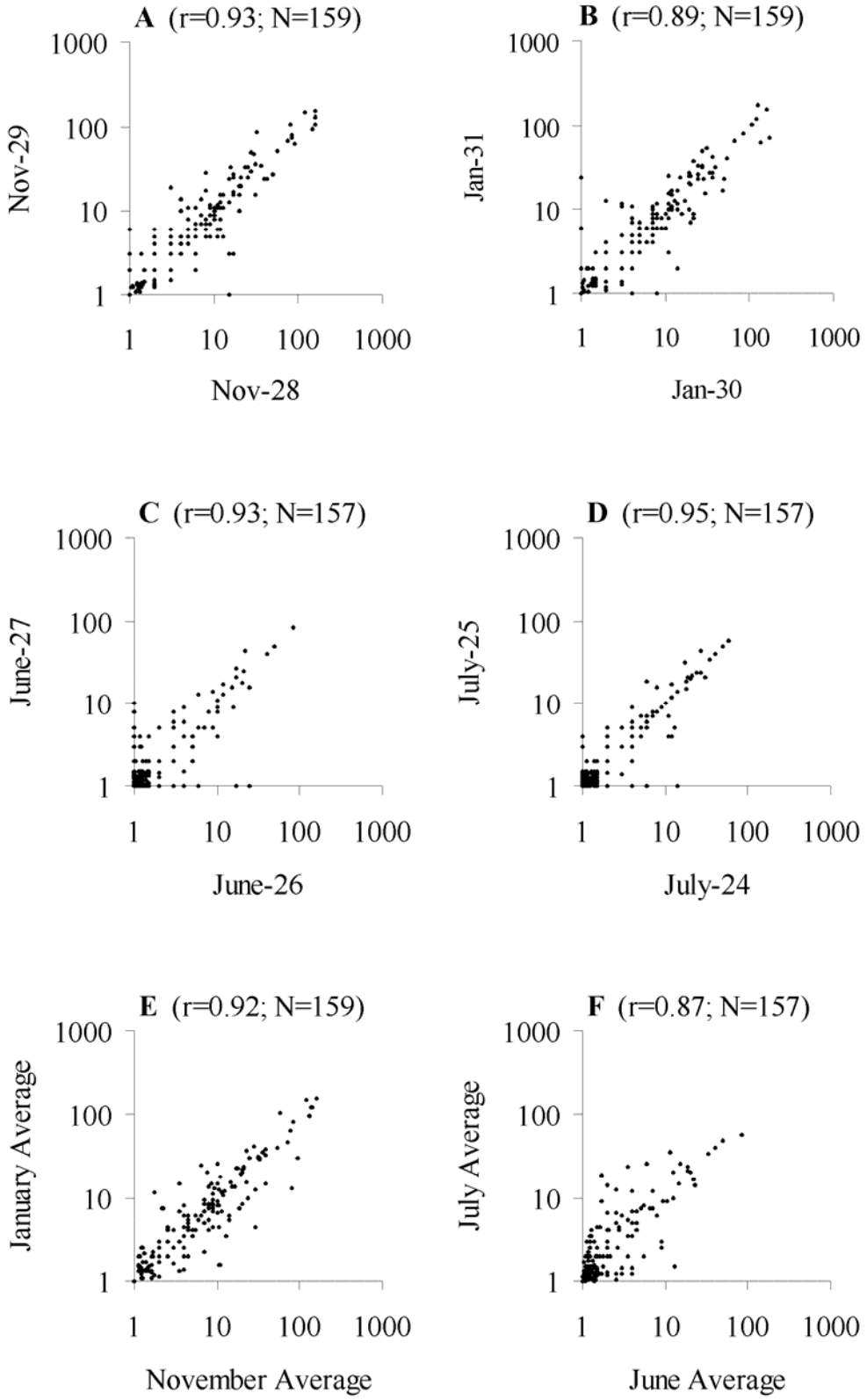

Figure 1. Correspondence between counts across all sites (each a point on the graph) comparing: consecutive days within months (A-D), and different months within seasons (E-F). r is Pearson's correlation coefficient.

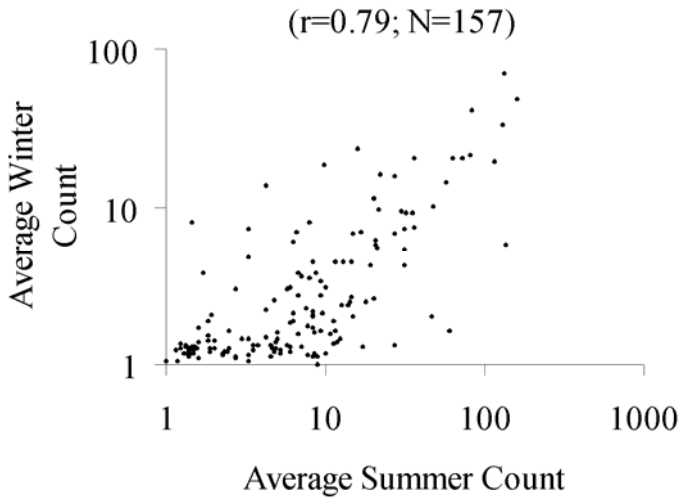

Figure 2. Relationship between the mean (of four) curlew counts in summer versus winter, across 157 sites. r is Pearson's correlation coefficient.

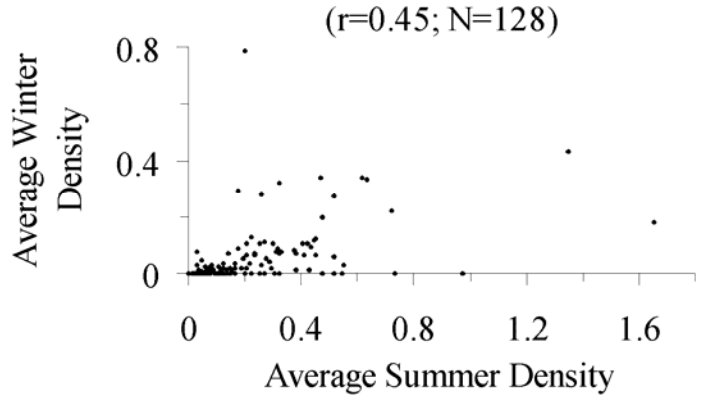

Figure 3. Relationship between the mean (of four) curlew density estimates in summer versus winter, across 128 sites. r is Pearson's correlation coefficient.

Why these areas are important for Eastern Curlew cannot be inferred from the count data obtained in this study. The distribution of shorebirds may be influenced by both the substrate type (Quammen 1982; Kelsey & Hassall 1989; Nehls & Tiedemann 1993; Yates *et al.* 1993), and disturbance by humans (Le Drean-Quenechdu *et al.* 1995; Bhuva & Soni 1998). These two factors are likely to be important determinants of the distribution of Eastern Curlew in Moreton Bay.

The substrate type at the preferred sites may offer a greater density and/or harvestability of prey. At all of the key areas for Eastern Curlew within Moreton Bay, the substrate was either sand or sandy mud as opposed to mud or coral. The particle size composition of a substrate affects its invertebrate biomass (Sanders 2000) and penetrability (Kelsey & Hassall 1989). The presence of coral would certainly reduce substrate penetrability and may be the reason why low abundances and densities of Eastern Curlew were recorded at sites where coral occurred. Quammen (1982) found that shallow-feeding shorebirds have a greater feeding efficiency on muddy substrates with little sand. Large, deep-feeding shorebirds such as Eastern Curlew are likely to have different preferences. Soft mud may be difficult for large shorebirds to walk through. The results of these surveys suggest that the distribution of seagrass may also be an important factor as all of the key areas except one, Hays Inlet, support dense patches of seagrass, although Congdon & Catterall (1994) found no association

Table 2. The 30 sites that supported the lowest and highest numbers of Eastern Curlew, ranked by mean count.

Low Counts of Eastern Curlew			High Counts of Eastern Curlew		
Location	Area (ha)	Count	Location	Area (ha)	Count
Coochiemudlo Id.	12	0.0	Ningi Ck. 4	31	19.3
Hays Inlet 1	1	0.0	N. Stradbroke Id. 3	43	19.5
Redcliffe 2	16	0.0	Pumicestone Passage 2	63	19.8
Redcliffe 3	5	0.0	Cox Bank	187	20.0
Redcliffe 5	3	0.0	Ningi Ck. 1	44	20.8
Redcliffe 6	5	0.0	Pumicestone Passage 6	45	21.3
Redland Bay 4	6	0.0	Deception Bay 2	103	26.0
Shorncliffe 2	22	0.0	Victoria Pt. 2	117	26.3
Aquatic Paradise	1	0.0	N. Stradbroke Id. 4	82	26.5
Victoria Pt. 1	5	0.0	Deception Bay 5	138	28.8
Cleveland Pt.	12	0.3	Wellington Pt.	246	29.8
Redcliffe 4	3	0.3	Thorneside 1	69	30.0
Redland Bay 3	11	0.3	Deception Bay 7	209	30.3
Wynnum	6	0.3	N. Stradbroke Id. 8	67	30.5
Brisbane Airport 4	2	0.5	Pumicestone Passage 9	96	30.8
N. Stradbroke Id. 5	16	0.5	Hays Inlet 3	105	34.3
Ningi Ck. 2	8	0.5	Lota 1	126	34.8
Peel Id. 1	4	0.5	Hays Inlet 2	57	35.0
Raby Bay 2	24	0.5	Moreton Id. 1	474	38.0
Redcliffe 7	26	0.5	Peel Id. 5	357	39.3
Redland Bay 1	4	0.5	Fisherman Id. 4	106	45.5
Manly Boat Harbour	2	0.8	Deception Bay 1	45	61.3
N. Stradbroke Id. 2	10	0.8	Fisherman Id. 3	297	70.5
Redcliffe 1	25	0.8	N. Stradbroke Id. 7	191	81.0
Shorncliffe 1	26	0.8	Moreton Id. 3	469	82.0
Redland Bay 1	5	1.0	Fisherman Id. 2	280	115.0
Brisbane Airport 3	27	1.3	Pumicestone Passage 10	316	127.8
Cleveland Pt. 1	46	1.5	Pumicestone Passage 4	255	132.3
Luggage Pt. 1	120	1.5	Fisherman Id. 1	353	133.8
Raby Bay 1	3	1.5	Moreton Id. 4	218	156.5

between Eastern Curlew density and seagrass occurrence at a local scale.

Moreton Bay is heavily utilised by both recreational and professional bait harvesters and fishers and human interference reduces the feeding efficiency of shorebirds (Smit *et al.* 1987; de Boer & Longamane 1996; Lord *et al.* 1997). De Boer & Longamane (1996) noted a 34 percent reduction in foraging time for Whimbrel due to human presence. Within all of the key areas, there is feeding habitat that is relatively inaccessible to humans. In areas where large scale professional bait harvesting takes place, such as Fisherman Island, the area is sufficiently large to provide some habitat well away from the commercial activities. Further research designed to elucidate the factors affecting Eastern Curlew distribution in Moreton Bay at different spatial scales is under way as part of the present project.

The utility of counts of feeding birds versus roost counts

The total numbers of Eastern Curlew counted on feeding grounds during this study were comparable to the numbers counted on roost sites during independent surveys conducted by the Queensland Wader Study Group (QWSG). Counts on intertidal flats gave similar results to roost counts for both total numbers of Eastern Curlew and summer/winter differences in numbers (Table 1; Driscoll 1997). Other studies have also noted a high correspondence between counts of shorebirds at feeding and roosting sites (Dominguez 1986; Yates & Goss-Custard 1991). However, this result is not always to be expected (Kirby *et al.* 1988). The winter population of Eastern Curlew in

Table 3. The 30 sites that supported the lowest and highest densities of Eastern Curlew, ranked by density. Mean count at each site is shown for comparison.

Low Density of Eastern Curlew				High Density of Eastern Curlew			
Location	Area (ha)	Density ($N.100ha^{-1}$)	Count	Location	Area (ha)	Density ($N.100ha^{-1}$)	Count
Aquatic Paradise	1	0.0	0.0	Empire Pt. 2	22	32.3	7.0
Coochiemudlo Id.	12	0.0	0.0	Manly Boat Harbour	2	32.4	0.8
Hays Inlet 1	1	0.0	0.0	N. Stradbroke Id. 4	82	32.4	26.5
Redcliffe 2	16	0.0	0.0	Hays Inlet 3	105	32.6	34.3
Redcliffe 3	5	0.0	0.0	Thorneside 2	22	37.7	8.3
Redcliffe 5	3	0.0	0.0	Pumicestone Passage 3	48	37.8	18.0
Redcliffe 6	5	0.0	0.0	Fisherman Id.1	353	37.9	133.8
Redland Bay 4	6	0.0	0.0	Pumicestone Passage 10	316	40.5	127.8
Shorncliffe 2	22	0.0	0.0	Fisherman Id. 2	280	41.1	115.0
Victoria Pt. 1	5	0.0	0.0	N. Stradbroke Id.7	191	42.5	81.0
Luggage Pt. 1	120	1.3	1.5	Fisherman Id. 4	106	43.1	45.5
Redcliffe 7	26	1.9	0.5	Thorneside 1	69	43.6	30.0
Raby Bay 2	24	2.1	0.5	Pumicestone Passage 1	31	44.3	13.5
Cleveland Pt.	12	2.2	0.3	N. Stradbroke Id. 3	43	45.2	19.5
Redland Bay 3	11	2.3	0.3	N. Stradbroke Id. 8	67	45.2	30.5
Bramble Bay 4	84	2.7	2.3	Pumicestone Passage 6	45	46.8	21.3
Shorncliffe 1	26	2.9	0.8	Ningi Ck. 1	44	47.5	20.8
N. Stradbroke Id. 5	16	3.1	0.5	Pumicestone Passage 5	17	47.7	8.0
Redcliffe 1	25	3.1	0.8	Empire Pt. 1	10	51.8	5.0
Cleveland 1	46	3.3	1.5	Pumicestone Passage 11	13	51.8	6.8
Cleveland 2	144	3.5	5.0	Pumicestone Passage 4	255	51.8	132.3
Peel Id. 7	58	3.9	2.3	Raby Bay 1	3	54.4	1.5
Bramble Bay 5	99	4.3	4.3	Pumicestone Passage 13	9	55.1	4.8
Bramble Bay 2	45	4.4	2.0	Hays Inlet 2	57	61.3	35.0
Wynnum	6	4.4	0.3	Ningi Ck. 4	31	63.0	19.3
Peel Id. 4	88	4.5	4.0	Moreton Id. 4	218	71.9	156.5
Brisbane Airport 3	27	4.7	1.3	Lota 2	9	73.3	6.8
Bramble Bay 3	109	4.8	5.3	Ormiston	12	97.6	12.0
Nudgee Beach	151	5.3	8.0	Deception Bay 1	45	134.9	61.3
Kippa Ring	127	5.7	7.3	Ningi Ck. 3	4	165.3	6.8

Moreton Bay remained at approximately 25% of the summer population (Table 1). This figure is not only supported by roost counts for Moreton Bay (Driscoll 1997), but is also similar to the percentage of winter to summer numbers obtained for Eastern Curlew elsewhere in Queensland (Houston & Mitchell 1997) and for other shorebirds that breed in the northern hemisphere (Thompson 1990a).

Counts on feeding grounds are useful for different reasons than counts on roosts. At roost sites, shorebirds are generally tightly packed into a relatively small area. In comparison, on feeding grounds, they are usually only loosely aggregated. Therefore, due to their spatial distribution, birds on roost sites may be harder to count accurately. Zwarts (*et al.* 1998) quantified an error of 37% in birds counted at roosts. This figure was not compared with counts on feeding grounds, but when compared to birds counted in flight, the error fell to 17% (Zwarts *et al.* 1998). Although there may be a reduced error associated with counting birds on feeding grounds, due to their relatively sparse and wide distribution, a greater area must be surveyed to census a significant proportion of the total population. Therefore, roost counts may be preferable for population monitoring over years because less time and effort is involved to survey a significant proportion of the population. However, surveys of roost sites are of limited usefulness in identifying key intertidal feeding habitat. Although roost counts do provide an estimate of the numbers of birds that feed on nearby intertidal areas, low tide counts are more appropriate for assessing the quality of these feeding habitats.

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WADERS AT LAKE MCLARTY, WESTERN AUSTRALIA

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ABSTRACT

The comprehensive RAOU waterbird survey 1981-1985 (Jaensch *et al.* 1988) included data from Lake McLarty, Western Australia. Since then, the ecology of the lake and its utilization by waders has changed drastically. We present the results of an extensive study of the waders of Lake McLarty conducted from 1996 to 2000. We link the results of the original RAOU survey to the present findings, how the patterns of wader use have changed since the early 1980s. Historical and current information show that an extraordinary number and variety of waders visit this ephemeral lake during the summer months. No less than 36 species of wader have been recorded. Several species occur in sufficient numbers to make this lake a site of national and international significance according to the Ramsar Convention criteria. We show the seasonal and annual fluctuations in key wader populations at the lake and how these change with water levels. Lake McLarty is still a relative pristine wetland and concerns are expressed about the impact nearby development may have on the wader populations. This study provides updated count data that can be used as a reference source to assist in the preservation of Lake McLarty.

INTRODUCTION:

Lake McLarty (32° 42' S 115° 43' E) is located within the Swan River coastal plains region of Western Australia, lying immediately to the east of the Harvey River estuary (Fig.1). It forms an integral part of the Peel-Yalgorup wetland complex and is the principal lake in the Lake McLarty subsection of this system (Jaensch & Lane 1993). The adjacent region was subject to farming development soon after European settlement and is currently extensively cleared and devoted to cattle, some of which still range freely through the Lake McLarty reserve.

The waders and waterbirds of Lake McLarty were surveyed as part of a extensive regional study in 1981-85 (Jaensch *et al.* 1988). However, the ecology of the lake has undergone significant modification since these surveys. The habitat has been transformed from one of extensive *Typha* beds and *Baumea* sedge margins to one of essentially open water and mudbanks. This has had a major impact on the birdlife that use the lake. Some species, such as rails, have been adversely effected but others, including the majority of waders, have been distinctly advantaged. The 1981-1985 report (Jaensch *et al.* 1988) recorded 18 wader species with the highest single species count being 800 Black-winged Stilt.

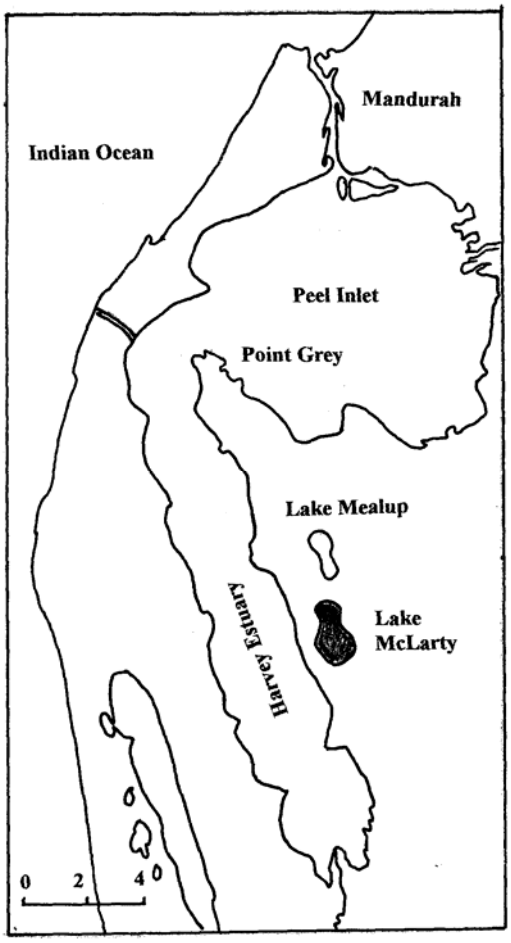

Figure 1. Location of Lake McLarty, southwestern Western Australia.

Whatever the cause, the recent ecological changes have resulted in significant modification to the status of many species. For example, Wood Sandpiper and Long-toed Stint were more common during the 1980s, but conversely those species preferring more open conditions (Black-winged Stilt, Red-necked Stint and Curlew Sandpiper) are more common now.

Data collected during the this study shows that the total number of waders has increased markedly, to the extent that for some species, this site now qualifies as one of international importance. In order to record these changes and update the baseline data on this important wetland, extensive surveys were undertaken from 1996 to 2000.

DESCRIPTION

Lake McLarty is a shallow oval freshwater lake with a gently sloping bottom. The open water covers a maximum area of approximate 2.1 km (N-S) by 1.25 km (E-W). The lake lies in a natural drainage depression within the rather flat coastal plains, and is isolated from the eastern shoreline of the Harvey River estuary (0.6 kilometres away) by a vegetated fossil dune ridge.

The actual bed of the lake comprises a thin layer of silt which develops into a somewhat thicker layer (40 mm maximum) of silty mud at the northern end, overlaying a firm sand; with shell fragments substrate. Little bottom vegetation was noted until autumn 1997, when extensive growths, predominantly of *Lemmna sp*. were evident. Whether this was an actual variation or whether the virtual absence of Coots *Fulica atra* over the period (*c*.4000 in previous seasons) had drastically reduced grazing is not known.

The emergent vegetation of the lake previously comprised extensive stands of Typha (*Typha orientalis*) in the open water areas with broad swathes of Baumea (including *Baumea articulata*) sedges along the margins. This was still the case during the 1981-1985 study (Jaensch *et al.* 1988) to the point where Jaensch (1993) considered the overgrowth of the lake by Typha a possible threat. In contras,t the lake is now almost barren. Only impoverished and still dwindling fragments of Typha still occur and the sedge margins have essentially disappeared (although some regrowth strikes recur temporarily as the water recedes in late summer) (Figs 2 and 3).

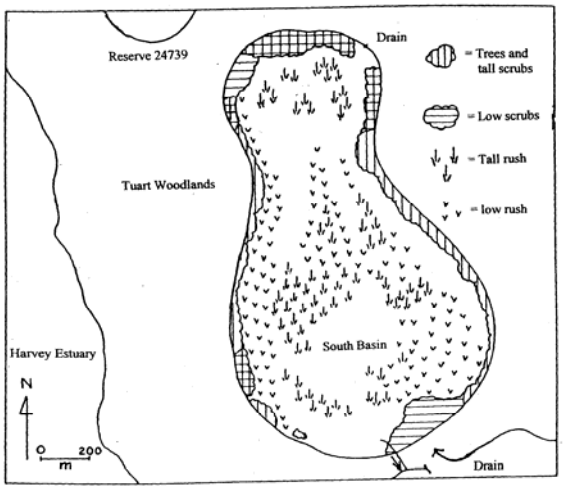

Figure2. Distribution of *Typha* at Lake McLarty in 1985.

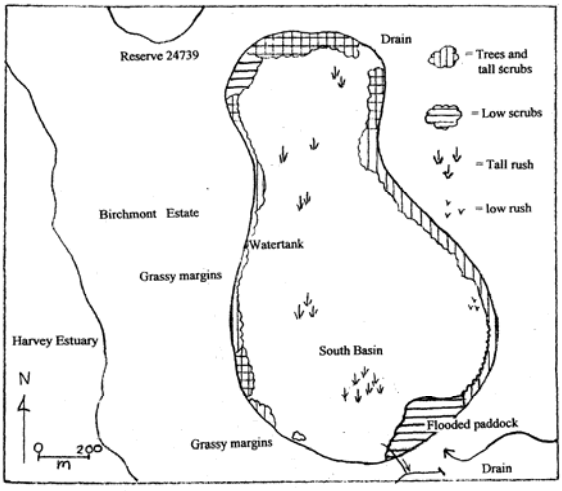

Figure 3. Distribution of *Typha* at Lake McLarty in 2000.

Since the reduction in sedges, the newly exposed, drying lake bed is vegetated only by sparse/short ephemeral grasses and weeds, but even those don't extend to the central lake bed area. Some 80-90% of the high water margin comprises dense stands of Melaleuca (including *M. teretifolia and M. raphiophylla*), with the remainder developed into pasture (along the southwestern corner) and into eucalypt parkland along the mid-western shore.

HYDROLOGY

Lake McLarty is located in an area of mainly winter rainfall (approx. 880 mm) and high, mainly summer surface evaporation rate (approx. 1800 mm). A combination of conditions that is responsible for the ephemeral nature of many of the local lakes. Lake McLarty itself is only marginally ephemeral, drying out for 1-3 months during the late summer and

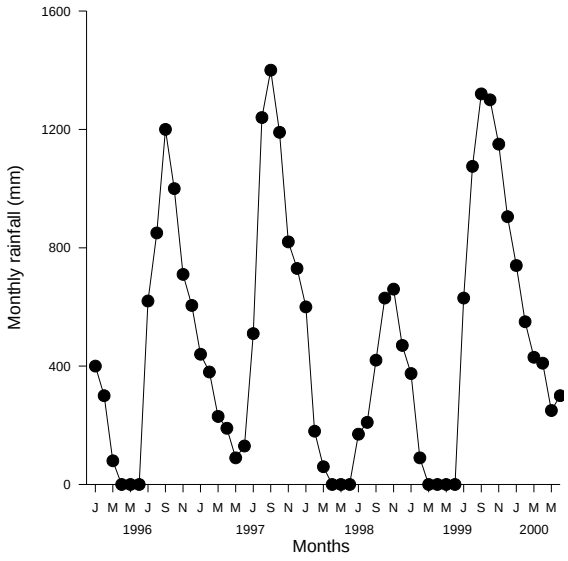

Figure 4. The mean water level at Lake McLarty each month between January 1996 and June 2000.

autumn months. This pattern occurs in most years and the rate and timing of recharge follow the pattern of local rains. The lake receives inflow from both direct surface runoff and an increase in the general ground water table. Currently, there are no actual streams flowing into the lake. Although the drainage ditch immediately to the south has been breached and diverted. A drainage channel leading to the estuary occurs in the south western corner. This channel has recently been modified as part of the subdivision development but it does not appear to have changed the previous overflow level. Except for this latter change, the current hydrological regime has existed since well before the 1981-1985 survey period and cannot have contributed to the recently observed modification to the ecology of the lake.

The maximum water depth of the lake during the study period was 1.4 m in 1996 but varies greatly. The date at which the peak level occurs also varies (Fig.4). In most years it occurs in the late August-late September period, but in 1998, it did not occur until late October. Even at the lowest observed peak level, the lake floods well back into the *Melaleuca* fringe and inundate the pastures immediately to the south.

From October onwards, rainfall generally decreases markedly, becoming in most years little more than random thunderstorms, insufficient to provide further inflow. This, in combination with high summer temperatures that cause high surface evaporation and a general lowering of the ground water table, results in a gradual decrease of the water level. In typical years, drying out occurs mid March. However, in some years the summer rains are more pronounced and are sufficient to retard the date of drying out or to prevent it altogether, especially if following a high peak level in winter/autumn.

For example, the January 2000 rains were sufficient to maintain a high water level (approx. 70% of the maximum open water area) through to the onset of the following winter rains. This event represented the highest summer/autumn lake water levels occurring during the survey period.

1996-2000 SURVEYS

Regular, although somewhat seasonally biased, surveys were carried out from mid 1990 until 1995. After 1996, observations have been much more regular and comprehensive. Tony Kirkby and Michael Craig carried out full species counts at monthly intervals with additional observations by John Darnell and Colin Davis.

During the peak wader season this often extended to weekly counts. These surveys are still maintained but for the purpose of this report taken up to June 2000. Data has been incorporated from various other publications and personal observations. This data has been compared with that collected during the 1981-1985 survey because of the modifications in the habitats of the lake. The actual counts were conducted in progressive steps, working from south to north along the east side of the lake accurately counting all waders present and taking any movements into consideration.
The surveys were generally conducted from dawn until late morning.

Although most of these surveys were carried out at weekends, others were deliberately undertaken during weekdays to investigate and eliminate possible variation due to disturbances from the Harvey/Peel estuary area. Activities considered included power boats, jet-skis, fishing, crabbing and other recreational activities. Thus, from January 1990 to December 1995 33 counts were made and from January 1996 to June 2000 there were 87 counts.

Despite the proximity of the Harvey River estuary and Peel Inlet system, waders did not appear to move between the lake and adjacent estuary. The wader population of the lake seemed to be resident, with little variation in numbers and species being witnessed. There were no records of waders departing or returning to roosting or loafing areas.

Harassment by raptors seemed to only move the birds to another feeding location within the lake. It certainly did not drive them from the lake.

INVERTEBRATES

In order to provide a better understanding of the overall ecology of the lake, including reasons for the recent modification of the habitat, parallel studies have been undertaken. These were mainly directed towards water quality - salinity, nutrient levels, pH values - and invertebrate fauna. The importance of an invertebrate study was recognized early on as they provide the biomass required to support the wader populations. Although some recent work has been carried out on water quality (Storey *et al.* 1993), there have been few studies of invertebrates.

Some preliminary invertebrate sampling was done on 4 and 27 February 2000. Five sampling points were chosen, the first and second in the shallows opposite the information board on the western shore, the third in mid depth (about 50-60 cm) on the way to some tall rushes, and the fourth and fifth at a stand of *Typha orientalis* near the centre of the lake.

Forty-six species of invertebrates were identified including seven species from the orders *Ostracoda*, *Zygoptera* and *Diptera*. The latter were considered key species in terms of their role in sustaining bird populations over the summer period. It suggests that the large numbrs of wader present is in part, due to the abundant life that exists in the shallow waters of the lake - namely chironomid larvae, dipteran larvae and ostracods (seed shrimps) (Davis 2000 in prep).

Table 1. Maximum total counts of waders at Lake McLarty, Western Australia.

Species	Maximum count	Breeding
Snipe species	1	-
Black-tailed Godwit	65	-
Bar-tailed Godwit	2	-
Whimbrel	2	-
Eastern Curlew	1	-
Marsh Sandpiper	142	-
Common Greenshank	204	-
Wood Sandpiper	112	-
Common Sandpiper	1	-
Grey-tailed Tattler	18	-
Ruddy Turnstone	1	-
Asian Dowitcher	1	-
Great Knot	2	-
Red Knot	13	-
Sanderling	1	-
Little Stint	1	-
Red-necked Stint	11500	-
Long-toed Stint	96	-
Pectoral Sandpiper	20	-
Sharp-tailed Sandpiper	4144	-
Curlew Sandpiper	3000	-
Broad-billed Sandpiper	2	-
Ruff	5	-
Black-winged Stilt	2439	-
Banded Stilt	*c* 1000	-
Red-necked Avocet	5468	-
Pacific Golden Plover	4	-
Grey Plover	2	-
Little Ringed Plover	1	-
Red-capped Plover	> 1500	Yes
Lesser Sand Plover	1	-
Greater Sand Plover	1	-
Black-fronted Dotterel	*c* 100	Yes
Red-kneed Dotterel	90	-
Banded Lapwing	2	-
Oriental Pratincole	10	-
TOTAL	29232	

RESULTS

A total of 36 species of wader have been recorded at Lake McLarty. Full results are tabulated in Table 1. The 1981-1985 surveys (Jaensch et al 1988) showed that Lake McLarty carried a good cross section of the south-western Western Australian coastal plain wader species. It showed that none were present in sufficient numbers to qualify it as a wetland of national and or international importance as defined in the Ramsar Convention. However, the results of the current study demonstrate that this locality is now of both national and international importance, qualifying on both categories for several species.

Palearctic shorebirds

For three species of palearctic migrants, Lake McLarty qualifies as being a site of international significance (supporting more than 1% of that species East Asian-Australasian flyway population) (Watkins, 1993). These are Red-necked Stint (2.5 % of the East Asian-Australasian Flyway population), Sharp-tailed Sandpiper (2.5 %) and Curlew Sandpiper (1.1 %).

These species also qualify automatically for listing under the category of national significance (holding more than 1% of the Australian population) (Watkins, 1993) and are joined in this category by three more species. These are Marsh Sandpiper (1.6 % of the total Australian population),.Common Greenshank (1.0 %) and Wood Sandpiper (1.9 %).

In addition to these species, this site regularly records nationally significant numbers of some of

the rarer species. Population counts of 20 Pectoral Sandpiper, 96 Long-toed Stint and 5 Ruff must rank amongst the highest single counts recorded in Australia reinforcing the value of Lake McLarty as a site of national importance.

In some species, Long-toed Stint, Wood Sandpiper and to a lesser degree Pectoral Sandpiper and Ruff, there has been a decline in numbers recorded over the last few years. This reduction has not been limited to this site. The former two species have shown a marked decline over the whole Swan Coastal Plains area. Several locations, such as Forrestdale Lake, Kogolup Lake and Thomsons Lake, where these species were regularly sighted in good numbers have similarly recorded far fewer if any of these species over the same period.

Not only is Lake McLarty important from the viewpoint of the total numbers of birds present, but also from the timing of the drying out period. Although this is variable (Fig. 4), in several of the years within the study period, low water levels and abundant food supply were maintained. These optimum conditions allowed migratory waders to build-up pre-departure body weight.

In some years these conditions would extend beyond the migrants departure date. This is in marked contrast with the majority of other local wetlands. The 2000 results have demonstrated however, that Lake McLarty cannot be viewed in isolation. In years of high water levels the lake cannot provide the required feeding areas and other lakes would have to fulfil this need.

Not all waders sighted at Lake McLarty are typical ephemeral wetland species. Some species seen would have originated from adjacent areas. Whimbrel, Eastern Curlew, Bar-tailed Godwit, Grey-tailed Tattler and Grey Plover occur in the Peel-Harvey estuary area and Ruddy Turnstone and Sanderling would have come from the groynes and coastal beaches. Occasional winter observations of Red-necked Stint, Curlew Sandpiper and Common Greenshank indicate that Lake McLarty acts as an overwintering site when suitable habitat is available. For example, on 17 June 2000; Red-necked Stint (300); Curlew Sandpiper (121), Greenshank (2), Black-tailed Godwit (2) were present.

Australian species

For two Australian resident species, this site qualifies as being of international significance (holding more than 1% of the total Australian/world population). These were Red-necked Avocet (5.1% of the Australian population) and Red-capped Plover (1.6 %). In common with all of the recorded Australian resident species these two are non-breeding visitors, although some of the latter regularly breed here. During the study period, Black-winged Stilt also maintained a fairly regular annual cycle of population variation, except when the lake dried out.

Red-necked Avocets show a similar summer peak but it is of quite short duration and regardless of the condition of the lake, few if any birds remain beyond April. The magnitude of their peak population is much more variable than that of the Black-winged Stilts. The maximum numbers obtained for 1994/1995 were 276 and for 1998/1999 were 560. On both occasions these follow a peak of *c.* 5000 birds in the preceding year. It is noted that coinciding with these figures, heavy cyclonic rainfalls had occurred across the inland (Goldfields) area of Western Australia. The ensuing flooding of many of ephemeral lakes in that area resulted in Banded Stilt breeding events. Red-necked Avocet also bred at several of these sites (R. E. Johnstone pers. comm.). Breeding activity continuing well beyond their normal late winter early summer breeding period. Eggs and downy chicks were still recorded in early/mid April. Such activity obviously precluded Red-necked Avocet arriving in large numbers at Lake McLarty in the January/February period.

The fact that these events resulted in such a marked decrease of their average summer/peak population was on both occasions in stark contrast with the situation in the Black-winged Stilt.
That species achieved its highest count in 1999 that suggests that the lake was in fact a suitable habitat. The difference between these two species highlights their different breeding requirements and reactions to such abnormal rainfall events.

SPECIES ACCOUNTS

Only sightings within the boundary of the reserve were recorded. We have endeavored to collate all existing records from the Lake McLarty Reserve. Generally this covers the period 1982-2000.

Where sufficient data was available two types of graph have been produced. The first graph represents the maximum number of waders sighted in a specific year during the period 1982 to 2000. (Figs. 5 - 19). This gives an overview of the status of a species during the past 19 years. It should be mentioned that some years are missing in the graphs due to a lack of data. Further, in some years

(generally the early 80s) only a few sightings were available. Nevertheless it was considered from an historical point of view to include these figures in the graphs. Observations from the early 90s onwards were more comprehensive. The second graph type shows the monthly fluctuation in wader numbers for the years 1996 to 1998. (Fig 5a to Fig 16a).

Whimbrel *Numenius phaeopus* One observation of two birds on 8 February 1997.

Eastern Curlew *Numenius madagascariensis* One record of Eastern Curlew on 9 February 1997. Probably originating from Peel/Harvey estuary.

Black-tailed Godwit *Limosa limosa* Usually seen in deeper water and as single species flocks. Present throughout summer and autumn months dependent on water levels. Numbers peak over summer (December to February). Being able to utilize the lake at higher water levels and being tolerant of feeding near the *Melaleuca* fringe, they are generally one of the early arrivals. Rarely recorded from flooded pasture. Feeding areas often just out of or near *Melaleuca* fringe but no records within it. Shows preference for feeding in belly-deep water with a muddy lakebed. It was estimated that 65% of feeding observations were made at northern end and remainder at southern end. Some birds noted in first year plumage (traces of juvenile plumage). Birds observed in partial breeding plumage from mid-March to early April. Winter observations rare. Often rests within flocks of loafing/roosting ducks/swans and roosts in loose groups rather than randomly scattered. Records show that the Black-tailed Godwit has maintained a fairly stable presence at the lake with little variation in numbers throughout the years. Earliest sighting 20 December 1998 Present: January - June, December. Max: 65 (30 March 1989).

Snipe species *Gallinago spp.* Sighting of unidentified snipe species during 1981-1985 survey. Snipe (some records mention Pin-tailed Snipe) was seen in sparse tall rush in February 1984.

Bar-tailed Godwit *Limosa lapponica* Although seen in the Peel Inlet rare at Lake McLarty.
Observation of two birds on 8 February 1997. Present: February, Max: 2.

Marsh Sandpiper *Tringa stagnatilis* Usually present in small numbers in flooded paddock at the south end of the lake. Prefers grassy margins early in the season when water levels are high. However is never far from *Typha* stands as these dry out. Feeds over whole lake sometimes in loose groups but at other times almost at random. Often seen with Common Greenshank but its shorter legs probably make it a later arrival than Greenshank. Some birds start acquiring breeding plumage early /mid April. Only odd bird recognized as having immature plumage. Wintering birds remain in non-breeding plumage (May-June 1997 records).
Numbers peaked through January and February (Fig. 5). Record number of 142 Marsh Sandpiper was sighted on 29 January 1992. A late observation was made of 7 Marsh Sandpiper on 22 May 1993. Earliest sighting: 23 November 1997; Present: January - June, November – December;
Max: 142 (29 January 1992).

Common Greenshank *Tringa nebularia* Found around the lake but as the lake dries out tends to prefer north/ north west end of the lake. One of the first migratory species to arrive at the flooded paddock at the southern end of the lake. Can be found along *Melaleuca* fringe when the water levels drop to about 400 mm. Feeds over whole lake area and is usually well spread amongst other species. Start of breeding plumage seen from early to late April. Some recognized in immature plumage. Often found resting within groups of ducks, stilts and avocets. Common Greenshanks have become more common in recent years (Fig. 6). A few winter observations from June. Earliest sighting: 26 October 1997; Present: January - June, October – December;
Max : 204 (10 January 1999).

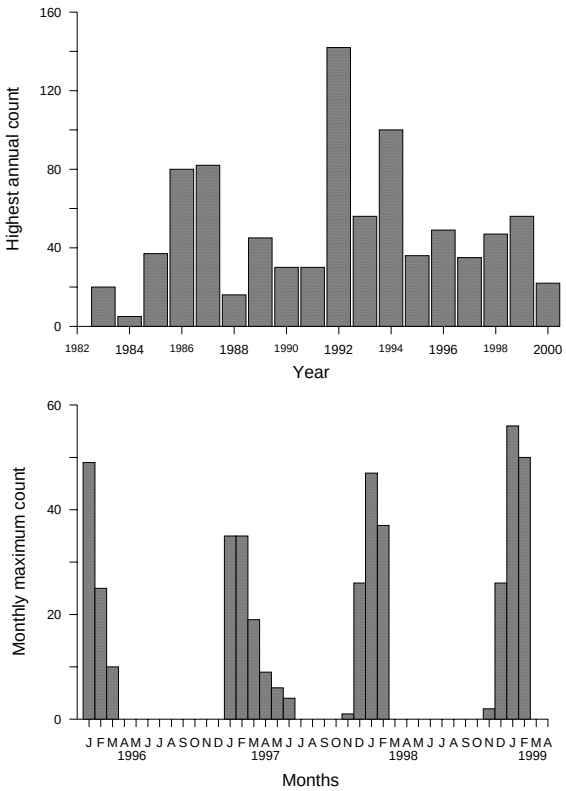

Figure 5. The highest annual count of Marsh Sandpiper at Lake McLarty between 1983 and 2000 (upper) and the maximum monthly count between January 1996 and February 1999.

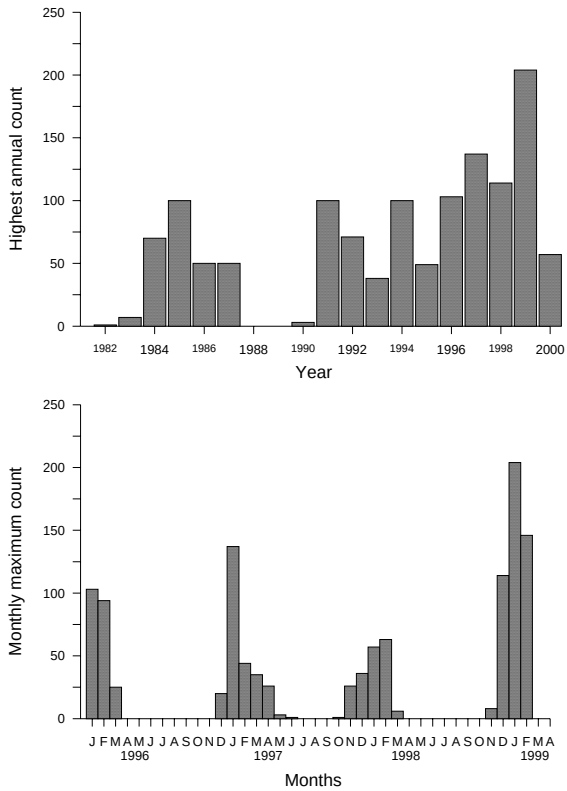

Figure 6. The highest annual count of Common Greenshank at Lake McLarty between 1982 and 2000 (upper) and the maximum monthly count between January 1996 and March 1999.

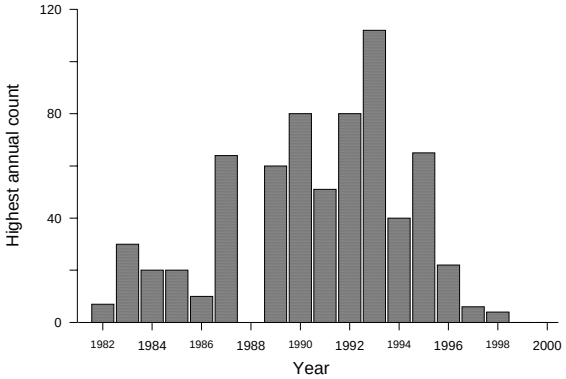

Figure 7. The highest annual count of Wood Sandpiper at Lake McLarty between 1982 and 2000.

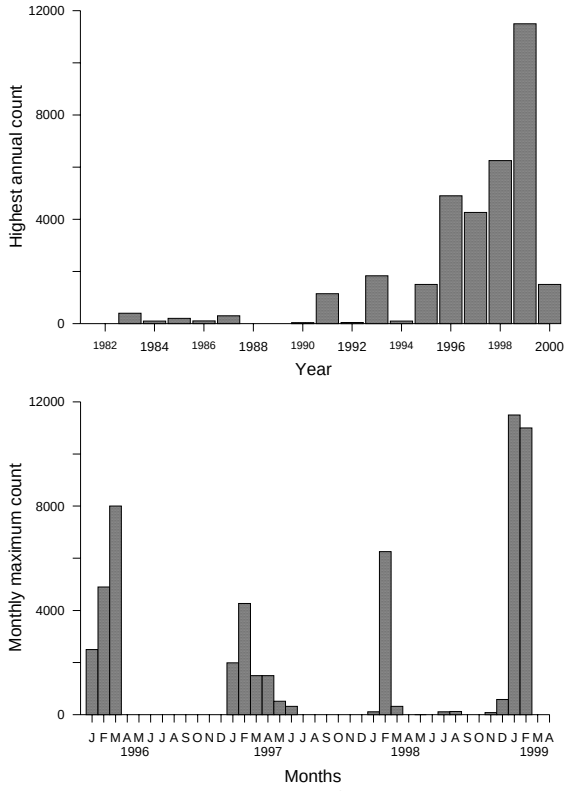

Figure 8. The highest annual count of Red-necked Stint at Lake McLarty between 1983 and 2000 (upper) and the maximum monthly count between January 1996 and February 1999.

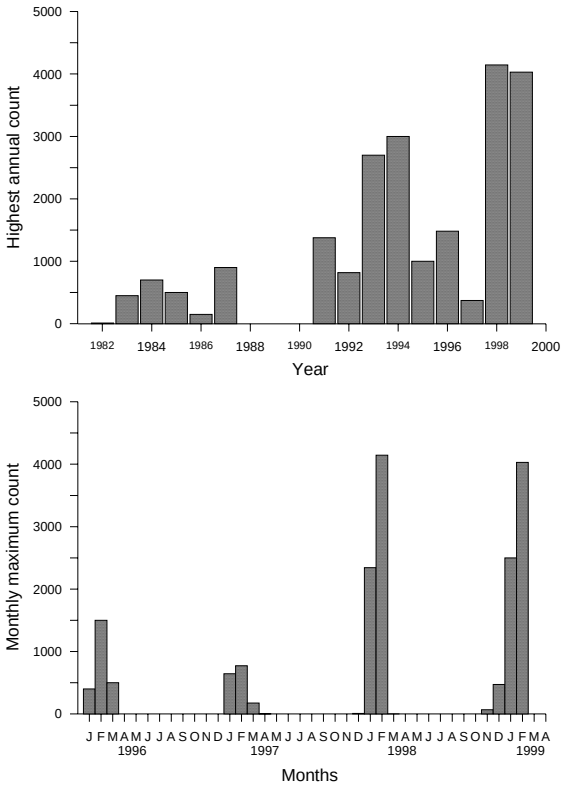

Figure 9. The highest annual count of Sharp-tailed Sandpiper at Lake McLarty between 1982 and 2000 (upper) and the maximum monthly count between January 1996 and February 1999.

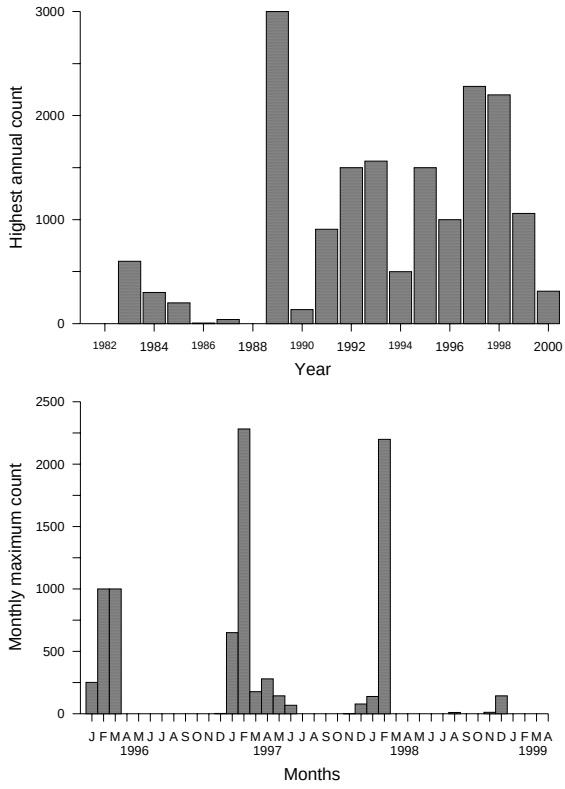

Figure 10. The highest annual count of Curlew Sandpiper at Lake McLarty between 1983 and 2000 (upper) and the maximum monthly count between January 1996 and December 1998.

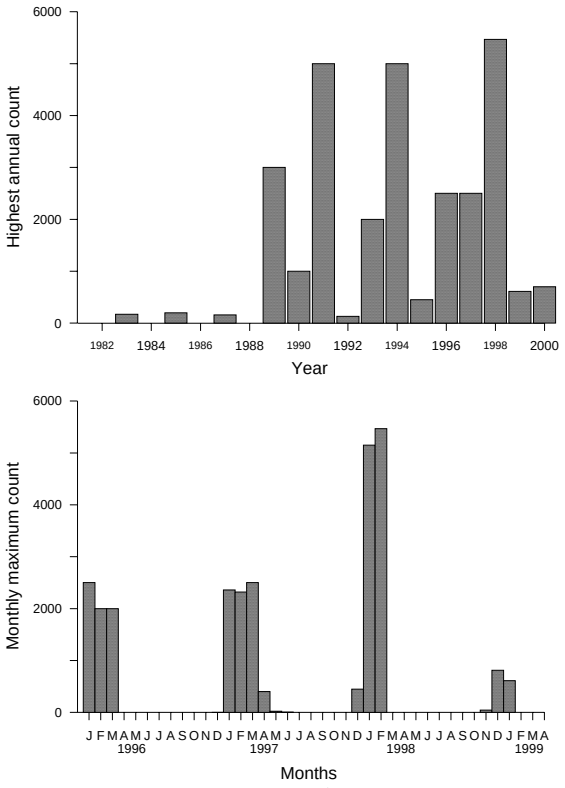

Figure 11. The highest annual count of Red-necked Avocet at Lake McLarty between 1983 and 2000 (upper) and the maximum monthly count between January 1996 and January 1999.

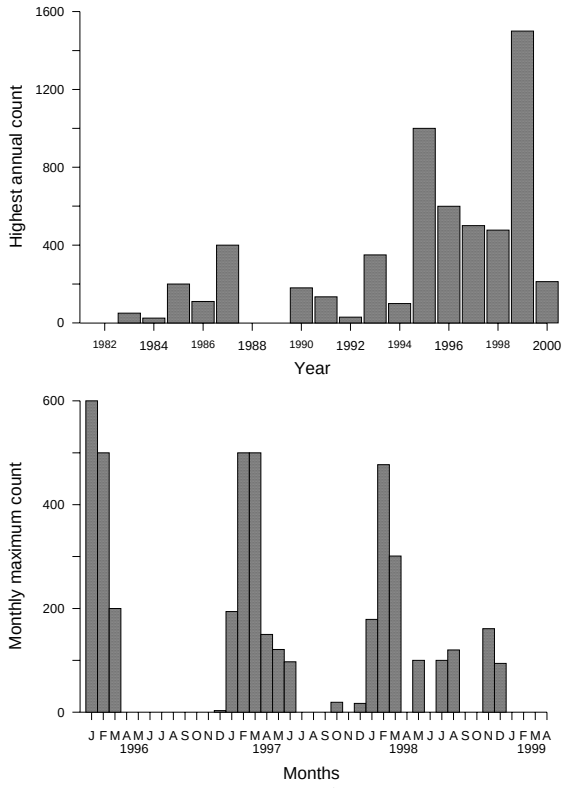

Figure 12. The highest annual count of Red-capped Plover at Lake McLarty between 1983 and 2000 (upper) and the maximum monthly count between January 1996 and December 1998.

Wood Sandpiper *Tringa glareola* Recorded at south end in flooded paddock and fringes of *Melaleuca*. Previously much more common before the disappearance of *Typha* and *Juncus* along south east side. This habitat modification may however not be the sole cause for this species decline since the status of this species is changing throughout the Swan River coastal plain to a relatively uncommon species. Numbers averaged 20 over the 1981-19985 study period (Fig. 7), increasing to an average of 80 in the early 90s. Since that time numbers have declined dramatically to no birds at all in 1999. Virtual full breeding plumage seen in late April. Earliest sighting: 10 October 1990; Present: January - April, October – December; Max: 112 (17 February 1993).

Common Sandpiper *Tringa hypoleucos* One observation (1) on 17 February 1993.

Grey-tailed Tattler *Tringa brevipes* Newly recorded during study period. Observations are only available from 1998 onwards. Grey-tailed Tattler often seen feeding with Common Greenshank. The preferred feeding sites were on the western side of the lake. Earliest sighting: 13 December 1998; Present: January, February, December; Max: 18 (10 January 1999).

Ruddy Turnstone *Arenaria interpres* One recorded during 1981-1985 survey on 12 February 1984.

Asian Dowitcher *Limnodromus semipalmatus* One sighting on 21 March 1992. Detailed report and description in Western Australian Bird Notes (WABN) No. 63; September 1992.

Great Knot *Calidris tenuirostris* Rare visitor. One observation of two birds on 27 April 1997 showing signs of breeding plumage. Present: April; Max: 2.

Red Knot *Calidris canutus* Only a few scattered records for this wader. Three Red Knot seen in full breeding plumage in early May 2000. Record of one Red Knot present during the months January and February 1994. Seen feeding on mud fringe on eastern side. Present: January - March, May; Max: 13.

Sanderling *Calidris alba* Lake McLarty is not the preferred habitat for Sanderling and the birds sighted have probably drifted or been blown in from the coastal beaches. The beach is only 8 kilometres away from Lake McLarty. One bird observed on 3 February 1999 and one on 12 March 2000.

Little Stint *Calidris minuta* Observation of Little Stint comes from 20 March 1993 ;WABN No.67; September 1993. One bird remained at the lake from 10 to 31 January 1999 in partial breeding plumage. Fed at waters edge usually just in the water. Feeding action more of picking rather than guzzling like Red-necked Stint. Noted to be very attached to small zone of waters edge. In over one hours of watching it only fed in a stretch of some 5-6 meters (back and forth). Both birds easily differentiated from Red-necked Stint by predominantly orange/rufous neck and breast. Present: January, March; Max: 1.

Red-necked Stint *Calidris ruficollis* Recorded throughout the year, although overwintering records can involve up to 300 birds (Fig. 8). Red-necked Stint numbers peak quite late, only just before departure, inferring the late arrival of some birds. Large influxes occur, as the lakebed areas become accessible (350mm-370mm) which is slightly later than most other species. Most numerous along eastern shoreline but large numbers also recorded from dry southeastern corner along with Red-capped Plovers. Largest concentrations were recorded at the centre of lake on a wet mud island when water levels were around 12.5 cm. Red-necked Stint is the last of the common waders to arrive in large numbers. Early returning birds are either in non-breeding plumage or showing juvenile/first year plumage. First signs of breeding plumage become evident from mid-February, with peak usually occurring in early to late April after which their percentage rapidly decreases. Most overwintering birds show no signs of breeding plumage but the odd ones noted with some indications of breeding plumage. Breeding plumage records: 23 February: 1-2% with signs of breeding plumage 15 March: 2-3% developed breeding plumage and 3% with signs of breeding plumage. 29 March: 4-5% with well developed breeding plumage and 3-4% with signs of some breeding plumage. 6 April: 4-5% well developed/developed breeding plumage and 4-5% with signs of breeding plumage.
20 April: 2-3% full/almost full breeding plumage and 8-9% well developed/developed breeding plumage. Some 20% of the remainder with spangled upperparts but lacking neck-face colour.

26 April: None in full breeding plumage, 1-2% developed breeding plumage.1 June: One out of (180) with partial breeding plumage. 2 August: Some noted with partial breeding plumage.

Numbers have increased dramatically since 1981-1985 surveys (Fig. 8), currently peaking at 11500 compared with 400 in the past. Leg flagged birds were seen on 4 January1999 (one yellow flag and one orange flag) and 26 January 1999 (two birds with orange flags). A huge crash in numbers was recorded in a matter of one week. As the lake dried out between 31 January 1999 and 5 February 1999, the number of Red-necked Stint fell from a record 11500 to 371. Small numbers (60-300) overwintered around the lake in 1997,1998 and 2000. Present: Recorded in every month; Max: 11500 (31 January 1999).

Long-toed Stint *Calidris subminuta* Previously more common. In particular from 1984 to 1994. Prefers the grassy margins of the lake when available earlier in the year but otherwise usually seen with Red-necked Stints and Sharp-tailed Sandpipers. Recent records show a general decline in numbers and this trend is consistent with other local areas. Two were seen in breeding plumage late April 1997. Record of 90 birds on 18 February 1991. A late sighting was reported of two birds on 8 May 1993 and the first winter sighting was made in June 2000.
Earliest sighting: 23 November 1997; Present: January - June, November, December; Max: 96 (8 March 1992).

Pectoral Sandpiper *Calidris melanotos* Almost always with Sharp-tailed Sandpiper. Regular visitor for the past eight years. Shows liking for flooded pasture and can arrive relatively early when water levels are around 500 mm. Conversely can be recorded as staying fairly late in years when lake does not dry out. Only one record of juvenile plumage and no records of full breeding plumage but some birds recorded in March as very noticeable dark. Earliest sighting: 23 November 1997; Present: January - April, November, December; Max: 20 (11 April 1997).

Sharp-tailed Sandpiper *Calidris acuminata* Mainly prefers southeast side but concentrates also along western side especially as lake becomes drier. It is not until the central lakebed area becomes available (<370mm) that the bulk of the birds arrive. Usually associates with Curlew Sandpiper but prefers slightly shallower water. Larger concentrations often seen in or near *Typha* beds. Birds with yellow leg flags sighted on 4 January 1999 and 5 February 1999 indicating Sharp-tailed Sandpipers moving down from north-west Australia. Numbers vary between years but there is a distinct trend to increased numbers. The 1981-1985 survey peak of 700 birds has now risen to over 4000 but in some years (1997 and 2000) with sustained high water levels, peak numbers did not even attain the levels of the earlier survey (Fig. 9). Earliest sighting: 30 November 1998; Present: January - April, November, December; Max: 4144 (17 February 1998).

Curlew Sandpiper *Calidris ferruginea* Recorded virtually throughout the year, except in the autumn period, although wintering records are far fewer and irregular. Early arrivals found along grassy margins and as water levels drop further (c 370mm) along the *Melaleuca* fringe.
It is not until shallow water areas of the lakebed can be utilized that numbers increase. Peak numbers are achieved slightly ahead of Red-necked Stint. Eastern shoreline is the main feeding area and some birds remain to last stages of dry-out. Only odd juveniles have been noted amongst early arrivals and no adults seen with obvious traces of breeding plumage. As with Red-necked Stint, maximum percentage of birds with signs of breeding plumage occurs in early/mid April. Overwintering birds are all in non-breeding plumage, although one seen (of 120) on 17 June 2000 was in full breeding plumage. In typical years, peak numbers are recorded in February but are sustained only for a relative short period (Fig. 10). The corresponding March peak being typically half to one third of that figure (1000 compared with 2500). One Curlew Sandpiper seen with orange leg flag (Victoria) on 28 December 1993. Present: January - August, November, December; Max: 3000 (30 March 1989).

Broadbilled Sandpiper *Limicola falcinellus* Rare and irregular summer visitor. One bird sighted on 3 January 1994 and one on 26 January 1999. Other records come from 7 January 1995 (1) and 4 February 1996 (2). Found feeding at water/mud edge of drying lakebed and in company with Red-necked Stint and Curlew Sandpiper. Present: January, February, March; Max: 2.

Ruff. *Philomachus pugnax* Uncommon but regular visitor. Both Ruff and Reeve have been sighted. Usually with Sharp-tailed Sandpipers but often in

deeper water. Odd birds noted to temporarily at least feed along edges of *Typha*. Adult male noted on 2 March 1996 with extensively white areas on neck and breast. Has been sighted each year since 1991. Earliest sighting: 27 December 1991. Present: January - May, December; Max: 5.

Black-winged Stilt *Himantopus himantopus* Black-winged Stilt seem more common in recent years. Present throughout the year depending on water levels. Recorded around the lake. Often feeds directly under or inside fringe of *Melaleuca* along eastern side. The Black-winged Stilt follows a cyclic pattern with numbers building up towards the end of summer before the lake dries out. The summer peak (*c.* 2000 birds) either crashed to zero when the lake dried or quickly decreased to a winter population of 1-200 birds. For example, numbers went from (2407) on 26 January 1999 to (26) on 5 February 1999. In either event, numbers increased slightly when winter rains recharged the lake (June/July). The lake was essentially vacated during the August to October period that coincides with the local breeding season. It was noted that over the late June - August period the population comprised of very high percentage of immature birds (as distinct from juveniles). On 31 July 1997 it was estimated that 50% were immature birds. On 4 July 1998 it was estimated that 75% were immature birds. Whether this infers that those immature birds return with the adults to the breeding areas is not known. Immatures also constitute a fairly high percentage of birds during the early summer peak period, although nowhere near as markedly so as in the pre-breeding period. In January 1996, it was estimated that 60-70% were immature birds. In January 2000, it was estimated that 20-25% were immature birds. Perhaps the immature birds vacated the breeding areas earlier than the breeding adults. Present: All year round; Max: 2439 (8 February 1998).

Banded Stilt *Cladorhynchus leucocephalus* Generally a regular visitor during summer and autumn months though a few winter sightings. Predominantly recorded during January and February. Mostly seen in small groups of 5-30. Numbers tend to vary considerably from year to year that is not unexpected considering the birds unusual breeding cycle. Usually seen with Black-winged Stilt but never very far from other Banded Stilt. High counts records are 12 March 1991 (690), 17 February 1998 (256), 26 January 1999 (244). Present: January - July, October – December; Max: circa 1000 (24 February 1991).

Red-necked Avocet *Recurvirostra novaehollandiae* Usually in one or two single-species flocks. Flocks generally densely packed. Also odd birds feeding with Black-winged Stilts. Seemed to spend much of the day loafing. In general, timing seems to shadow that of the Black-winged Stilt but appears to be recorded less in the winter months. Around 20% of Red-necked Avocet were in immature plumage in a flock observed on 28 January 1996. Peak numbers vary widely between years possibly linked to inland breeding opportunities. Numbers can rise rapidly, as was the case in January/ February 1994 when they went from 2500 to 5000 (Fig. 11). Present: January - June, November, December; Max: 5468 (8 February 1998).

Pacific Golden Plover *Pluvialis dominica* Scarce and irregular visitor during summer months usually single birds. Record of four Pacific Golden Plover on 15 January 1995. Earliest sighting: 30 November 1998; Present: January, February, November, December; Max: 4.

Grey Plover *Pluvialis squatarola* One sighting of two birds on 24 January 1999.

Little Ringed Plover *Charadrius dubius* Two sightings at Lake McLarty. First sighting 21 March 1992. WABN No. 63; September 1992. Second sighting on 4 February 1995. WABN No. 73; March 1995.

Red-capped Plover *Charadrius ruficapillus* Breeding species though usually not very successful. Foxes seen around lake. Adult seen taken by Australian Hobby *Falco longipennis*.
Earlier in the year tends to the southeastern corner where it breeds and roosts. Also feeds here usually with Red-necked Stint. Becomes widely distributed as lake dries out but on the western shore only occurs in small groups. Red-capped Plover numbers peak over the summer months (Fig. 12). The Red-capped Plover has an extended breeding season at Lake McLarty from December to June. Breeding records: 29 March 1992, two nests with two eggs; 29 March 1993, runners seen; 13 April 1993, runners seen. 28 December 1993, two nests with two eggs; 22 February 1996, two runners; 8 February 1998 runners; 20 December 1998, nest with 2 eggs; 10 January 1999, runners seen; 26

January 1999, 3 nests 2 eggs each, and 3 runners; 5 May 2000, 2 runners; 17 June 2000, 2 runners; Present: January - August, October – December; Max: >1500 (31 January 1999).

Lesser Sand Plover *Charadrius mongolus* One Lesser Sand Plover observed on 19 February 1995.

Greater Sand Plover *Charadrius leschenaultii* One observed with Red-capped Plovers at south end on 26 January 1999.

Black-fronted Dotterel *Charadrius melanops* Surveys show numbers can fluctuate markedly from year to year. Prefers areas of darker mud and short grass along north, west sides and south west corner. Also in flooded paddock at south end. Breeding records: 13 April 1993, three runners; 28 December 1993, two nests with 1 egg and one nest with two eggs; 25 May 1997, nest and immature; Present: January - August, November, December; Max: circa 100 (13 April 1993).

Red-kneed Dotterel *Erythrogonys cinctus* Mainly summer and autumn visitor in small groups. Absent in winter. Usually recorded at southwestern corner near *Melaleucas* but sometimes in similar habitat at north end. Generally one or two immatures present with adults.
Recorded in flooded paddock at south end of reserve. Red-kneed Dotterel were recorded in larger numbers in the late 80s. In recent years average number present has been around ten birds. Present: January - May, October – December; Max: 90 (15 January 1986).

Banded Lapwing *Vanellus tricolor* Two sighting of two birds on 15 June 1997 and 22 July 1998. Flocks of 60-70 birds have been seen in pastoral and agricultural areas near to the lake in January and February 2000. Present: June, July; Max: 2.

Oriental Pratincole *Glareola maldivarum* Five were seen on dry mud on 1 March 1985. By 2 March 1985 this number had increased to 10 birds. Other sightings come from January 1987 (1) and January 1989 (1). Present: January, March; Max: 10.

DISCUSSION

The shorebirds recorded include both Australian resident and paleartic migrant species. As can be expected, utilization of the lake by these two groups differ somewhat but for both it is a non-breeders feeding ground and refuge area. High water levels generally preclude migratory waders using the lake until several weeks, even months after their arrival. The lake is therefore most important as a feeding site during the late summer and pre-departure periods.

Few waders use the lake from when it dries out until the onset of winter rains and the ensuing filling of the lake. During this time, wader sightings are restricted to Australian resident species such as Black-winged Stilt. Conversely, as peak water levels are approached only small areas along the western shoreline and the south-western corner are available for waders. Few, if any are recorded, and these are mainly wet grassland species such as Black-winged Stilt.

Water levels around 450-500 mm: Numbers of waders start to build up as the water levels drop usually from mid-December to mid-January. The first waders to arrive can usually be found in the flooded southern pastures and the central western shoreline. The former is a particularly favoured habitat in the case of early Pectoral Sandpipers as well as Common Greenshank and Black-winged Stilts.

Water levels around 400-450mm: Longer-legged species can be found feeding in close proximity to or actually within the *Melaleuca* fringe particularly along the south eastern corner. The species involved are mainly Black-winged Stilt, Red-necked Avocet and Greenshank and to a lesser extent Black-tailed Godwit and Marsh Sandpiper (Table 2)
At the lower end of this range the southern pasture area is essentially dried out.

Water levels around 370-350mm: The margins of the lakebed within the *Melaleuca* fringe become exposed. Once water levels drop below this level, a ‘window of opportunity’ is presented for shorter legged wader species that can then utilize this wetland. Further small decreases in water level translate into large accessible feeding areas. This has the additional advantage of the shoreline becoming further from the *Melaleuca* fringe and therefore safer.
In a matter of days the numbers of Red-necked Stint, Curlew Sandpiper and Sharp-tailed Sandpiper can increase from zero to thousands. Coincident with this influx, the number of species already present also increases.

Table 2. Preferred feeding habitat of the common species of wader at Lake McLarty, Western Australia.

Species	Southern Pasture	*Melaleuca* fringe	*Typha* beds	SE Corner	Shallow water	Deep water	Muddy lake bed	Throughout
Black-tailed Godwit	Rare	Common	-	-	-	Common	-	-
Marsh Sandpiper	Occasional	-	-	Occasional	-	-	-	Common
Common Greenshank	Common	Common	-	-	-	-	-	Common
Wood Sandpiper	Common	-	-	-	-	-	-	-
Red-necked Stint	Occasional	-	-	Common	-	-	Common	-
Long-toed Stint	Common	-	Rare	-	Common	-	Common	-
Pectoral Sandpiper	Common	-	Common	-	-	-	Common	-
Sharp-tailed Sandpiper	-	-	-	Common	Common	-	Common	-
Curlew Sandpiper	Occasional	-	-	Occasional	Common	-	-	-
Black-winged Stilt	Occasional	Common	-	-	-	Common	-	Common
Red-necked Avocet	-	Occasional	-	-	Common	-	-	-
Red-capped Plover	Occasional	-	-	Common	-	-	-	-
Black-fronted Dotterel	Common	-	-	-	-	-	Common	-
Red-kneed Dotterel	Common	-	Occasional	-	-	-	-	-

Water levels around 200mm: The maximum number of waders occur with water levels of about 200mm and remain high, gradually dwindling until the lake is no more than a few extensive but isolated pools. At that point numbers crash rapidly with the last birds disappearing before final evaporation of the lake. The actual timing of the final dry-out is variable and may not occur at all (Fig. 4). In some low peak seasons it occurs well before the departure time of paleartic migrant waders but in others it is sufficiently late to allow them to remain and feed until departure time. Few birds remain after May with the exception of resident waders. Of course, this simplified pattern is subject to variation associated with rainfall and water level patterns.

Water levels high to *Melaleuca* throughout the year: Only one season (1999-2000) of this type was noted during the total observation period. In that year, wader utilization did not progress beyond that noted for the 500mm plus level, except for a brief period when very late in the season. Whereas virtually no Red-necked Stint had been recorded from this site, some 300-400 birds suddenly arrived in April/May 2000 and stayed for 2-3 weeks. Conditions had remained unchanged from the previous months. In parallel to this observation, Curlew Sandpiper, Red Knot, Black-tailed Godwit, Marsh Sandpiper and Common Greenshank were recorded in high numbers. Some of these birds were in full breeding plumage and recorded their species' latest departure times.

THREATS AND RECOMMENDATIONS

Whereas Jaensch *et al.* (1988) recognized no immediate threats to the lake other than probable overgrowth with *Typha*, several are now imminent:

1. A recent subdivision development along the western side of the lake has been concluded with only minimal shoreline separation. 'Birchmont Estate' is a special rural subdivision and still further stages of development are planned on the southwestern side of the lake.
2. A new highway is planned to the east of the lake (extension of the Kwinana Freeway).
3. A new township with an estimated population of 7000 is proposed at Point Grey. This includes a tourist development, marina and golf course.

All of these developments are considered to adversely impact on the dynamics of the lake. Disturbance will greatly increase due to shoreline settlement and improved access roads. The potential of dogs chasing waders and ducks through shallow waters could well be disastrous particularly bearing in mind that some of the latter are flightless during heavy moult.

Ground water extraction bores, by local householders and local authorities may well effect the natural inflow of water to the lake. A reduction in ground water levels may result in a premature drying of the lake that in turn would jeopardize wader-feeding habitat. The current water regime of Lake McLarty creates suitable feeding habitats for departing paleartic waders and allows them to achieve the necessary increase in bodyweight prior to migration. This is one of the very few local lakes where this happens.

Residential development has the potential to increase nutrient runoff and this may effect water quality. Similar settled areas adjacent to wetlands elsewhere have demanded and received mosquito

control programs. Aerial pesticide spraying is undesirable and highly disruptive to birds. There are past records showing this practice has led to wader moralities. Whether the highway construction will divert surface water flow or modify ground water catchment is not known.

RECOMMENDATIONS

Certain measures should be implemented immediately to assist in the maintenance of Lake McLarty.

1. Additional reserve areas should be declared to cover the entire lake. This would create a larger buffer zone.
2. Fox baiting should be carried out on a regular basis.
3. At least the western side of the reserve bordering on the subdivision should be fenced and have screening vegetation planted.
4. Lake McLarty should be nominated as a Ramsar site.
5. New National legislation (July 2000) relating to environmental protection and biodiversity conservation should be applied to ensure the future of the lake.
6. A separate management plan should be developed for the reserve by the Department of Conservation and Land Management.
7. The quality of the lake water should be monitored and measures taken to prevent nutrients entering the ecosystem.
8. A ground water extraction plan should be investigated and regulated to ensure local water levels are not adversely effected.
9. An invertebrate study would provide a means of monitoring water quality and wader food sources.

CONCLUSION

Since the original 1981-1985 surveys, the role of this lake has been transformed significantly. Obviously the disappearance of the emergent vegetation has had a major role in this change. Other regional development may have had some impact on the number of shorebirds. For instance, the opening of the Dawesville Channel (April 1994) has significantly changed water levels in the Peel-Harvey estuary (Lane 1997) and has reduced the accessibility of mudflats to smaller waders. This may be a contributing factor for the marked increase in such species as Red-necked Stint and Sharp-tailed Sandpiper. On the other hand it may be due to adverse environmental conditions prevailing at wetlands elsewhere.

The reasons behind the loss of the sedges and reeds in the lake is not known. Nevertheless the productivity of the aquatic invertebrate fauna still appears to be high and capable of providing an abundant food source for a large population of waterbirds. This together with the current open nature of the drying lake which generally coincides with the latter part of the Paleartic shorebird species presence provide an ideal habitat. It is also a major refuge area for Australian shorebird species with two of these in sufficient numbers as to qualify the lake of international importance. Lake McLarty is not only important for waders but also all other waterbirds. A wetland is considered of international importance if it regularly supports 20.000 waterbirds. There have been regular records at Lake McLarty of in excess of 20.000 waterbirds (this includes waders). Some are 25 February 1996 (26690); 23 February 1997 (34104) and 25 January 1998 (30177). Despite this, Lake McLarty is currently considered to be under threat and methods to maintain its present status should be actively pursued. The Department of Conservation and Land Management is entrusted with the protection of the lake and should be taking further steps to ensure its preservation.

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NORTHWARD MIGRATION OF SHOREBIRDS THROUGH THE HUANG HE DELTA, SHANDONG PROVINCE, IN THE 1997 – 1999 PERIOD

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ABSTRACT

Comprehensive counts of shorebirds have been conducted in the Huang He National Nature Reserve, and adjacent coastal wetlands, at different stages during the 1997, 1998 and 1999 northward migrations. The counts have provided very important information on the numbers, distribution and migration strategies of the different shorebird species passing through the delta region. Peak shorebird numbers in the reserve, which exceed 100 000, occur in late-April. Differences in the timing of migration exist between species, with the more northerly breeders passing through later than those nesting at the milder southerly latitudes. The count data obtained during the three-year period suggest that the delta, as a whole, supports in excess of 250 000 shorebirds during the northward migration period.Thus making it is one of the most important shorebird areas in the East Asian-Australasian Flyway. The delta is internationally important for at least 18 species, 15 of which occur on northward migration. It is very desirable that a similar count programme be carried out during southward migration in order that a comprehensive picture can be obtained of the role and significance of the Huang He delta for migratory shorebirds.

INTRODUCTION

Comprehensive counts of shorebirds have been conducted in the Huang He National Nature Reserve, and adjacent coastal wetlands, during the 1997, 1998 and 1999 northward migrations as part of the continuing China-Australia cooperative programme of shorebird study activities. Personnel from the Nature Reserve, Wetlands International - China Programme and the Australasian Wader Studies Group were involved.

Information on the Huang He delta and Nature Reserve, including a summary of previously published information on the significance of the reserve for shorebirds and analyses of the 1997 and 1998 counts, have been presented in Barter *et al.* (1998a, 1998b, 1999a, 1999b).

METHODS

Details of the count programme, including scope, logistics, and tide and weather details, have been described in Barter *et al.* (1998a, 1999a, 1999b) and Zhu *et al.* 2000. Counts were conducted from 4-10 April (1999), 18 April-1 May (1997) and 27 April-7 May (1998). The terms "early-April", "late-April" and "early-May" are used to identify the three count periods. A map of the Huang He delta region (37° 56'N 118° 51' E), with the locations of the individual count areas and the boundaries of the Nature Reserve is given in Figure 1.

Coverage of the delta differed from year to year and poor weather significantly affected the count at one important site in 1998. West Da Wen Liu (Site 9) was only visited in 1997, when 3 553 birds were counted. The Guangli-Zima Rivers mouth (Site 10) was only counted comprehensively in 1997 with 23 364 birds being recorded, making this the most important area counted that year. In 1998, bad

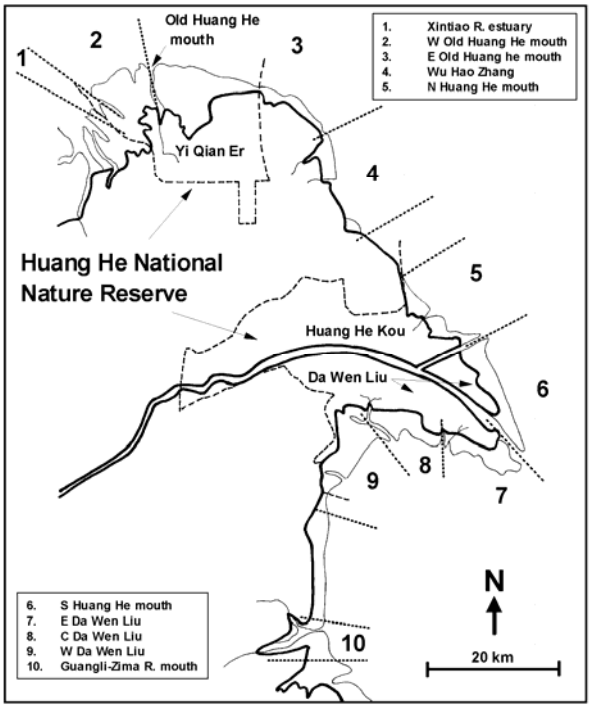

Figure 1. Locations of the individual count areas and the boundaries of the Huang He National Nature Reserve.

weather seriously affected the count which totalled 14 062. The site was not visited in 1999. Also a number of inland sites, including two saltworks, were only visited in 1997. A special survey for Little Curlew was conducted in grassland areas in 1998, following some preliminary counts in 1997 (see Barter *et al.* 1999b for details of methodologies).

With four exceptions, population estimates from WIO (2000) (based largely on Rose and Scott 1997) were used to calculate the 1% criteria used to determine whether individual species were present in internationally significant numbers. The exceptions were Eurasian Curlew, Dunlin, Grey Plover and Kentish Plover. The higher population estimates of these species are based on extensive counts conducted in the Yellow Sea coastal regions in recent years. These data indicate that the numbers of these four species migrating through the Yellow Sea greatly exceed the WIO (2000) flyway population estimates. The provisional new estimates, based on the assumption that the great majority of individuals of these four species migrate through the Yellow Sea, are Eurasian Curlew: 30 000 (vs. 10 000 previously), Dunlin 600 000 (vs. 130 000), Grey Plover 100 000 (vs. 25 000) and Kentish Plover 100 000 (vs. 25 000).

A listing of the common English and scientific names of all shorebird species recorded, and mostly counted, during 1997-1999 is given in Table 1.

Table 1. Shorebird species recorded in the Huang He National Nature Reserve during the 1997- 99 period.

Species	Scientific name
Common Snipe	*Gallinago gallinago*
Black-tailed Godwit	*Limosa limosa*
Bar-tailed Godwit	*Limosa lapponica*
Little Curlew	*Numenius minutus*
Whimbrel	*Numenius phaeopus*
Eurasian Curlew	*Numenius arquata*
Eastern Curlew	*Numenius madagascariensis*
Spotted Redshank	*Totanus erythropus*
Common Redshank	*Totanus totanus*
Marsh Sandpiper	*Tringa stagnatilis*
Common Greenshank	*Tringa nebularia*
Spotted Greenshank	*Tringa guttifer*
Green Sandpiper	*Tringa ochropus*
Wood Sandpiper	*Tringa glareola*
Terek Sandpiper	*Xenus cinereus*
Common Sandpiper	*Actitis hypoleucos*
Grey-tailed Tattler	*Heteroscelus brevipes*
Ruddy Turnstone	*Arenaria interpres*
Asian Dowitcher	*Limnodromus semipalmatus*
Great Knot	*Calidris tenuirostris*
Red Knot	*Calidris canutus*
Red-necked Stint	*Calidris ruficollis*
Temminck's Stint	*Calidris temminckii*
Long-toed Stint	*Calidris subminuta*
Sharp-tailed Sandpiper	*Calidris acuminata*
Dunlin	*Calidris alpina*
Curlew Sandpiper	*Calidris ferruginea*
Broad-billed Sandpiper	*Limicola falcinellus*
Ruff	*Philomachus pugnax*
Eurasian Oystercatcher	*Haematopus ostralegus*
Black-winged Stilt	*Himantopus himantopus*
Pied Avocet	*Recurvirostra avosetta*
Pacific Golden Plover	*Pluvialis fulva*
Grey Plover	*Pluvialis squatarola*
Kentish Plover	*Charadrius alexandrinus*
Lesser Sand Plover	*Charadrius mongolus*
Greater Sand Plover	*Charadrius leschenaultii*
Oriental Plover	*Charadrius veredus*
Grey-headed Lapwing	*Vanellus cinereus*
Oriental Pratincole	*Glareola maldivarum*

RESULTS

Shorebird numbers in the three count periods

Detailed count data for the individual species in each year are listed in Table 2. Totals of 64 614 shorebirds (20 species) were counted in early-April 1999, 130 122 (37 species) in late-April 1997 and 77 944 (33 species) in early-May 1998. These numbers included 4 085, 13 071 and 18 300 unidentified shorebirds, respectively, i.e. 6%, 10% and 23% of the respective total counts. In total, 38 species were recorded over the three years.

Due to variations in coverage between years, a realistic comparison of the count totals and species numbers between periods can only be made by eliminating the counts at inland sites and at the coastal Sites 9 and 10. The resulting totals based on same-site coverage are: 64 614 in early-April, 100 062 in late-April and 63 882 in early-May (Table 3).

It appears that peak shorebird numbers occur in late-April although, as is noted below, there are often significant differences in the timing of the individual species' peaks.

Individual species numbers in the three count periods

Consideration is limited to those species in Table 3 (i.e. same-site coverage) that were present in internationally important numbers during at least one of the three count periods (Black-tailed Godwit, Bar-tailed Godwit, Whimbrel, Eurasian Curlew, Eastern Curlew, Spotted Redshank, Great Knot, Dunlin, Grey Plover and Kentish Plover).

The criterion of similar-site coverage eliminates those internationally significant species that were

Table 2. Complete count details for 1997-1999 count. *early-April* = 4-10 April 1999, *late-April* = 18 April-10 May 1997, *early-May* = 27 April-10 May 1998. *CRITERION* is the 1% portion of the estimated flyway population that determines site international importance. N.B. early-May Little Curlew estimate taken from Barter *et al.* (1999b), and is almost certainly a significant underestimate of the numbers in the region at that time.

SPECIES	CRITERION	PERIOD early-April	late-April	early-May
Snipe sp.		6		
Black-tailed Godwit	2 894	7 197	113	1 700
Bar-tailed Godwit	509	10 678	10 050	3 300
Godwit sp.	212		200	
Little Curlew		1 619	(17 000)	2 000
Whimbrel	37	1 444	2 626	840
Eurasian Curlew	9 766	6 835	263	300
Eastern Curlew	1 125	307	30	310
Curlew sp.	814	12 487	557	
Spotted Redshank	5	594	10	100
Common Redshank	12	23	4	
Marsh Sandpiper	1	1 135	1	900
Common Greenshank	4	585	434	420
Spotted Greenshank		1	4	
Green Sandpiper		2	1	
Wood Sandpiper		95	1	
Terek Sandpiper	13	213	724	500
Common Sandpiper	6	12	5	
Ruddy Turnstone		5	1	
Asian Dowitcher	1	1	7	
Great Knot	1 126	11 957	12 816	3 300
Red Knot		371	756	
Red-necked Stint	2 036	1 896	589	
Temminck's Stint		2	18	
Long-toed Stint		5		
Sharp-tailed Sandpiper		33	2	
Dunlin	13 450	24 106	14 411	6 000
Curlew Sandpiper		6	7	
Broad-billed Sandpiper		6	7	
Ruff		8		
Eurasian Oystercatcher	44	76	3	
Black-winged Stilt	22	173		100
Pied Avocet	3	6	2	
Grey-headed Lapwing			9	
Pacific Golden Plover		18	9	
Grey Plover	4 133	14 899	13 507	1 000
Kentish Plover	24 313	19 939	2 150	1 000
Lesser Sand Plover	3	201	321	
Greater Sand Plover		80	5	
Oriental Plover		1	1	
Oriental Pratincole		29		
Unidentified waders		4 085	13 071	18 300
ANNUAL TOTALS	**64 614**	**130 122**	**77 944**	

not covered in a sufficiently similar manner over the three years to enable any conclusions on migration timing to be drawn (Marsh Sandpiper, Common Greenshank, Terek Sandpiper and Black-winged Stilt).

The special situation of the Little Curlew is covered separately below.

The migration strategies appear to fall into three categories: early, late and variable timing.

Early migrants

This group comprises Black-tailed Godwit, Eurasian and Eastern Curlews, Spotted Redshank and Kentish Plover. Black-tailed Godwit, the two curlews (allowing for unassigned birds) and Spotted Redshank appear to peak in numbers in the second half of April, whilst Kentish Plover showed a

Table 3. Comparison of shorebird numbers at sites that were covered each year between 1997 - 1999. *early-April* = 4-10 April 1999, *late-April* = 18 April-10 May 1997, *early-May* = 27 April-10 May 1998.

	PERIOD		
SPECIES	**early-April**	**late-April**	**early-May**
Black-tailed Godwit	2 894	7 195	113
Bar-tailed Godwit	509	7 426	3 889
Godwit sp.	212		200
Whimbrel	37	802	2 589
Eurasian Curlew	9 766	6 633	216
Eastern Curlew	1 125	278	28
Curlew sp.	814	9 939	557
Spotted Redshank	5	330	10
Common Redshank	12	13	4
Marsh Sandpiper	1	801	1
Common Greenshank	4	319	359
Spotted Greenshank			1
Green Sandpiper			1
Wood Sandpiper		2	1
Terek Sandpiper	13	61	146
Common Sandpiper	6	10	5
Ruddy Turnstone			1
Asian Dowitcher	1	1	
Great Knot	1 126	2 353	10 310
Red Knot		318	738
Red-necked Stint	2 036	652	589
Temminck's Stint			18
Sharp-tailed Sandpiper		6	1
Dunlin	13 450	19 799	13 451
Curlew Sandpiper		5	5
Broad-billed Sandpiper		6	7
Ruff		8	
Eurasian Oystercatcher	44	15	2
Black-winged Stilt	22		
Pied Avocet	3	4	
Grey-headed Lapwing			9
Pacific Golden Plover			1
Grey Plover	4 133	12 822	12 815
Kentish Plover	24 313	18 857	1 726
Lesser Sand Plover	3	89	51
Greater Sand Plover		68	5
Oriental Plover		1	
Oriental Pratincole		1	1
Unidentified waders	4 085	11 256	16 032
ANNUAL TOTALS	**64 614**	**100 062**	**63 882**

modest decline during the month. Relatively few individuals of these five species remained in early May.

Late migrants

This group consists of Whimbrel, Great Knot and Grey Plover. Numbers of Whimbrel and Great Knot seem to build up slowly in April, but increase greatly by early May. Grey Plover numbers rise significantly between early- and late-April and then remain steady through to early May.

Migrants with variable timing

Both Bar-tailed Godwit and Dunlin seem to peak in late April, but relatively large numbers are still present in early May. In the case of Bar-tailed Godwit, two races with widely separate breeding areas (*baueri* and *menzbieri*) migrate through the Yellow Sea and it is probable that the decrease in numbers between late-April and early-May is due to the earlier departure of one of these (*baueri*) (Barter *et al.* 2000c). The situation could be the same for Dunlin, which probably has two or more races migrating through the Yellow Sea (Wenink and Baker 1996).

Little Curlew

This species inhabits grassland areas and fallow rice paddies and is difficult to count because of its widespread dispersion and cryptic plumage. The

species was noted as being present in large numbers in late-April 1997 and a detailed census carried out in early-May 1998 (Barter *et al.* 1999b) resulted in an estimate of 17 000 birds being present in a small part of the available suitable habitat within the reserve. During the 1999 survey, no Little Curlew were seen either during the coastal count period (4-9 April), as a whole, or when the 1998 census area was revisited on 10 April. It seems that this species does not arrive until later in April and is present in large numbers at least until early May.

DISCUSSION

The count data obtained during the three-year period provides evidence that the delta, as a whole, probably supports in excess of 250 000 shorebirds over the entire northward migration period. The counts conducted in the 1997-1999 period mainly focussed on the coastal region of the reserve. However, additional extensive areas of suitable coastal and inland shorebird habitat lie within the delta, but outside the reserve. These can be expected to support many tens of thousands of birds. Additionally, it can be expected that species that are difficult to count, such as Little Curlew and snipe sp., will be present in considerable numbers.

The counts demonstrate that the delta is internationally important for at least 15 species on northward migration. It is likely that further counting during this period will lead to the reserve being identified as important for other species, such as Red-necked Stint and Lesser Sand Plover. Additional species already found to be present in internationally important numbers at other times of the year are Oriental Pratincole (22 072 present during the 1997 and 1998 breeding seasons [pers. obs.]), Sharp-tailed Sandpiper (3 760 during southward migration in August 1998 [pers. obs.]) and Grey-tailed Tattler on southward migration (Wang *et al.* 1991).

The estimated passage numbers and species diversity on northward migration confirm that the Huang He delta is one of the most important shorebird sites in the East Asian-Australasian Flyway.

Comparison between numbers present in the three count periods shows clearly that the peak migration period is in late-April. However, individual species have varying migration stategies. The differences between species in the timing of migration is explained by the fact that those species passing through first occupy the more southerly breeding habitats that are available relatively early. The later migrants are those nesting in the high arctic, which is snow-covered until at least late May.

The count data collected from the Huang He delta region during 1997-1999 provides very useful information on the role and importance of the Yellow Sea during northward migration, especially when this is combined with data from other sites in the northern Yellow Sea, such as Shuangtaizihekou, Linghekou and Yalu Jiang(Barter *et al.* 2000a, 2000b, 2000c) .

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IMPORTANT WADER SITES IN THE EAST ASIAN-AUSTRALASIAN FLYWAY: 1. WESTERN PORT, VICTORIA, AUSTRALIA

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ABSTRACT

Western Port ranks among the top twenty wader sites in Australia, and is listed under the Ramsar Convention. It was one of the first large sites where waders were counted regularly (by the Bird Observers Club of Australia, from 1973). On average, the main sites in the bay have supported 12,100 Palaearctic migratory waders and 1,420 Australasian breeding waders over this 27-year period, with 99% of the former and 80% of the latter using 14 major high-tide roosts. The most numerous species are Red-necked Stint, Curlew Sandpiper and Eastern Curlew. This paper describes the distribution of waders in the bay and the habitats used. Tidal mudflats are extensive (27,000 ha) and fresh water wader habitats scarce. Mangroves line the northern shores and form an important part of the ecosystem. They are attractive to some waders as roost sites (or for feeding on nearby mudflats) but limit the availability of mudflats at higher tidal levels, and hence the numbers of small waders that the bay can support. The bay is of international importance for seven wader species, notably Eastern Curlew with 6.2% of the currently estimated flyway population. Public access for viewing waders is most convenient from Jam Jerrup, Reef Island and Observation Point (high tide roosts).

INTRODUCTION

This paper is the first in a proposed series dealing with important sites for waders in Australasia. The series is intended to provide geographical details of the sites and their importance to different species.

Western Port is a large embayment (67,000 ha), east of Melbourne on the coast of southern Victoria, Australia. It contains 27,000 ha of intertidal mudflat and is an important habitat for migratory waders, being ranked third in the State and among the top twenty in Australia in terms of wader numbers (Lane 1987, Dann 1994) and the number of species meeting criteria for international importance (maximum counts >1% of estimated flyway populations) (Watkins 1993). It has international importance for seven wader species (Eastern Curlew *Numenius madagascariensis*, Common Greenshank *Tringa nebularia*, Red-necked Stint *Calidris ruficollis*, Curlew Sandpiper *Calidris ferruginea*, Double-banded Plover *Charadrius bicinctus*, Hooded Plover *Thinornis rubricollis* and Pied Oystercatcher *Haematopus longirostris*) and national importance for Pacific Golden Plover *Pluvialis fulva* (Watkins 1993). It also attracts high proportions of the estimated populations of Whimbrel *Numenius phaeopus*, Grey-tailed Tattler *Tringa brevipes* and Masked Lapwing *Vanellus miles* in coastal Victoria (Emison *et al*. 1987, Dann 1994). The bay is listed under the Ramsar Convention on Wetlands (Ramsar, Iran, 1971), and has been added to a Shorebird Site Network for the East Asian-Australasian flyway.

Western Port is close to Melbourne (1-2 hours drive, Fig. 1), a city of almost 4 million people, and is popular for recreational fishing and boating. Phillip Island on the southern edge of the bay is a major tourist destination supporting over 100,000 people in the summer months, and is connected to the mainland by bridge from San Remo. Part of it is managed as a Nature Park. French Island is twice as large but supports only about 100 people, and a large part of it is State Park. A regular passenger ferry service provides access to French Island from Stony Point (near Hastings) and Cowes (Phillip Island). Much of the catchment has been cleared, and large swamps to the north-east of the bay were drained for agriculture in the 19th and early 20th centuries (Corrick 1981, Roberts 1985). Industrial development has been limited to small areas near Hastings, where access to deep-water channels is maintained by dredging (Shapiro 1975). The peripheral vegetation of the bay includes extensive stands of White Mangrove *Avicennia marina* in the north and in sheltered bays elsewhere, often backed by saltmarsh (Bridgewater & Hughes 1974). Intertidal mudflats support stands of seagrass *Zostera* and *Heterozostera* spp. that are the main source of primary productivity (Shapiro 1975, Bulthuis 1981). A detailed study of wader feeding ecology was conducted by Dann (1979, 1987, 1991, 1993, 1999a, b). A useful account of wetlands on

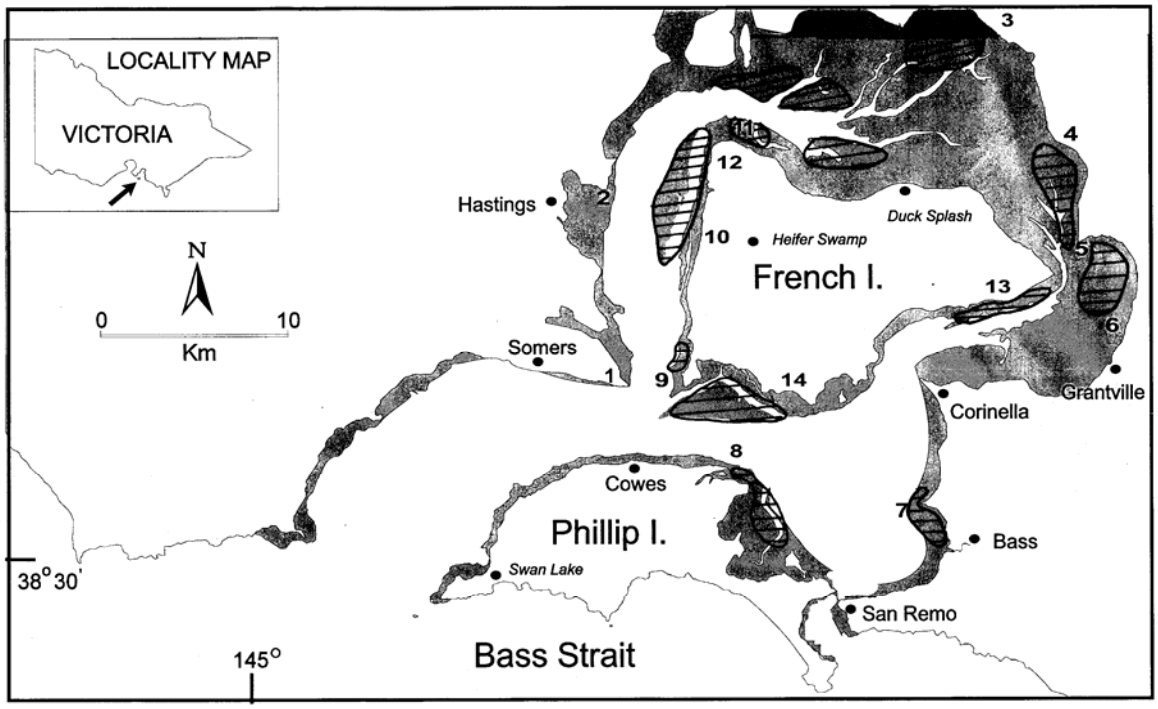

Figure 1. Map of Western Port showing major high-tide roosts (numbered as in text), major feeding areas (hatched) and intertidal areas (shaded) including mudflats, sandbanks and some rocky shores.

French Island was given by Quinn & Lacey (1999), and earlier information on the fauna of the whole catchment has been summarised by Andrew *et al*. (1984).

The bay is of special interest as it is one of the first Australian sites where waders and other waterbirds were counted systematically by teams of voluntary observers (Loyn 1975, 1978, Dann *et al*. 1994). This work began in 1973 as part of the Westernport Bay Environmental Study (Shapiro 1975), and has been continued subsequently as a project of the Bird Observers Club of Australia (BOCA). Previous studies of smaller sites had been conducted elsewhere in Victoria, Tasmania and the Northern Territory (Wheeler 1955, Thomas 1970, Thompson 1977). These surveys and the BOCA Western Port survey were forerunners of the systematic wader counting that has added much to our knowledge of wader numbers throughout the country and the flyway.

Western Port was also one of the first sites in Victoria where migratory waders were caught and banded (Evans 1975). Since that time, *c*.32,000 birds have been banded by the Victorian Wader Study Group (VWSG) at various sites in the bay but particularly at Bunyip River/Yallock Creek and Jam Jerrup (Minton 1999).

WADER SURVEYS

Much of the numerical information presented in this paper comes from the BOCA survey. Some major high tide roosts were known when the survey started and others had to be located through exploration (Loyn 1978). Subsequent exploration by individuals from BOCA and the VWSG has revealed a number of minor roosts or sites used for roosting on an occasional basis.

Teams of voluntary observers from BOCA visited up to 20 key sites (including all 14 major high tide roosts) simultaneously at high tide on selected dates from October 1973. These counts were made monthly in the first two years, and in five "seasons" a year subsequently to 1996. The seasonal counts were in late summer (late January/February), autumn (April/May), winter (June/July or early August), spring (September/ October) and early summer (late November/ December). The autumn count was missed in 1977. Autumn and spring counts were abandoned from 1996, and the survey continues with two counts each summer and one in winter.

Observers counted all water birds in their designated stretch of coast including any high tide roosts. The period began with one of the wettest periods on record in south-eastern Australia (1973-75) followed by irregular cycles of wet and dry periods, with widespread drought from 1980-83 and in the early 1990s. This paper focuses on geographical distribution of waders, which has been quite stable over time (Dann *et al*. 1994, Loyn *et al*. 1994, Loyn *et al*. in prep.).

WADER HABITATS

The inner part of the bay around French Island is shallow, with low wave energy and has vast areas of mudflat exposed at low tide (Fig. 1) despite a tidal drop of only 2-3 m. This would appear to offer abundant feeding opportunities for waders. However, much of the perimeter of the north part of the bay and some of the sheltered inlets elsewhere support a growth of mangroves, so there are relatively few areas where waders can feed for long periods on each tidal cycle. Small waders need to feed for long periods (Evans 1974, Dann 1999a) because they must maintain a higher metabolism than large birds to compensate for greater heat loss to the environment. Large waders are better able to exploit distant mudflats available for short periods at low tide. The numbers of medium to large waders in Western Port are higher than elsewhere in Victoria, with the exception of Corner Inlet where similar conditions apply. Numbers of small waders are substantially lower than on the western side of Port Phillip Bay where nutrient-rich non-tidal feeding areas are available in artificial habitats such as the Western Treatment Plant and a series of saltworks (Loyn 1978, Lane 1987, Dann 1994, Appleby 1999).

WADER NUMBERS

Mean numbers of waders at the main roosts are shown in Table 1 are based on the broad seasonal period of greatest abundance. These are the mean of early and late summer for Palaearctic breeders; winter for New Zealand breeding Double-banded Plover; winter, spring and early summer for Red-necked Avocet *Recurvirostra novaehollandiae*; various periods for common local breeders; and all year for other species (Table 1). These values were summed to give minimum estimates of the numbers of waders known to be using each site in an average year, and summed across sites to indicate the numbers of each species using the bay (mean count). Using this procedure, the main sites in Western Port are seen to support populations of 12,100 Palaearctic migratory waders and 1,420 Australasian waders in an average year. The latter figure has increased to ~2500 in recent years with increases in Pied Oystercatcher and Red-necked Avocet.

The most numerous wader species in the bay are Red-necked Stint, Curlew Sandpiper and Eastern Curlew, all of which are widely distributed (Table 1). As noted in earlier papers, Common Greenshank occur mainly in the mangrove-lined inner parts of the bay and Bar-tailed Godwit *Limosa lapponica* and Whimbrel mainly in the outer seaward parts (Loyn 1978, Dann *et al*. 1994). Red Knot *Calidris canutus* are erratic visitors, and flocks are widely distributed in years when they are numerous.

The mean count of 1294 Eastern Curlew (Table 1) represents 6.2% of the currently estimated flyway (world) population of 21,000 (Watkins 1993). Similar estimates for other species suggest that in an average year Western Port supports 2.1% of the flyway population for Pied Oystercatcher, 1.8% for Curlew Sandpiper and 1.2% each for Red-necked Stint and Double-banded Plover.

FEEDING AND ROOSTING SITES

Most wader roosts in Western Port are located on sheltered sides of rocky or sandy spits and islets that remain dry at high tide, and many of them are adjacent to raised but mangrove-free mudflats where small waders can continue feeding for the required time. Some species also roost on saltmarshes (notably Eastern Curlew, Masked Lapwing and Pacific Golden Plover), pasture (Double-banded Plover), isolated banks of mangroves (Grey-tailed Tattler, Pacific Golden Plover and Terek Sandpiper *Tringa cinerea*), jetties and moored boats (Common Sandpiper *Actitis hypoleucos*), and freshwater pools or dams (Common Greenshank and Masked Lapwing). Ruddy Turnstone *Arenaria interpres* often roost on lightly vegetated rocky mounds, along with Pacific

Table 1. Mean counts of waders at main roosts* in Western Port, at the seasons when numbers are high [#], over 26 years 1973-98. Sites are those shown on Figure1 and numbered in the text (1 – Sandy Point, 2 – Long Island, 3 – Bunyip River and Yallock Ck, 4 – Settlement Road, 5 – Jam Jerrup, 6 – Red Bluff Ck, Pioneer Bay and Queensferry, 7 – Reef Island, 8 – Observation Point, 9 – Tortoise Head, 10 – Chilcott Rocks-Fairhaven, 11 – Barralliar Island and reefs, 12 – Bullock and Decoy Swamps, 13 Bluegum Point, 14 – Rams Island).

Species	1	2	3	4	5	6	6	6	7	8	9	10	11	12	13	14	Total
Palearctic Waders																	
Bar-tailed Godwit[1]	0.09	0	6.56	0.75	4.02	0.93	8.83	1.28	0.06	315.2	3.32	17.26	3.51	0	0.79	25.07	388
Whimbrel	0.01	0.06	1.6	0.04	0.29	0.02	0.45	0.1	0.09	15.78	0.38	0	0.3	0.11	0.48	0.04	20
Eastern Curlew	21.61	98.2	167.92	12.13	147.4	112.8	276.3	61	34.89	32.12	163.7	41.63	57.55	0.05	12.21	47.33	1294
Common Greenshank	8.93	0	25.38	2.75	1	1.36	0.41	0	7.66	3.57	0.58	6.34	56.83	62.86	0	0.91	179
Terek Sandpiper	0	0	1.16	0.22	0.48	0	0	0	0	0	0.04	0	0.57	0	0	0.07	3
Grey-tailed Tattler[2]	0.39	0	0.24	0	0.02	0	0.21	0	7.11	0.04	0.42	0	12.66	0.09	0	1.53	23
Ruddy Turnstone	2.11	0	0.04	0	0	0	0.24	0	37.55	0.02	19.9	7.89	0.53	0	0	24.73	93
Red Knot	0.03	0.03	4.56	1.25	6.18	3.91	0.48	0	0.21	18.78	0.86	1.03	4.89	0	1.21	1.22	45
Red-necked Stint	149.9	192.8	1245	314.5	603.1	111.6	228.3	11.8	535.2	96.45	351.8	407.51	727.96	116.07	157.4	191.7	5447
Sharp-tailed Sandpiper	0.75	0.79	107.18	9.92	22.41	23.29	4.24	0	26.91	0.24	39.14	10.51	60.64	44.82	0.91	0.58	353
Curlew Sandpiper	27.15	109.2	1157.9	113	281.5	163.9	145.8	3.3	217.9	76.14	302.5	322.34	1044.7	142.5	25.24	55.62	4202
Pacific Golden Plover	0	0	14.86	0.08	0	0.02	0	0.15	20.13	0.06	4.6	0.03	19.09	0.02	0	5.09	64
Grey Plover	0	0	1	0.1	0.27	0	0	0	0	0	0.32	0.04	0.47	0	0.04	0.06	2
Lesser Sand-plover	0.16	0.03	0.96	0	0.04	0	0	0	0.09	0.08	2.86	0.06	0	0	0.03	2.09	6
Greater Sand-plover	0	0	0.2	0.04	0	0	0	0	0	0	0.74	0	0	0	0	0.24	1
Australasian Waders																	
Pied Oystercatcher[1]	2.3	23.46	1.86	2.07	55.87	4.24	9.5	1.26	5.62	38.28	25.46	32.25	9.69	2.42	11	8.34	236
Sooty Oystercatcher[3]	0.09	0.25	0	0	0.58	0	0.03	0	0.21	0.22	1.05	0.08	0	0	0.05	0.23	3
Black-winged Stilt	0	0	0.07	0	0	0	0	0	0.01	0	0.03	0	0	0.17	0.04	0	0
Red-necked Avocet[4]	0	0	0	0	6.77	26.62	23.56	0	0	0	0	0	0	0	0	0	45
Red-capped Plover	32.73	23	20.13	8.93	9.02	1.81	10.96	0.03	12.54	2.02	10.16	11.58	0.36	0.19	3.5	9.02	157
Double-banded Plover	22.3	20.29	103.92	78.25	79	2.17	15.27	0	57.6	7.92	60.71	7.21	11.63	0	35.29	89.86	598
Black-fronted Dotterel	0	0	0.06	0	0	0	0	0.03	0.04	0	0	0	0	3.19	0	0	4
Hooded Plover[3]	0.82	0	0	0	0	0	0	0	0	0.91	0	0	0	0	0	0.01	2
Masked Lapwing	18.45	7.49	74.26	36.43	29.92	5.88	21.66	10.2	15.31	10.24	15.34	24.97	8.73	32.2	18.36	9.02	375
Totals																	
Palaearctic waders	211	401	2735	455	1067	418	665	78	888	558	891	815	1990	367	198	356	12120
Australasian waders	77	74	200	126	174	59	57	12	91	60	113	76	30	38	68	116	1420
Total per site	288	476	2935	580	1241	477	723	89	979	618	1004	891	2020	405	267	473	13540

* These roosts attracted over 99% of the Palaearctic migratory waders counted in the main area of the bay, and over 80% of the Australasian waders. Totals include some additional minor sites.

[#] Values are mean counts for early and late summer (Palaearctic migratory species), late summer, autumn and winter (Pied Oystercatcher), winter to December (Red-necked Avocet), autumn and winter (Red-capped Plover), winter (Double-banded Plover), all seasons except spring (Masked Lapwing) and all seasons (other Australasian waders).

[1] Numbers increased over the 26 years.

[2] Numbers decreased over the 26 years.

[3] More numerous on ocean beaches outside the survey area, with mean counts of 43 Hooded Plover (23 Phillip Is, 20 Cape Schanck-Pt Leo) and up to 35 Sooty Oystercatcher (10 Phillip Island, 25 Flinders)

[4] Red-necked Avocets became regular visitors in the late 1990s, with counts of up to 900.

Table 2. Main habitats used by waders in Western Port, 1973-2000

SPECIES	FEEDING	Roosting
PALEARCTIC WADERS		
Bar-tailed Godwit	shallows 2	1
Whimbrel	mudflats, rock platforms	1, rocks
Eastern Curlew	mudflats	1, saltmarsh, rocks
Common Greenshank	shallows 2 near mangroves	beaches, fresh water margins, rocky islets
Terek Sandpiper	mudflats	1, formerly mangrove banks
Common Sandpiper	narrow mudflats	posts, jetties, moored boats
Grey-tailed Tattler	mudflats near rocks	rocks, mangrove banks
Ruddy Turnstone	mudflats near rocks	rocks, vegetated rocky mounds
Red Knot	mudflats, shallows 1-2	1
Red-necked Stint	mudflats [#]	1 *
Sharp-tailed Sandpiper	seagrass, saltmarsh [$]	1, saltmarsh *
Curlew Sandpiper	mudflats [#], shallows 1	1 *
Pacific Golden Plover	mudflats near rocks	saltmarsh, mangrove banks, vegetated rocky mounds
Grey Plover	mudflats	1
Lesser Sand-plover	mudflats	1, vegetated rocky mounds
Greater Sand-plover	mudflats	1, vegetated rocky mounds
Australasian Waders		
Pied Oystercatcher	mudflats	1, dead mangroves, wooden structures
Sooty Oystercatcher	ocean beaches, rocks	rocks
Black-winged Stilt	fresh water	no tidal roosting
Red-necked Avocet	shallows 3	1
Red-capped Plover	firm sandy mudflats	1
Double-banded Plover	mudflats, wet pasture	1, saltmarsh, pasture
Black-fronted Dotterel	fresh water margins	no tidal roosting
Hooded Plover	ocean beaches	ocean beaches
Masked Lapwing	mudflats, pasture, lawns	1, saltmarsh, dams, pasture

Note: The terms "mudflats" and "shallows" both refer to tidal environments. Shallows 1 means birds feed by wading along the shoreline and in adjacent wet mud, shallows 2 birds wade at slightly greater depth and shallows 3 they wade or swim further out again. Some birds classed as feeding from mudflats also wade in very shallow water.
The main roosting sites used by waders are sheltered sides of raised spits and islets, denoted by 1.

[#] Also feeds on broad muddy edges of fresh water wetlands when available
[$] Also feeds as above, especially among aquatic vegetation
* May occasionally continue feeding over high tide, when suitable shores are available in nearby fresh water swamps or flooded saltmarsh

Golden Plover, Lesser Sand Plover *Charadrius mongolus* and Greater Sand Plover *Charadrius leschenaultii*. On French Island, resident pairs of Pied Oystercatchers regularly roost on dead mangroves and in the north-west of the island a few have taken to visiting a freshwater swamp 400 m inland (Bullock Swamp) at high tide and roosting on sticks or wooden nest-boxes supplied for duck. This is possibly a unique use of a freshwater habitat by this species that is otherwise exclusively coastal (in contrast to “pied” oystercatchers elsewhere in the world).

Of the species that feed on tidal mudflats in Western Port, just one (Masked Lapwing) also occurs widely in open country and beside farm dams, and on Phillip Island it is remarkably tame and common even on suburban lawns. Several other wader species make little or no use of tidal mudflats. Banded Lapwings *Vanellus tricolor*

occur sparsely and breed on pasture with short grass (Dann 1981) and Black-fronted Dotterels *Elsyornis melanops* occur beside freshwater dams and occasionally on pools in saltmarsh. Latham's Snipe *Gallinago hardwickii* gather in densely vegetated fresh water habitats, and appear to make intermittent use of suitable habitat in Western Port. Black-winged Stilts *Himantopus leucocephalus* inhabit large fresh water dams and lakes such as Swan Lake. Pools of rainwater in pasture or saltmarsh have attracted species such as Black-winged Stilt and Red-kneed Dotterel *Erythrogonys cinctus* on an occasional basis. Hooded Plover inhabit sandy ocean beaches. Sooty Oystercatchers *Haematopus fuliginosus* inhabit ocean-facing sandy beaches and rock platforms, making only occasional use of tidal mudflats within the bay (in contrast to Corner Inlet where they regularly gather on tidal mudflats).

Most migratory waders select extensive mudflats as their main habitat for feeding (Table 2). Within that habitat, species mix or segregate according to tidal stage, water depth and subtle habitat preferences for substrate. One species (Common Sandpiper) avoids the extensive mudflats favoured by other species and inhabits narrow muddy shores of river estuaries and mangrove-lined inlets throughout the bay. Up to 11 Common Sandpipers were found in early years of the survey but there has been no recent census. Favoured sites include Jacks Beach, Canons Creek, Tooradin inlet, Bass River and San Remo/Newhaven.

VIEWING WADERS

The best time to view waders in Western Port is within 3 hours of high tide, as waders are widely dispersed at other times. Waders are more tightly packed and more easily disturbed when roosting than feeding, so the best viewing may be when they have started to spread out to feed 2-3 hours after high tide, or have continued to feed after arriving at their roost. As roost sites and associated high-tide feeding areas appear to be limited in the bay, it is important to keep human disturbance to a minimum. Disturbance on small islets (e.g. Barralliar Island) may be especially detrimental, forcing flights of several kilometres. Studies at Observation Point on Phillip Island have suggested that human disturbance may be significant for feeding waders also, particularly for the larger waders (Taylor and Bester 1999).

The most easily accessible major sites are those at Observation Point (viewed from the cliff-top near Rhyll), Reef Island (viewed from the mainland shore south of Soldiers Road: beware getting trapped at high tide if you cross to the island itself) and Jam Jerrup (formerly known as Stockyard Point). Each of these sites supports a distinct suite of wader species (Table 1). Access to other major mainland roosts involves long walks or crossing private property. Public hides overlook a minor fresh water habitat at Swan Lake on Phillip Island.

Two of the major roosts on French Island (Tortoise Head and Chilcott Rocks/Fairhaven) can be accessed in about an hour's walk from the ferry terminal at Tankerton. The other roosts on French Island require longer walks or hired transport. Barralliar Island can be accessed by hired self-drive boat from Warneet in the north-west of the bay.

SITE DESCRIPTIONS

The following accounts deal with major and minor high-tide roosts and associated feeding areas round the mainland shore of the bay (clockwise from Flinders in the south-east), Phillip Island and French Island respectively. Sites outside the area covered by the BOCA survey are listed in square brackets, and major sites are numbered and titled in bold type.

MAINLAND SHORES AND NEARBY ISLETS

[*Ocean beaches, Cape Schanck to Flinders (Mornington Peninsula)*] Small flocks of small waders use the beaches from time to time, but wave action and human disturbance may limit numbers. Hooded Plover breed and up to 36 were counted along this coast from eight spring counts 1992-94 (Weston 1993, 1995) with a mean of 20. Pied and Sooty Oystercatchers are resident in small numbers.

[*Flinders*] Flocks of small waders feed among kelp on the sandy beach west of West Head, roosting mainly on shores of the headland. Recent observations by VWSG have shown that numbers of some species can be substantial (C.Minton, pers. comm.). Typically, 50-150 Ruddy Turnstone and 150 Red-necked Stints roost in summer on the stony shore at West Head or on the sandy beach to its west, with up to 50 Ruddy Turnstone and fewer Red-necked Stints remaining over winter. A few Sooty Oystercatchers roost on the same stony shore or nearby rocks, with numbers building up to 15-25 in late summer and autumn. A Grey-tailed Tattler

has been seen here each summer from 1998-2000 (C.Minton, pers. comm.).

1. Sandy Point Flocks of small waders roosted regularly on the sheltered north-eastern side of the spit in the 1970s and 1980s, but made little use of the site in the 1990s and it has been dropped from the regular survey. They fed mainly from the mangrove-lined mudflats of Hanns Inlet, which were also visited by a regular flock of 50-100 Common Greenshank. A pair of Hooded Plover was resident at the point in these early years. Small numbers of Common Greenshank, Sharp-tailed Sandpiper and other species occasionally roosted and fed at a small sewage plant serving the adjacent naval base HMAS Cerberus, and may visit public wetlands at Coolart (near Somers) when water levels are low. Access to Sandy Point involves a 6 km walk along the beach from Somers, or special arrangements with the naval base.

2. Long Island This artificial island near Hastings was formed as a by-product of channel dredging. It ranks eleventh in the bay in terms of mean wader abundance, and is used as a roost by waders feeding in the North Arm or disturbed from Barralliar Island. Temporary pools in the nearby steel works have attracted migratory waders (mainly in the 1980s, and including uncommon species such as Terek Sandpiper). Latham's Snipe have also occurred among vegetation in these pools. When the Hastings marina was being built in the 1980s, flocks of small waders used one of the harbour walls for roosting but this no longer occurs. Long Island can be accessed by boat or viewed from the Esso jetty nearby (restricted access).

Blind Bight A small sewage plant was built in the late 1980s, with a farm dam on the edge of the property beside Gentle Annie Road. The dam attracted a flock of 75-100 roosting Greenshank in the late 1980s and early 1990s. They roosted on the grassy banks but ceased to use the site in such numbers when houses were built within 30 m (C.Minton, pers. comm.). Small numbers of Greenshank (<10) continued to be recorded roosting there on rare occasions through the mid 1990s, but vegetation may then have become too dense for larger flocks. Otherwise, flocks of Masked Lapwings and pairs of Black-fronted Dotterel are the only waders regularly observed at this site.

Tooradin A flock of 50-75 Common Greenshank was recorded roosting beside the inlet ~1 km up-river from the road bridge for five years in the mid 1990s, until the vegetation became too long. Banding retraps showed that this was the same flock that had previously roosted at Blind Bight (C.Minton, pers. comm.). They fed generally in the extensive mudflats north of French Island. Small numbers of Latham's Snipe have occasionally been seen north of the inlet. Otherwise, Common Sandpipers are the only migratory species seen regularly here.

3. Bunyip River and Yallock Creek The sandy shore and adjacent earth banks north of the Yallock Creek estuary are the site of the largest wader roost in the bay. Pools in saltmarsh to the north-east are also used by some species (e.g. Pacific Golden Plover, Greenshank and Sharp-tailed Sandpiper) when they hold fresh water. Nearby pasture is used for roosting by Pacific Golden Plover, and for roosting and feeding by Double-banded Plover (and other species after heavy rain). Many of these waders feed at the estuary of the Bunyip River as the tide drops, before dispersing widely to feed in the extensive mudflats north of French Island. A wide range of species is often present, sometimes including uncommon species such as Terek Sandpiper and Greater Sand Plover, and occasional rarities such as Broad-billed Sandpiper *Limicola falcinellus* (most recently one in February 1997) and Oriental Pratincole *Glareola maldivarum* (one in January 1974). Perhaps because of the fresh water influence, Pied Oystercatchers are rarely seen at this site. Bunyip River is also known as Main Drain, as it was channelised in the course of draining the nearby Kooweerup Swamp. Access to Yallock Creek involves crossing private farmland, or a 4 km walk east from the Bunyip River estuary which is 0.6 km across private farmland from the Bass Highway. A car park and scenic viewing tower are available on the landward side of the highway where it crosses the Bunyip River.

4. Settlement Road Narrow eroding beaches on the walled coast south of Yallock Creek and north of Lang Lang River were the site of a major high-tide roost in the 1970s and early 1980s. It was dropped from the regular survey in the mid 1980s after several negative visits, with few waterbirds of any sort. However, waders continue to use these beaches occasionally, as evidenced by large numbers of footprints on some recent visits (R.Millsom pers. comm.). It seems that the area is now used only intermittently, perhaps after disturbance at Yallock Creek. Flocks of Double-

banded Plovers sometimes feed and roost in pasture behind the sea wall. This site is accessed through private farmland from Settlement Road.

5. Jam Jerrup Formerly known as Stockyard Point, this is the third largest wader roost in the bay. Waders roost mainly on a mobile system of sandy banks and a sheltered bay east of the main sandy spit. In early years they often roosted on the spit itself, but human disturbance has contributed to reduced use of that part of the site. However, total numbers of waders using the roost have increased over the years (Loyn *et al*. in prep., C.Minton, pers. comm.). Eastern Curlew gather to roost in saltmarsh further east, where they may be counted either from Jam Jerrup or from Red Bluff Creek. Small waders feed in the bay east of the point as the tide drops before moving further onto mudflats that extend past Grantville to Queensferry. Some flocks also fly across the channel to the east coast of French Island, and banding has revealed substantial interchange of small waders between here and Yallock Creek (C.Minton, pers. comm.). Two species that are regularly found at nearby roosts (Common Greenshank and Grey-tailed Tattler) are rare at Jam Jerrup (Table 1). In the 1990s this site began to attract flocks of up to 900 Red-necked Avocets, mainly in winter and spring, although the species had formerly been considered a mere vagrant to the whole bay. The Avocets feed mainly by wading or swimming in the calm shallow waters of Grantville Bay, and have also been found feeding further north at the mouth of the Lang Lang River. Jam Jerrup often supports a wide range of species, including uncommon birds such as Terek Sandpiper and Grey Plover *Pluvialis squatarola*. Sanderling *Calidris alba* and Broad-billed Sandpipers have been recorded more often than elsewhere in the bay. Flocks of Red Knot tend to favour this area in the occasional years when they are numerous in the bay. Monthly counts at this roost from 1973-83 (Jones 1983, 1984) revealed that waders other than the twelve most common species were likely to be observed on one visit in seven (Jones 1983), and included one species not recorded elsewhere in the bay (Banded Stilt *Cladorhynchus leucocephalus*: one in January 1979 and 3 in June 1981). Bay Road leads to a small parking area beside the beach 1 km north of the point.

6. Red Bluff Creek, Pioneer Bay and Queensferry Waders have been found roosting at different times at a range of sites along this broad bay, and feeding in the same areas as described under Jam Jerrup (above). Eastern Curlew are often best counted from Red Bluff Creek (formerly known as GMH Drain). Combined counts from these sites are similar to those from Jam Jerrup, and some double counting may have occurred inadvertently between these sites. A major rarity was discovered during the survey when a Ringed Plover *Charadrius hiaticula* was found at Pioneer Bay in 1996, and remained there from 23 November to 21 December (Dennett and Hudson 1997). Several tracks lead to the coast along this bay.

Corinella Small numbers of waders roost on the rocks at the point, presumably feeding on nearby mudflats as the tide drops. Whimbrel are among the less common species sometimes observed at this site. On an odd note, two Latham's Snipe were once flushed from dry scrubby woodland behind the town in November 1977 (Dann *et al*. 1994). The point can be accessed or viewed from a public jetty.

Pelican Island Small numbers of waders including Pacific Golden Plover, Whimbrel and Ruddy Turnstone have been seen roosting among rocks on this island. The island is rarely visited and may deserve further inspection.

Dwyers Road Swamp This small swampy dam on private land occasionally attracts a few Sharp-tailed Sandpipers and fresh water waders. It can be viewed from Dwyers Road or Agar Road.

7. Reef Island This is the fifth largest roost in the bay (Table 1), and regularly attracts flocks of Pacific Golden Plover, Ruddy Turnstone and Grey-tailed Tattler, though the latter species has declined greatly in recent years. Waders roost on the rocky island and sometimes on Kennedy Point opposite the island before dispersing to feed on mudflats to the north and south across Bass Bay. Red-capped Plover breed there in most years. Soldiers Road leads to the beach 1 km north of Kennedy Point. . A natural causeway is submerged ~2 hours each side of high tide.

PHILLIP ISLAND

Churchill Island Mudflats between Rhyll and Churchill Island (known as Churchill Tidal Flats) are a major feeding site for large waders that roost on Observation Point (see below). Some waders make use of Churchill Island itself from time to time, and a pair of Pied Oystercatchers

breed there. The island has historical interest and access is available by road bridge between 9 a.m. and 5 p.m.

8. Observation Point This is the eighth largest roost in the bay, and the most important for medium to large waders (notably Bar-tailed Godwit and Whimbrel, Table 1). They roost on the sandy spit north of the inlet, and also gather on a rocky islet dubbed 'Ghetto Rocks' because of its dense concentration of waders (A.Swan, pers. comm.). Numbers of Bar-tailed Godwit have increased from 200-240 in the 1970s to 400 in the 1990s. The site is regularly used by flocks of Red Knot in years when they visit the bay, and Great Knot *Calidris tenuirostris* and Black-tailed Godwit *Limosa limosa* have been recorded more often than at other sites. Most of the large waders feed from mudflats between Rhyll and Churchill Island at low tide, whereas small waders feed from closer mudflats such as those in Rhyll Inlet (Figure 1). A pair of Hooded Plover has nested on the beach west of the point in some years. The site can be viewed from the end of McIlwraith Road in Rhyll. A 3 km walk east along the beach from Sanders Road in Cowes gives closer access but risks disturbance. A boardwalk has been made through mangroves at Rhyll Inlet and a hide overlooks an ibis colony at Rhyll Swamp, but are not generally useful for waders.

[*Swan Lake*] This vegetated freshwater lake at the west end of Phillip Island regularly attracts Black-winged Stilts (which occasionally breed), Sharp-tailed Sandpipers, Red-necked Stints, Black-fronted Dotterels and other small waders. These birds feed and roost on the muddy shores of the lake, and there seems to be little if any interchange with intertidal habitats. Two uncommon fresh water species (Wood Sandpiper *Tringa glareola* and Pectoral Sandpiper *Calidris melanotus*) have been recorded. Many of these birds also occur on a large complex of artificial dams in nearby farmland. Two public hides give good views of Swan Lake, which is close to famous breeding colonies of seabirds (Little Penguins *Eudyptula minor* and Short-tailed Shearwaters *Puffinus tenuirostris*).

[*Ocean beaches of southern and western Phillip Island*] These beaches support breeding populations of Hooded Plover and Sooty Oystercatcher. Up to 28 Hooded Plover were counted from eight spring counts 1992-94 (Weston 1993, 1995), with a mean of 23. A one-year study showed that numbers of Sooty Oystercatchers reached a seasonal peak of 10 in autumn 1979 (Considine 1982). Small flocks of the common small waders also visit these beaches to feed among piles of kelp, especially in winter when there is little human disturbance. Flocks of Ruddy Turnstone occur throughout the year, especially between Cat Bay and the Nobbies and on Seal Rocks.

FRENCH ISLAND

French Island supports a high density of breeding Pied Oystercatchers, probably because there are no Red Foxes *Vulpes vulpes* on the island. They nest on raised banks behind mangroves, in saltmarsh and on offshore islets. Numbers counted in the bay have doubled during the 27 years of the survey (Loyn *et al*. in prep.). A passenger ferry accesses French Island at Tankerton.

9. Tortoise Head This is the second largest roost on or near French Island and the fourth largest in the bay (Table 1). Small waders roost mainly among rocks and on pebble banks on the south-west side of the Head, and feed nearby before moving to mudflats further north along the west coast of French Island. Ruddy Turnstone and Pacific Golden Plover tend to roost among vegetation on rocky mounds, whereas other species prefer to roost on sand or pebble banks. Grey-tailed Tattlers occur occasionally on rocks. Sometimes small waders also roost on rocks near Tankerton Jetty, and they are included in the totals for Tortoise Head. Eastern Curlew tend to roost on rocks (on both sides of the head) or in saltmarsh north-east of the Head, and feed on extensive isolated mudbanks south of French Island. When rainwater pools have collected in the saltmarsh, they attract feeding flocks of Sharp-tailed Sandpipers and occasionally Latham's Snipe. A wide range of species is often present (Table 1). This site supports a regular flock of a few Lesser Sand Plover (up to 18), accompanied by up to four Greater Sand Plover. These species do not occur as regularly elsewhere in the bay, and are uncommon in Victoria. Short-tailed Shearwaters breed on the Head. Access involves a 3 km walk south from Tankerton, with a section through mangroves that is submerged at high tide.

10. Chilcott Rocks Formerly termed Fairhaven, this roost has assumed increasing importance for waders during the course of the survey, attracting low and variable numbers of

waders in the 1970s but now ranking as the third largest on or near French Island and the sixth in the bay. It is mainly used by small waders, Pied Oystercatchers and Common Greenshank that feed along the west coast of French Island and on mudflats in the North Arm. It is probably used as an alternative roost to Tortoise Head, Sandy Point and Long Island, although it rarely attracts Grey-tailed Tattler, Pacific Golden Plover or Sand Plovers. The main roosting site is 750 m south of the basalt rocks 3 km north of Tankerton known as Chilcott Rocks (Quinn and Lacey 1999), but waders may roost anywhere along this 1 km stretch of beach or in adjacent saltmarsh. Waders sometimes roost on a rocky reef 300 m offshore and this site is favoured by Ruddy Turnstone. The bay's only record of a Ruff was of an orange-legged bird seen at Bullock Swamp in November 1997 (see below) and Chilcott Rocks from 31 January to at least 14 February 1998 (Quinn and Mitchell 1998; Quinn and Lacey 1999). It was seen flying inland towards nearby Duschers Swamp or Shag Lagoon, and these may provide alternative feeding sites for waders when water levels are suitable. Access involves a 2-4 km walk north along the beach or a parallel dirt road from Tankerton.

Fairhaven and north-west French Island coast
Waders sometimes roost and often feed from mudflats north of the derelict Fairhaven Jetty (7 km north of Tankerton), and especially in a small bay known as Mini Inlet (Quinn and Lacey 1999), 2 km north of the jetty and immediately south of extensive mangroves. Mini Inlet is especially important for Common Greenshank and Pied Oystercatchers. Minor roosts are used intermittently at the mouth of Redbill Creek (mainly Pied Oystercatchers) and on north-facing beaches in the far north-west. These sites are not regularly visited as part of the survey.

11. Barralliar Island and reefs to north
This is the second largest roost in the bay, and along with Yallock Creek helps serve the vast areas of mudflat in the North Arm and north of French Island. Most waders roost in dense flocks on stony beaches and sandbanks on the eastern side of the 1 ha island. Common Greenshank prefer to roost on the western side, often standing in shallow water close to mangroves. Three pairs of Pied Oystercatchers are resident on different parts of the island. When the tide is not too high, some large waders (notably Eastern Curlew) are able to roost on Long Reef, an extensive stony mudbank ~1 km north-east of Barralliar Island. Conversely, when the tide is too high, many waders are forced to leave both sites and roost elsewhere (e.g. Bullock Swamp, Long Island or Duck Splash). Waders roosting on Barralliar Island usually feed nearby as the tide drops and then fly to Long Reef and then disperse more widely to mudflats north of French Island. Common Greenshank fly east to feed along the mangrove-lined north shore of French Island as the tide drops. On a rising tide, Long Reef is often the final feeding place for waders other than Common Greenshank before moving to roost.

In the first three years of the survey (1973-76), a flock of up to 81 Grey-tailed Tattlers roosted habitually on an isolated bank of mangroves on a basalt reef south of Barralliar Island, often accompanied by Terek Sandpipers, Pacific Golden Plover and a range of other species (all perching on the mangroves). Numbers then declined and this bank has not been used subsequently. In the late 1980s and early 1990s, smaller numbers of Grey-tailed Tattlers (up to 14) and larger numbers of Pacific Golden Plover (up to 65) were found roosting on a similar bank of mangroves north of Long Reef and south of Blind Bight.

Barralliar Island has a high species list, but one species is notable by its scarcity, with just 14 records of Red-capped Plover in 27 years of survey (involving more than five birds on only two occasions: 20 in December 1978 and 12 in February 1979). Up to three pairs of Little Penguin breed on the island.

Self-drive boats can be hired from Warneet to access this site and Bullock and Decoy Swamps (below): beware getting stranded on a falling tide.

12. Bullock Swamp Water levels and salinity vary greatly in this 7 ha swamp on private property next to the State Park. In late summer there is usually an expanse of muddy shore where waders can feed, and it is then used as a high-tide feeding and roosting site by many hundreds of small waders along with flocks of Common Greenshank. Up to six Pied Oystercatchers (nine on one occasion) also fly there to roost, perching on wooden nest-boxes. Fresh water waders such as Black-fronted Dotterel and Black-winged Stilt are often present. A Ruff was seen here from 19-21 November 1997 (C.Minton pers. comm., Quinn & Lacey 1999). Bullock and Decoy Swamps are usually accessed by the team counting Barrallier Island (see above),

landing on French Island at a channel between dead mangroves. It can also be accessed by dirt road 12 km from Tankerton. Permission is required from the owners.

Decoy Swamp This private 4.5 ha swamp is surrounded by tea-tree. When water levels are suitable, flocks of small waders and Common Greenshank gather to feed there at high tide, but numbers are usually lower than at Bullock Swamp. As flocks move between both sites, counts from both sites have been combined. Pasture inland from the swamp was drained many decades ago, and the current landowners have blocked these drains to restore more wetland. Sharp-tailed Sandpipers have been observed in small numbers in the restored wetland.

[*Other inland swamps in north-west French Island*] Heifer Swamp sometimes attracts Common Greenshank (up to 100), Sharp-tailed Sandpiper (200), Latham's Snipe (6), Black-winged Stilts, Black-fronted Dotterel, and other small waders on rare occasions (Quinn & Lacey 1999). Two other swamps between Heifer Swamp and Chilcott Rocks (Shag Lagoon and Duscher's Swamp) attract similar suites of wader species on a more regular basis. Pasture in this area attracts wintering flocks of Double-banded Plover when partly flooded.

Duck Splash This wetland among saltmarsh on the north coast of French Island is quite remote and has not been included in regular counts since the late 1970s. It often supports over 100 Greenshank and is an important high-tide roost for that species. A few small waders also occur there or visit abandoned saltworks further east. Flocks of Eastern Curlew occasionally roost in saltmarsh in this general area.

13. Bluegum Point This obtuse point was regularly used by several hundred waders in the early years of the survey, but is now used less often and by fewer birds. Waders roost on either side of the blunt apex, and much less often on the more prominent but exposed sandy point 2 km further east (known as Great Sandy Point). They spread out to feed on mudflats either side of Bluegum Point, mainly moving south-west along the east coast of French Island. Sometimes they cross the channel to Jam Jerrup on the mainland coast. On one occasion when large flocks were seen at Great Sandy Point itself, those birds flew to Jam Jerrup as the tide dropped: they were probably using the site in response to disturbance at Jam Jerrup 2.5 km away. Access involves a 2.5 km walk east from the former Macleod Prison Farm at Freeman Point.

14. Rams Island Rams Island was a major roost in the early years of the survey, when it was commonly used as an alternative roost to Observation Point for large waders feeding near Churchill Island (mainly Bar-tailed Godwit and Whimbrel). Since the mid 1980s it has been used much less often by those birds, though a record count of 567 Bar-tailed Godwits was made on 6 December 1991. The site continues to attract flocks of smaller species, including Ruddy Turnstone and Pacific Golden Plover. Waders roost on stony beaches and gravel banks on the island itself and on the main French Island shore ~50 m opposite (west of Long Point). If disturbed from Rams Island, Grey-tailed Tattlers would sometimes roost on a bank of mangroves to the north-west (Quinn and Lacey 1999), but the species has not been recorded since 1989. Groups of Lesser Sand Plovers and Greater Sand Plovers were a common feature in early years (here as at Tortoise Head), and now are rarely recorded. A Hooded Plover was seen on 10 December 1988, and is the only record for French Island. Apart from the Bar-tailed Godwit and Whimbrel, most waders disperse west to feed along the south coast of French Island as the tide drops. Eastern Curlew also move out to offshore mud-banks. Pairs of Pied Oystercatcher and Red-capped Plover often breed on the island. This paper does not consider non-breeding terns. However, it should be noted that Rams Island is an important breeding site for Fairy Terns *Sterna nereis* in some years (with habitat now maintained by the Friends of French Island) and often attracts a breeding pair of Caspian Terns. Access is by dirt road from Tankerton or 7 km walk east along the coast from Tortoise Head. A short natural causeway is submerged ~2 hours each side of high tide.

Pecks Point and coast to Tortoise Head Small flocks of small and large waders roost at Pecks Point and elsewhere along the south coast of French Island when high tide is relatively low.

Bird Rock This small islet south of Rams Island sometimes attracts a few Sooty Oystercatchers (visible from Rams Island), but is not an important habitat for waders generally.

CONSERVATION, RISKS AND THREATS TO WADERS AND THEIR HABITAT

The main wader habitats in Western Port benefit from statutory protection through the listing of Western Port as a Ramsar site. Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, Ramsar sites are matters of national environmental significance and approval from the Minister for the Environment is required for actions likely to impact significantly on their values. Similarly, migratory species are also matters of national environmental significance and approval is required for actions likely to impact significantly on their habitat. This should mean that any major developments in the bay are planned to avoid loss of wader habitat. Many parts of Phillip Island and French Island are conserved as State Park, Nature Park or conservation reserves under the Victorian *Crown Land (Reserves) Act 1978*.

Despite this level of protection, change is inevitable and some of it carries risks to waders and their habitat. Some of the high-tide roosts on the mainland shore are on private land, with ownership typically extending to high-tide level (and outside the boundaries of the Ramsar site) (Appleby 1999). More importantly, land clearing and subsequent changes in the catchment over the last century have initiated various processes that affect the bay. Sediment deposition is likely to have increased as a result of erosion in the catchment, altering the dynamics of sediment movement in the bay. Erosion is visibly affecting the north-west coast, already modified by construction of a low sea-wall. Cycles of seagrass dieback and recovery may be natural, but loss over an extended period is surely not, and has occurred in various parts of Western Port (Bulthuis *et al*. 1984; EPA 1995). Causes may include smothering by sediments or epiphytic algae. Gastropods that eat algae may have been reduced by toxic chemicals such as antifouling compounds (EPA 1995, 1997).

Human disturbance is often cited as a negative influence on birds as its effects are immediately visible. Numerous examples have been observed during the survey, and disturbance will increase with increasing recreational use of the bay (Taylor and Bester 1999). Bird watchers have greater effects than casual visitors because their attention is targeted on the birds, and they should take great care to minimise those effects. However, roosts where numbers of birds have declined are among the least disturbed by people in the bay (e.g. those on French Island) (Loyn *et al*. in prep.). Productivity of nearby feeding areas is likely to be the crucial factor in determining use of roost sites by birds.

Increased recreational use can pose risks that will need to be managed. Risks include effects of any over-fishing, damage to seagrass beds from outboard motors, disturbance by jet-skis and effects of dogs on breeding and roosting birds. Special measures have been implemented to protect nesting Hooded Plovers from domestic dogs and other predators on Phillip Island and the Mornington Peninsula (Dann & Baird 1997, Dowling & Weston 1999, Phillip Island Nature Park 2001). Measures are being implemented to control Red Foxes on Phillip Island (Phillip Island Nature Park 2001).

The introduced cordgrass *Spartina* spp. has established unwelcome footholds at Bass River (Bridgewater & Hughes 1974, Williamson 1996) and control measures are being implemented. It also occurs in at least one inlet near Tooradin in the north-east of the bay. Early control is recommended to contain this species, which has caused problems elsewhere in Australasia and the Pacific (e.g. Daehler & Strong 1996, Hedge & Kriwoken 2000).

Heavy industrial development is confined to the North Arm near Hastings, where dredging has helped provide new roosting habitat for waders (Long Island). Regular shipping carries risks of pollution and introduction of exotic marine organism in ballast water. These risks will need to be managed, especially if plans proceed for further deep-water port development.

Migratory waders are subject to pressures from hunting and habitat loss at various points along the flyway. Sea levels are expected to rise as a consequence of global warming, and this is likely to have profound effects on intertidal wader habitats. These global issues are beyond the scope of this paper, but monitoring can contribute to assessing such effects as they occur.

DISCUSSION

As a habitat for waders, the main feature of Western Port is the vast extent of mudflats available at low tide. Areas available for feeding at higher tidal levels are quite restricted, especially in mangrove-fringed coasts, and are important for small waders

that need to feed for long periods (Evans 1974, Loyn 1978, Dann 1999a). These features are shared with many embayments throughout the eastern flyway. The extent of mudflats at low tide poses challenges to bird watchers and counters, which are best addressed by focusing efforts close to high tide when birds are concentrated. The best viewing opportunities arise either side of the roosting period, when waders are less susceptible to disturbance.

Recent development may have increased the availability of feeding areas at higher tidal levels by providing new sources of sediment through clearing in the catchment and by dredging. However, most favoured feeding sites in Western Port appear to be essentially natural in origin. Mangroves play a fundamental role in the ecology of the bay, and along with seagrass beds are the main source of primary productivity (Shapiro 1975). In Western Port some wader species habitually feed along mangrove-lined shores (Common Greenshank) or use mangroves for roosting (Table 2), as they do elsewhere in Australia (Higgins & Davies 1996, Minton 2000). Hence mangroves should be seen as a positive feature of the habitat for waders, despite their role in restricting feeding opportunities for some species.

Fluctuations in numbers of waders have been observed over the 27-year course of the survey (Dann *et al*. 1994; Loyn *et al*. in prep.; BOCA data unpublished), and some are related to the condition of the intertidal habitat and the seagrass beds. Changes in bird numbers can be among the first or most conspicuous signs of ecological change. Following the dieback of seagrass in the early 1980s (Bulthuis *et al*. 1984; EPA 1995), recovery of waterbird numbers has been strong in some places but weak in others (e.g. Settlement Road, i.e. the segment between Yallock Creek and Lang Lang River). Numbers of Eastern Curlew have recovered from a decrease at that time, but Grey-tailed Tattlers remain less numerous than in the early years of the survey (Loyn *et al*. in prep). Information of this sort needs to be accessed routinely by conservation managers and planners. Protection of intertidal habitat needs to be the prime consideration in future conservation measures.

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BRISTLE-THIGHED CURLEW *NUMENIUS TAHITIENSIS* ON MANUS, ADMIRALTY ISLANDS, PAPUA NEW GUINEA

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A Bristle-thighed Curlew *Numenius tahitiensis* on the airfield at Manus I., Admiralty Is. (Bismarck Archipelago) on 13 August 2000 represents the first record for this species from Papua New Guinea and one of the most westerly records of this species. The bird was initially found by Voni Strasser, a client on the Victor Emanuel Nature Tours Inc. tour to the island, who pointed it out to PRK. The bird was standing in rough grassland approximately 100 metres from the boundary road. Although it was clearly aware of our presence, it was not unduly nervous and allowed continuous observation from 08:00 to 09:30.

The bird was clearly a medium sized *Numenius* showing well-defined and obvious dark lateral crown stripes that bordered a narrow, paler central crown stripe. Although Whimbrel *Numenius phaeopus* is the most likely *Numenius* to occur in this region (Coates 1985, Bishop pers. obs.), the bird was recognised as Bristle-thighed Curlew by PRK who has previous experience of this species from the Tuamotu archipelago, French Polynesia. After observing the bird for approximately 10 minutes, it began to preen its tail, revealing the cinnamon colour to the rump, upper tail coverts and the black and cinnamon barred tail.

With the identification clinched, the other observers on the island were rounded up and all saw the bird well and agreed with the identification. Due to the limited time available before the departure of our flight to Kavieng, we decided to flush the bird in order to allow all observers to see the diagnostic cinnamon colouration to the rump and uppertail coverts. The bird was very approachable, allowing three observers to get to within 15 meters before it flew past all the observers and landed on the beach adjacent to the road. Here it favoured the rocky coastline and was seen alongside two Wandering Tattlers *Heteroscelus incanus*. Against the breaking waves, the long 'bristles' appeared silvery and could clearly be seen extending down from the lower flank feathers around the base of the tibia.

The bird was clearly not an adult in breeding plumage and it is probable that the bird was an immature possibly over-summering on Manus I. Studies on Laysan Island have shown that immature Bristle-thighed Curlews remain on the island for at least three years and many for four years before returning to Alaska (Marks & Redmond 1996). The presence of just a few adult scapulars perhaps indicates this bird was in its second calendar year and had yet to complete its body moult from first winter to second winter plumage.

A video recording was made of the bird by Joe Strasser, which illustrates the bird at rest and in flight.

Detailed description

The crown was clearly marked by dark brown lateral crown stripes with a pale, narrow stripe through centre, much as Whimbrel. These bands merged at the rear of the crown and formed a dark diffuse line down the centre of the nape, contrasting with paler neck feathering. The supercilium was pale and broad, extending from base of the bill to the rear edge of the ear coverts where it curved down behind them. The dark lores and a line behind the eye extended to the rear of the ear coverts. The sides of the head and neck were slightly warmer than those of Whimbrel and lacked the conspicuous streaking of that species.

The breast was pale sandy brown and faintly streaked darker. The flank colour was similar but marked with faint vertical barring. The belly was pale sandy brown and unmarked, appearing paler than breast. The posterior flanks were washed with faint cinnamon. Scapulars and wing coverts were worn and abraded so that they appeared fairly uniform greyish-brown with little in they way of patterning. However at least three scapulars had been replaced and showed the clearly marked bright buff notches and black centres characteristic of adult summer Bristle-thighed Curlew. The old, worn scapulars and coverts contrasted with these replaced scapulars. Rump and uppertail coverts were bright cinnamon which was very obvious when bird was preening and also in flight. The tail was a similar bright cinnamon colour but barred black.

The bristles – long feather shafts – were only obvious at close range when seen with the breaking sea behind.

The bill was slightly longer and straighter at the base than shown by Whimbrel. The distal 30% was decurved. The upper mandible was black while the lower mandible was largely dull-pink with only the distal 25% being black. Overall, it appeared to be heavier and blunter. The legs were greyish. The pale lower mandible indicates that the bird was probably an immature as it is completely black in adults (Zimmer pers. comm.).

No call was heard even when flushed.

Status

Bristle-thighed Curlew breeds only on the tundras of western Alaska (A.O.U. 1998). It migrates to winter on islands in the Pacific from north-west Hawaii south-east to Ducie Island. The main wintering range extends from Midway Island in the north- west Hawaiian Islands south-east to the atolls in the Marquesas, Tuamotu and Society groups in Polynesia. Further west, it becomes scarcer but still occurs regularly in eastern Micronesia, including Samoa, Tonga, Fiji, the Marshall Islands and New Caledonia. Its occurrence is casual in western Micronesia including Mariana and Caroline Islands and Yap (Higgins & Davies 1996).

There are a handful of records of Bristle-thighed Curlew from the Solomon Islands: 16 September 1997 four seen on and around Pileni, Reef Islands (Dutson in prep.); Duff Islands (Marks & Redmond 1994), Tikopia (Stickney 1943) and Malaita (Scofield 1994). Two specimens from Malau Lalo in the Three Sisters, Solomon Islands are lodged in the Natural History Museum (U.K.). One was collected on 30 October 1935 (and the other, undated but with a consecutive collection number) was collected by W.H. Barons (Dutson pers comm.).

The main wintering range therefore lies well to the east of Papua New Guinea with the nearest regular wintering birds occurring about 2000 km away. This species becomes increasingly uncommon further west in its winter range and the only accepted records, to date, for this species in the Australasian region are of three single birds in the Kermadec Is. (Higgins & Davies 1996).

The occurrence of Bristle-thighed Curlew on Manus in the Admiralty Is., Papua New Guinea, while surprising, is not entirely unexpected (Coates 1985). It remains to be seen whether regular observations on Papua New Guinea's outlying islands show that the species occurs regularly in the region.

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POWDERCOATING OF ABBS BANDS – AN EXAMPLE USING CRESTED TERN BANDS

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PREPARATION OF BANDS

Frames to hold the bands were constructed by welding iron together into a rectangular frame. The individual wire's on each frame specifically have been made specifically to hold Crested Tern band (size 7). Bands are manually placed onto ten frames, which contain individual wires from which each band will be suspended. Each frame holds 100 bands so a total of 1000 bands are powdercoated annually.

POWDERCOATING PROCESS

The automated powdercoating procedure features a 7-stage zinc phosphate pretreatment system that allows coating of various base metals. The bands are then dried off for eight minutes at 230^{o}C. A polyester powder is then applied of whatever commercially available colour. The powder used for the process is a mixture of finely ground particle of pigment additives and resins', which is electrostatically applied (or perhaps better described as being "fogged") onto the surface to be coated. The charged powder particles adhere to the electrically grounded surfaces until heated and fused into a smooth coating which cures for a total of 20 minutes. The result is a uniform, durable, high quality, and attractive finish.

PERFORMANCE

The standard durability of the polyester exterior formulation is:

- 2 hours, Water Immersion at 40° C
- 240 hours, 98% Humidity at 40°C
- 240 hours, Neutral Salt Spray per ASTM B117.

Crested Tern chick with a orange powdercoated band (Source: Petina Pert).

Summary of Crested Tern bands powdercoated, colour and year applied.

Year	Colour applied	No. of bands powdercoated	No. of bands used
1995	Orange	1000	1000
1996	Blue	1000	1000
1997	Yellow	1000	697
1998	Green	1000	938
1999	White	1000	1000

OCCASIONAL COUNTS NO 5

WADER COUNTS ON KIDNEYBEAN CLAYPAN AND ADJACENT ROEBUCK PLAINS, NORTHWESTERN AUSTRALIA

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INTRODUCTION

Roebuck Bay, in northwestern Australia, is one of the most important sites in Australia for migratory shorebirds (Watkins 1993). Its large intertidal flats are used as feeding grounds by many thousands of shorebirds and the roost sites along its northern beaches have been a focus for banding studies and regular counts in the past 20 years. It is perhaps not so widely recognized that the adjacent Roebuck Plains, a large grassland system to the north and east of Roebuck Bay, are also of great importance to shorebirds of north-western Australia. In this note we present the first data on the birds of Kidneybean Claypan, a large wetland within the Roebuck Plains system that only became known to ornithologists recently and is proving to be an impressive shorebird site.

DR and Andrew Dunn 'discovered' this claypan on 7 April 1998, while attempting to locate the areas where shorebirds of Roebuck Bay roost on spring tides higher than 8.5 metres. Examination of aerial photographs and a 1:100,000 map of the Broome area suggested that a claypan some 8 km east of Broome Bird Observatory might offer suitable habitat for roosting shorebirds.With some difficulty we worked out a route into the area, using a GPS and a decaying fenceline for guidance. On arrival, it was immediately apparent that the claypan was one of the most outstanding birdwatching sites in the Broome area. As it was unnamed at the time, we informally christened it Kidneybean (the main claypan is shaped a bit like a Kidneybean when viewed from the air).

Since then Kidneybean has been visited fairly regularly by birdwatchers, many lured by the prospect of seeing Yellow Chats (a species that is common and regularly seen at Kidneybean, but is otherwise a difficult bird for birdwatchers to find). We have undertook shorebird counts during these visits, and these are summarized here. However, many of these counts have been hasty or incomplete. A further impediment to our understanding of the area has been access – although there is now a fairly well-defined track to Kidneybean, for several months a year it is too wet and muddy for an approach even by four-wheel drive vehicles. We have occasionally managed to reach Kidneybean in these conditions, but the punishing walk, involving up to a 17 km return trip through difficult terrain, is not a light undertaking.

GEOGRAPHY AND HABITAT

A rough map of Kidneybean Claypan and its surrounds is shown in Figure 1. It occurs on the saline grasslands of Roebuck Plains, close to their interface with the samphire flats which lie between Kidneybean and the mangroves of Roebuck Bay (for descriptions of habitat types, see Kenneally *et al*. 1996). When water levels are high, Kidneybean appears to be a single large wetland, but when drying out water contracts to two main wetlands, known informally to us as "Main Lake" and "Duck Lake" (Fig. 1). To the southwest of Kidneybean Claypan, there is an extensive unvegetated claypan referred to as the Southern Pan in this paper. Although this claypan is larger than Kidneybean, it seldom holds as much water (we suspect that unlike Kidneybean, water from this claypan drains to the sea) and is usually relatively birdless. However, when water-

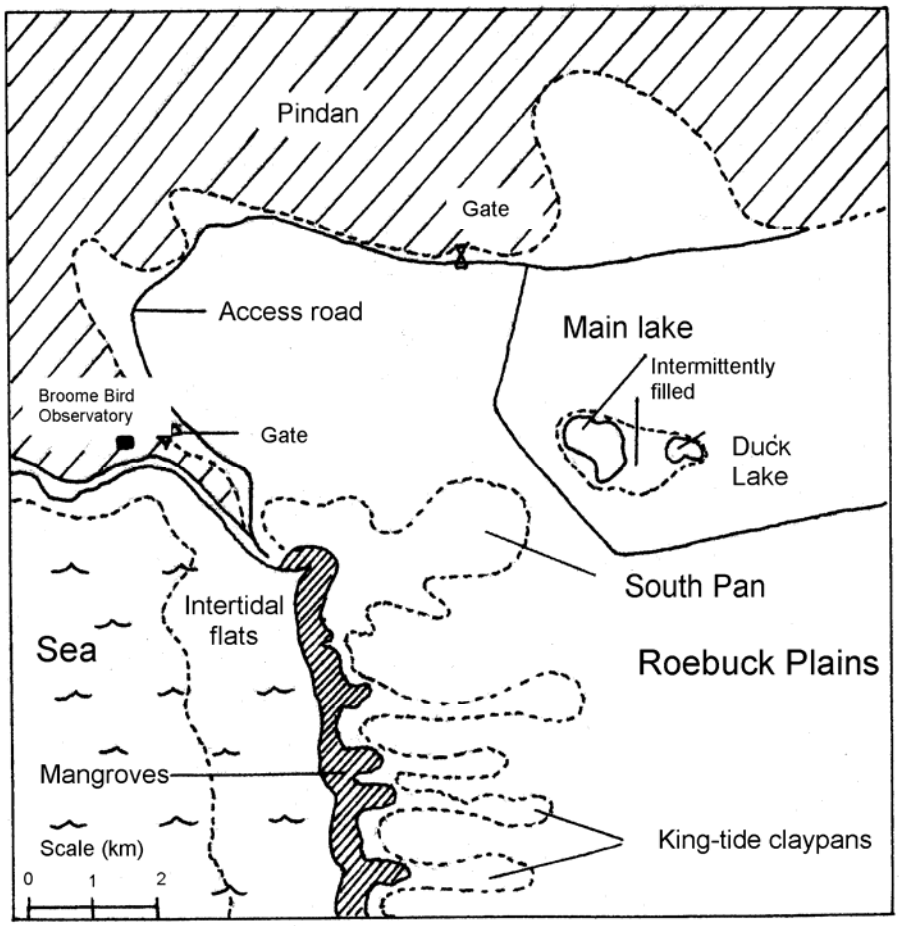

Figure 1. Map showing Kidneybean Claypan (17° 58.353' S 122° 25.124' E) and surrounding Roebuck Plains. Adapted from 1:100,000 maps of the Broome and Villaret areas; the Southern Pan is larger than shown on these maps (pers. obs.).

filled it can form a large lake with impressive numbers of waterbirds, and we usually take a look at it when in the Kidneybean area; bird counts from this pan are also mentioned in this document. Maps and aerial photographs suggest there are about ten claypans similar to the Southern Pan (rather than to Kidneybean) along the eastern coast of Roebuck Bay (Fig. 1).

Kidneybean Claypan lies in a very open and flat area; the claypan is about 5 km from the nearest trees (mangroves to the south and east, *Acacia* dominated woodlands to the north). The claypan itself is not heavily vegetated, but it holds an aquatic grass, *Najas sp.*, which we consider important to waders (see below). The claypan is surrounded by a narrow band of fairly sparse saltmarsh dominated by Samphire (*Halosarcia auriculata*), in which shorebirds such as Sharp-tailed Sandpipers and Little Curlews feed, given appropriate water levels. Much of the surrounding grass (*Eriachne* sp.), especially to the north of Kidneybean, is fairly tall (frequently up to 1.5 m tall when flowering in the wet season) with some bare ground between tussocks; in places there are shorter, denser patches of Saltwater Couch *Sporobolus virginicus*. Our perception is that is the grasslands are too dense for most waders. The nearby samphire (mainly to the south) is sparser, interspersed by small bare patches from a few to *c.* 50 metres wide. These can hold reasonable numbers of shorebirds (especially Sharp-tailed Sandpipers and Common Greenshanks) when flooded.

The suitability of Kidneybean Claypan and its surrounds for waders is strongly affected by water levels. Most or all of the water in Kidneybean comes from local rain, which mainly falls in the wet season from about December to April. Initially, we suspected that Kidneybean Claypan received some of its water from king tides, as the water within Kidneybean generally tastes somewhat brackish. However, we now think this brackish quality must be related to salt within the local soil. Subsequent visits have shown

Table 1. Maximum counts of waders at Kidneybean Claypan, 1998 to 2000. Species denoted with an asterisk * are discussed in the main body of the text.

SPECIES	Maximum count	Date of maximum count	Water levels during maximum counts
Black-tailed Godwit*	50	7 Sep. 2000	Shallow
Bar-tailed Godwit*	2	7 Apr. 1998	Deep
Little Curlew*	1285	28 Sep. 1999	Shallow
Common Redshank	4	24 July 2000	Deep
Marsh Sandpiper*	620	14 Oct. 2000	Shallow
Common Greenshank*	600+	8 Sep. 1999	Shallow
Wood Sandpiper	5	22 Aug. and 20 Sep. 1999	Deep, shallow
Terek Sandpiper	1	30 Sep. 2000	Shallow
Common Sandpiper	1	1 Oct. 1999 and 22 Aug. to 8 Sep. 2000	Shallow
Grey-tailed Tattler	8	19 Sep. 2000	Deep
Ruddy Turnstone*	100	4 Oct. 1999	Drying out
Asian Dowitcher	2	7 Sep. 2000	Deep
Great Knot*	6900	31 Aug. 2000	Deep
Red Knot*	1930	31 Aug. 2000	Deep
Red-necked Stint	300	26 Sep. 1999	Shallow
Long-toed Stint	16	30 Sep. 2000	Shallow
Pectoral Sandpiper	1	20 Oct. 2000	Drying out
Sharp-tailed Sandpiper*	3000	15 Apr. 2000	Shallow
Curlew Sandpiper*	1500	24 July 1998	Shallow
Broad-billed Sandpiper	6	30 Sep. 2000	Shallow
Ruff	1	1 Oct. 2000	Nearly dry
Red-necked Phalarope	1	1-28 Sep. 2000	Shallow, drying out
Black-winged Stilt	3000	13 June 1999	Deep
Banded Stilt	1	7 Sep. 2000	Deep
Red-necked Avocet	30	8 Sep. 1999	Shallow
Pacific Golden Plover	40	28 Sep. 1999	Drying out
Red-capped Plover*	650	28 Sep. 1999	Drying out
Lesser Sand Plover	10	30 Sep. 2000	Drying out
Greater Sand Plover	220	28 Sep. 1999	Drying out
Oriental Plover*	400	29 Sep. 1999	Drying out
Red-kneed Dotterel	80	28 June 1999	Deep
Masked Lapwing	105	7 Sep. 2000	Drying out
Oriental Pratincole	3	14 Oct. 2000	Drying out
Australian Pratincole	260	22 Sep. 1999	Drying out

that king tides of *c*. 10 m have fallen short of Kidneybean, though they can get to within a few hundred metres and fill the Southern Pan. It is possible that storm surges do occasionally send sea-water into Kidneybean. This would explain the presence of shells of intertidal molluscs found in the claypan (identified by M. Lavaleye). These include *Nassarius dorsatus* (Röding, 1798), a dogwhelk (Nassaridae) characteristic of the intertidal flats of Roebuck Bay, and several mangrove-dwelling species such as the periwinkle *Litoraria filosa* (Sowerby, 1832; family Littorinidae), *Cerithidae reidi* (Houbrick, 1986; family Potamidae), and the pulmunate snails (family Ellobiidae) *Elobium aurisjudae* (Linnaeus, 1758) and *Cassidula nucleus* (Gmelin, 1791).

In our presentation of maximum counts from Kidneybean Claypan (Tables 1 and 2), we have made a rough classification of water levels during each visit. The categories identified are:

- **Deep:** Entire claypan immersed, with water extending into the vegetation at the sides of the claypan. In such conditions Kidneybean can hold large numbers of ducks and Ciconiiformes, and the vegetation at the fringes can support cryptic birds such as crakes. Open areas of the claypan

Table 2. Maximum counts of waterbirds of interest at Kidneybean Claypan, 1998 to 2000.

SPECIES	Maximum count	Date of maximum count.	Water depth during maximum count
Magpie Goose	380	7 Sep. 2000	Deep
Plumed Whistling Duck	270	22 Aug. 1999	Deep
Wandering Whistling Duck	580	22 Aug. 1999	Deep
Black Swan	79	7 Sep. 2000	Deep
Radjah Shelduck	1	7 Sep. 2000	Deep
Australian Wood Duck	8	7 Sep. 2000	Deep
Pacific Black Duck	2000	18 July 1999	Deep
Grey Teal	1320	7 Sep. 2000	Deep
Pink-eared Duck	2	27 Sep. 1999	Shallow
Hardhead	250	7 Sep. 2000	Deep
Australasian Grebe	600	13 June 1999	Deep
Hoary-headed Grebe	2	7 Sep. 2000	Deep
Great-crested Grebe	9	13 June 1999	Deep
Little Pied Cormorant	20	20 Sep. 1999	Shallow
Pied Cormorant	8	18 July 1999	Deep
Little Black Cormorant	1	18 July 1999	Deep
Darter	1	13 June 99; 6 Aug. 99	Deep
Australian Pelican	260	6 Sep. 2000	Deep
White-faced Heron	69	13 June 1999	Deep
Little Egret	120	6 Apr. 1999	Deep
White-necked Heron	40	30 June 1999	Deep
Great Egret	160	6 Apr. 1999	Deep
Intermediate Egret	1	18 July 1999	Deep
Glossy Ibis	3000	13-28 June 1999	Deep
Australian White Ibis	2000	13 June 2000	Deep
Straw-necked Ibis	1500	13 June 1999	Deep
Royal Spoonbill	28	7 Sep. 2000	Deep
Black-necked Stork	4	26 Sep. 2000	Deep
Black Falcon	6	22 Aug. 1999	Deep
Brolga	134	6 Aug. 1999	Deep
Australian Spotted Crake	16	13 June 1999	Deep
Purple Swamphen	30	13 July 1999	Deep
Coot*	1550	13 June 1999	Deep
Red-backed Button-quail	1	12 Sep. 2000	Shallow
Gull-billed Tern	280	18 July 1999	Deep
Caspian Tern	58	6 Aug. 19999	Deep
Whiskered Tern	400	22 Aug. 1999	Deep
Yellow Chat*	1060	22 Aug. 1999	Deep
Tawny Grassbird	1	12 Sep. 2000	Shallow

are generally too deeply immersed to be suitable for shorebirds, but some (particularly Common Greenshanks) make use of small pools in nearby saltmarsh. In addition, the Southern Pan can offer suitably open and shallow water for shorebirds.

- Shallow: Claypan largely (>50%) covered by shallow surface water, with an area of exposed mud between the surface water and the nearest vegetation. It is in this condition that we have found the largest numbers of shorebirds at Kidneybean.

- Drying out: Little (<50%) or no surface water, with much mud exposed around the remaining pools of surface water in the centre of the claypan. Most or all of this mud is still moist. When Kidneybean is drying out, the aquatic grass *Najas* (which grows in Kidneybean when it is full) forms a smooth thick (*c*. 3 cm) carpet on the bed of the claypan; on exposure it rapidly bleaches to become clean white (making the claypan look a barren place!). The *Najas* carpet seems to hold water well, and for up to a month after the last surface water has evaporated, the bed of the claypan beneath the *Najas* carpet remains moist and rich in invertebrates.

- Dry: No surface water, bed of claypan dry. Few or no shorebirds remain at Kidneybean in such conditions.

Water levels in Kidneybean Claypan have differed in each of the three years that we have visited the area,

although in each year the claypan has been filled by rainwater during the January-March wet season. In 1998 Kidneybean was already shallow during several visits in April, and it had dried out by 2nd August. In 1999, reasonable rainfall during the wet season was followed up by heavy and unusual rains during the dry season, and Kidneybean Claypan did not dry out until October. In 2000, exceptionally heavy rainfall during the wet season resulted in remarkably high water levels and Kidneybean Claypan did not completely dry out until November. An interesting feature of this year was that the bed of *Najas* covering the bed of Kidneybean Claypan was not as extensive as in previous seasons, although there was more *Najas* to be found in the Southern Pan. We suspect that water levels in Kidneybean may have been too deep for *Najas* in this particular season.

BIRD COUNTS

Table 1 presents maximum counts of waders from Kidneybean Claypan. It is based on 23 complete counts and a smaller number of partial counts, mainly from April 1999, June to October 1999 and September to November 2000. Table 2 summarises noteworthy counts of waterbirds made at the same time. Below, some additional notes are given on selected species.

Black-tailed & Bar-tailed Godwits: A distant flock of thousands of unidentified godwits was seen on 8 Sept. 1999.

Little Curlew: Large numbers were seen in late September and October in both 1999 and 2000. Another noteworthy count was of 400 birds seen unusually late, on 15 April 1998, when birds seen were obviously fat, in fresh and complete breeding plumage, and feeding quietly in sparse flooded saltmarsh at the boundary of Kidneybean. We do not know if large numbers of Little Curlew occur here in all departure seasons (high water levels prevented us reaching the area during the departure seasons of 1999 and 2000).

Common Greenshank: Numbers around Kidneybean are easily underestimated, especially when water levels are high; in such conditions they occur not only in the main claypan, but in small secluded pools within adjacent saltmarsh.

Ruddy Turnstone: In late September and October 1999 there was an influx into Kidneybean, presumably from Roebuck Bay. Kidneybean had almost dried out by this stage, with little or no surface water remaining; the recently exposed areas were covered by a carpet (*c*. 4 cm thick) of moist *Najas*. Ruddy Turnstones fed by turning over *Najas* and taking unidentified invertebrates from the moist mud surface below; we estimated that 100 or fewer Turnstones tore up *c*. 30% of the *Najas* cover of Kidneybean Claypan during this period.

Great Knot: Usually Kidneybean holds very few (<5) or no Great Knots. The only time large numbers were seen was during a spring high tide of 8.9 m. On other occasions, we have visited Kidneybean on equally high tides but found no Great Knots. The unusual feature of the spring tide of 31 Aug. 2000 (when Great Knots were present in large numbers) may have been that it was the first big high tide of a rising series; this meant that salt-flats closer to Roebuck Bay had not been moistened by a previous tide and were probably therefore uncomfortably warm for roosting shorebirds.

Red Knot: The only high count of roosting Red Knots at Kidneybean was during a spring high tide which also moved many Great Knots to the area. Unlike Great Knots however, reasonable numbers of feeding Red Knots have been seen at Kidneybean. All such observations were in late September to October 1999, when 78-263 Red Knots fed on *Najas* mats on the drying claypan. Most birds involved were recently arrived juveniles, and in addition to capturing small insects some were seen eating the small black seeds of *Najas*.

Sharp-tailed Sandpiper: Counts of 2000 or more have been made both on northwards passage (1998) and on southwards passage (1999, 2000). Previously, the largest flocks seen in the Broome area were only on the order of 200 to 250 birds (Collins 1995).

Red-capped Plover: Red-capped Plovers breed regularly at Kidneybean when it is drying out. They also inhabit and breed upon the Southern Pan when this is drying out but still has moist ground covered by a mat of *Najas*. As there is about 10 other claypans further south that appear (from aerial photographs) to be very similar to this one, the total number of Red-capped Plovers using and breeding on the claypans of Roebuck Plains is likely to be in the thousands. The numbers of Red-capped Plovers on high-tide roosts on the northern beaches of Roebuck Bay vary substantially and this has been attributed to them

moving "inland" to breed when conditions are favourable (Collins 1995). While we agree, we suspect that the inland movement for most individuals is only a matter of a few kilometres to Kidneybean and other claypans within the Roebuck Plains complex.

Coot: Used Kidneybean at least once as a moulting area; on 6 April 1998, when we saw a single raft of 900 moulting, flightless Coots.

Whiskered Tern: Breeding colonies have been recorded in each of 1998, 1999 and 2000.

Yellow Chat: Numbers fluctuate; numbers counted on visits to Kidneybean range from 3 to 1060. At times (especially when water levels are high) Yellow Chats scatter over Roebuck Plains and Kidneybean appears to hold no particular attraction for them. In general though, densities of Yellow Chats are higher around Kidneybean than on other parts of the plains. This was particularly clear in September-October 1999, when Kidneybean was drying out and most of Roebuck Plains had already dried. Yellow Chats were abundant in the vegetation surrounding Kidneybean and some even foraged on the mud of the open claypan; it is possible that the moist *Najas* mats remaining on Kidneybean were a breeding ground for the invertebrates that Yellow Chats were feeding on.

DISCUSSION

Counting shorebirds can be difficult at Kidneybean Claypan, especially when water levels are high and some species (such as Common Greenshanks, Little Curlews and Sharp-tailed Sandpipers) can feed in wet vegetated areas where they are difficult to see. For many species, it is likely that the maximum counts we have so far observed at Kidneybean fall well short of the numbers of birds that actually use the site. Nevertheless, the early data collected suggest that Kidneybean Claypan is important to the conservation of many shorebird species. Following the criteria of Watkins (1993), it would appear to sometimes hold nationally significant numbers of Marsh Sandpipers (>1% of the national population) and internationally significant numbers of Common Greenshank, Oriental Plover, Sharp-tailed Sandpiper and Black-winged Stilt (>1% of the estimated population of the East-Asian Australasian Flyway). Kidneybean is also a local stronghold for Little Curlews, Red-capped Plovers, and arguably Pacific Golden Plover, Long-toed Stint and Australian Pratincoles. Great Knots and Red Knots have been recorded on Kidneybean Claypan in internationally significant numbers, but probably only roost there on a small number of spring high tides when preferred spring tide roosts closer to Roebuck Bay are unsuitable.

Counts at Kidneybean Claypan should be continued to develop a better understanding of shorebird use of the area. Birdwatchers visiting the area should contact Broome Bird Observatory first, in part for advice on track conditions, and also so as not to endanger the cordial relations between BBO and the landowner. It is important to keep vehicles on the existing tracks to Kidneybean Claypan, as wheel ruts make a lasting impression on the local grasslands. Count procedures at Kidneybean depend very much on water levels, so no precise guidelines can be made. When water levels are high, a good deal of walking needs to be done in order to find all waterbirds in the vegetated fringes of the claypan. Even when water levels are lower, a good deal of walking is required; Main Lake, Duck Lake and the Southern Pan all need to be inspected if a complete count is being attempted. Finally, further exploration of potential shorebird sites on Roebuck Plains is needed. It is not impossible that other claypans similar to Kidneybean occur on Roebuck Plains.

Kidneybean Claypan is part of Roebuck Plains Station. The claypan is fairly remote and is seldom visited by anybody except birdwatchers. We are not aware of any immediate threats to the area. Cattle sometimes move into Kidneybean to graze near or drink at the claypan. At this stage there is no evidence that they do any harm to the waders of the area; wader and cattle must have co-existed here for some time. However we have no information on how shorebird use of the area might have differed before cattle were introduced, and it is likely that reasonably intensive cattle grazing in the area will have had some impact on the local vegetation. A detailed study the effects of cattle grazing on the shorebird habitats of Roebuck Plains would be very helpful.

For the longer term the legal conservation status of Kidneybean Claypan merits consideration. It falls in the "Roebuck Bay Area" listed on the Register of the National Estate, and has Ramsar listing. However this does not automatically protect Roebuck Plains from subsequent development, and it is not certain that this

area will always be used only as a cattle station. For example, schemes have been proposed to irrigate Roebuck Plains for cotton cultivation and a kaolin mining proposal is currently under consideration by the wardens court of the Department of Minerals and Energy (DOME). The site for this is on the neighbouring Thangoo pastoral lease. The site is approximately 18 km south of Kidneybean Claypan in very similar habitat. Some kind of legal classification or agreement to protect Kidneybean Claypan and its surroundings from such development would be desirable.

ACKNOWLEDGEMENTS

Most shorebird counts performed at Kidneybean Claypan have been performed for Broome Bird Observatory or with their assistance. We are also grateful to Roebuck Plains Station (especially ex-manager Rodney Illingworth) who allowed us access to the Kidneybean area. Doug Watkins and Tim Willing responded quickly and helpfully to questions that arose as we prepared this paper.

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POPULATION MONITORING COUNTS FOR WINTER 1999, SUMMER 2000 AND WINTER 2000

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The population monitoring counts are given for winter 1999, summer 2000 and winter 2000. There are still a few counts missing, but these will be published later. The counts are published without comment in the interest of not delaying their publication any longer. Count organisers are encouraged to return their counts as quickly as possible. We hope that February counts can be published in the April *Stilt* in the future and June counts in the October *Stilt*. Many thanks to all the counters involved and to the regional organisers. This work is extremely valuable and must be continued. Indeed, it is possibly the best day's fieldwork that can be done by any individual.

WINTER 1999	QUEENSLAND								NEW SOUTH WALES						
	Cairns	Townsville	Mackay	Gladstone	Moreton Bay	Lockyer Valley	Bowen	Tweed	Richmond	Clarence	Hunter	Tuggerah	Parra	Botany Bay	Shoalhaven
Latham's Snipe															
Black-tailed Godwit			110		3						226				
Bar-tailed Godwit	69	254		3	1681		2	9	29		7			204	
Little Curlew															
Whimbrel	66	17	17		116			2	21		13				
Eastern Curlew	38	85	38	18	904		1	17	17						
Marsh Sandpiper					1										
Common Greenshank	27				44										
Wood Sandpiper															
Terek Sandpiper	1	2	30												
Common Sandpiper															
Grey-tailed Tattler		29	45		369				3		4			7	
Wandering Tattler															
Tattler Spp	64														
Ruddy Turnstone					9										
Great Knot	98	78			168										
Red Knot					15										
Sanderling															
Red-necked Stint	38	129			25				5						
Pectoral Sandpiper															
Sharp-tailed Sandpiper															
Curlew Sandpiper	1														
Bush Stone-curlew	5		4												
Beach Stone-curlew	3	5													
Pied Oystercatcher	8	15	2		217			1	6					54	
Sooty Oystercatcher							1	1	1					1	
Black-winged Stilt	1	26		55	2935		24	221	74		130			7	
Banded Stilt								4							
Red-necked Avocet					552						290				
Pacific Golden Plover					7				4					1	
Grey Plover															
Red-capped Plover	39	45	25	6	95		10		12						
Double-banded Plover					59			15	46						
Lesser Sand Plover		7			23										
Greater Sand Plover	2				13										
Oriental Plover															
Black-fronted Dotterel	3	26		1	8		15	4			8				
Hooded Plover															
Red-kneed Dotterel					13			3							
Banded Lapwing					2										
Masked Lapwing	38	17	15	4	83			13	37		5				
Long-toed Stint															
Redshank															
Broad-billed Sandpiper															
Ruff															
Swinhoe's Snipe															
Asian Dowitcher															
Unidentified small															
Unidentified medium															
Unidentified large															
TOTAL	501	735	286	87	7342	0	53	290	255	0	683	0	0	274	0
No SPECIES	17	14	9	6	23	0	6	11	12	0	8	0	0	6	0

WINTER 1999	VICTORIA							TASMANIA			SA	WEST AUSTRALIA				NT
	Corner Inlet East	Corner Inlet West	Westernport	East Pt Phillip	Altona	Wrrbee/Avalon	BilmeP/Mud Is	EDerw/Pittwater	Marion Bay	Cape Portland	SE cst SA	Albany *	Swan*	80 Mile	Broome	Darwin
Latham's Snipe																
Black-tailed Godwit															1	
Bar-tailed Godwit	2587		4			24	88	35	5						132	
Little Curlew																
Whimbrel	2														236	
Eastern Curlew	26		128				1	4							73	
Marsh Sandpiper																
Common Greenshank				7	1	1	37		3		2					
Wood Sandpiper																
Terek Sandpiper	2		1												104	
Common Sandpiper															2	
Grey-tailed Tattler	4														165	
Wandering Tattler																
Tattler Spp																
Ruddy Turnstone	10		3				15			4	1				5	
Great Knot	22														6922	
Red Knot	275		1			1	14								830	
Sanderling	1															
Red-necked Stint	918		1147	3	307	1430	2342	224	168	217	127				85	
Pectoral Sandpiper																
Sharp-tailed Sandpiper																
Curlew Sandpiper			3		7	53	46	1		2						
Bush Stone-curlew																
Beach Stone-curlew																
Pied Oystercatcher	846		275			4	80	716	131	14	8				110	
Sooty Oystercatcher	139						1	53		32	4				15	
Black-winged Stilt				144	265	267	378						6			
Banded Stilt																
Red-necked Avocet			143	15	48	160	24									
Pacific Golden Plover							3			2						
Grey Plover	27														19	
Red-capped Plover	36		143		48	47	480	221	79	114	41		1			
Double-banded Plover	111		590		460	63	398	294	70	410	110					
Lesser Sand Plover										2						
Greater Sand Plover	1														215	
Oriental Plover																
Black-fronted Dotterel				103	1	46	11	6								
Hooded Plover	5						13	33	8	9	3					
Red-kneed Dotterel					1	75	53									
Banded Lapwing										23						
Masked Lapwing			164	39	7	78	246	943	125	69	15					
Long-toed Stint																
Redshank															2	
Broad-billed Sandpiper																
Ruff																
Swinhoe's Snipe																
Asian Dowitcher															4	
Unidentified small																
Unidentified medium																
Unidentified large																
TOTAL	5012	0	2602	311	1145	2249	4230	2530	589	898	311	0	7	0	8920	0
No SPECIES	17	0	12	6	10	13	18	11	8	12	9	0	2	0	17	0

Albany *. There were high water levels and no waders. Also few at the Swan.

SUMMER 2000	QUEENSLAND								NEW SOUTH WALES								
	Cairns	Townsville	Mackay	Gladstone	Moreton Bay	Lockyer Valley	Bowen	Tweed	Richmond	Clarence	Hunter	Tuggerah	Brisbane Waters	Parramatta	Botany Bay	Shoalhaven
Latham's Snipe								2								
Black-tailed Godwit	60				441		2									
Bar-tailed Godwit	88		120		9119		29	190		27		141	8	70		
Little Curlew					3											
Whimbrel	63		50		751		46	61					9			
Eastern Curlew	69		134		1604		8	101		38		17	41			
Marsh Sandpiper	4				32		19									
Common Greenshank	13				246		11	13				11				
Wood Sandpiper																
Terek Sandpiper			95		56											
Common Sandpiper	4						2	1								
Grey-tailed Tattler	2		46		830		14	46				7				
Wandering Tattler					1											
Tattler Spp																
Ruddy Turnstone			32		95							33				
Great Knot	260		31		404											
Red Knot					2											
Sanderling																
Red-necked Stint	237		40		233		28					126				
Pectoral Sandpiper																
Sharp-tailed Sandpiper	230				289		113	18						42		
Curlew Sandpiper	156				290		112	1				67		37		
Bush Stone-curlew	3		7										5			
Beach Stone-curlew	7		2													
Pied Oystercatcher			2		430		21	4				2	7			
Sooty Oystercatcher					2		1	1				14				
Black-winged Stilt					484		27	48				34		209		
Banded Stilt																
Red-necked Avocet																
Pacific Golden Plover	23				224		2							8		
Grey Plover					26											
Red-capped Plover	11		100		287		37					5				
Double-banded Plover																
Lesser Sand Plover	222		1000		555		17			57						
Greater Sand Plover	38		550		80		46			1						
Oriental Plover																
Black-fronted Dotterel	4				3		8	2						25		
Hooded Plover																
Red-kneed Dotterel														2		
Banded Lapwing																
Masked Lapwing	35		1		72		20	14		1		67	30	13		
Long-toed Stint																
Redshank																
Broad-billed Sandpiper	8															
Ruff																
Swinhoe's Snipe																
Asian Dowitcher																
Unidentified small																
Unidentified medium																
Unidentified large																
TOTAL	1537	0	2210	0	16559	0	563	502	0	124	0	524	100	406	0	0
No SPECIES	21	0	15	0	26	0	20	14	0	5	0	12	6	8	0	0

SUMMER 2000	VICTORIA							TASMANIA				SA	WEST AUSTRALIA				NT
	Corner Inlet East	Corner Inlet West	Westernport	East Pt Phillip	Altona	Wrrbee/Avalon	BlimeP/Mud Is	EDerw/Pittwater	Marion Bay	North-west	Cape Portland/ NNE	SE cst SA	Albany	Swan**	80 Mile*	Broome	Darwin
Latham's Snipe			C	42	C		255										C
Black-tailed Godwit			O		O							11			2	983	O
Bar-tailed Godwit	7390	1203	U		U	1	278	72	4		8				6569	5036	U
Little Curlew			T		T										35		T
Whimbrel	42	22	S		S			4			2				6	34	S
Eastern Curlew	866	358				5	97	82	3	45	35	2			53		
Marsh Sandpiper			M	8	M	18	28								178		M
Common Greenshank	30	58	S	4	S	52	461	64	18		21	19	57	5	321		S
Wood Sandpiper			S	1	S	1											S
Terek Sandpiper			I		I								1		860	262	I
Common Sandpiper			N	2	N								1			11	N
Grey-tailed Tattler			G		G	3					2	1	7		1246	559	G
Wandering Tattler																	
Tattler Spp																	
Ruddy Turnstone	112					15	110			430	111	652	2		46	183	
Great Knot	90						60						330		6731	4629	
Red Knot	592					30	90	1					55		23	367	
Sanderling	236									20		322			15		
Red-necked Stint	23675	680		5		5603	9171	1694	188	2000	503	1241	180		471	1304	
Pectoral Sandpiper				3		2					1						
Sharp-tailed Sandpiper				3000		2714	4460	7				691	1				
Curlew Sandpiper	920	108				5074	961	550		300	128	57	2		725	139	
Bush Stone-curlew																	
Beach Stone-curlew																	
Pied Oystercatcher	721	97				46	54	893	153	378	58	9	51	2	2	30	
Sooty Oystercatcher	106	238					1	40		43	48	3	3			19	
Black-winged Stilt				146		350	577							32			
Banded Stilt						12	2690										
Red-necked Avocet						77											
Pacific Golden Plover						13	10	90		15	116	161	18		28		
Grey Plover	415						56						85	4	126	48	
Red-capped Plover	60			1		82	209	146	30	93	71	11		1	6		
Double-banded Plover	1							1		6	2	1					
Lesser Sand Plover	2						9	1	2		2					9	
Greater Sand Plover													7		4102	825	
Oriental Plover															4077		
Black-fronted Dotterel				9		7	19										
Hooded Plover	5						1	10		29	5	6					
Red-kneed Dotterel				15		25	20										
Banded Lapwing						11					2						
Masked Lapwing	8	10		122		299	552	267	60	5	28	35					
Long-toed Stint																	
Redshank															1		
Broad-billed Sandpiper																73	
Ruff																	
Swinhoe's Snipe																	
Asian Dowitcher																11	
Unidentified small																	
Unidentified medium																	
Unidentified large																	
Unidentified wader							2000						500				
TOTAL	35271	2774	0	3358	0	14440	22169	3922	458	3364	1143	3222	1300	44	25623	14522	0
No SPECIES	18	9	0	13	0	22	23	16	8	12	18	16	15	5	22	18	0

* 80 Mile Beach-Anna Plains camp site to 15 kms south

** High water levels in Swan River had made estuary unsuitable for waders

WINTER 2000	QUEENSLAND								NEW SOUTH WALES						
	Cairns	Townsville	Mackay	Gladstone	Moreton Bay	Lockyer Valley	Bowen	Tweed	Richmond	Clarence	Hunter	Tuggerah	Parra	Botany Bay	Shoalhaven
Latham's Snipe															
Black-tailed Godwit			50		13						3		130		
Bar-tailed Godwit			90		712			37		174	400				27
Little Curlew															
Whimbrel			68		116		3	7		3	15				
Eastern Curlew			27		362		11	11		30	143				
Marsh Sandpiper															
Common Greenshank															1
Wood Sandpiper															
Terek Sandpiper					1										
Common Sandpiper															
Grey-tailed Tattler			2		147					1	2				
Wandering Tattler															
Tattler Spp															
Ruddy Turnstone					14							3			
Great Knot			60		7					1	1				
Red Knot												20			
Sanderling															
Red-necked Stint					6							3			
Pectoral Sandpiper															
Sharp-tailed Sandpiper							4								
Curlew Sandpiper					22					1					
Bush Stone-curlew			6				6								
Beach Stone-curlew															
Pied Oystercatcher			5		253		16	6		2		2			2
Sooty Oystercatcher							1			6		2			
Black-winged Stilt					554			140		53	158		21		
Banded Stilt															
Red-necked Avocet															
Pacific Golden Plover					31										
Grey Plover															
Red-capped Plover			40		208		12			3					23
Double-banded Plover					53			16				20			
Lesser Sand Plover					43										
Greater Sand Plover															
Oriental Plover															
Black-fronted Dotterel					25			1			4	6	23		
Hooded Plover															
Red-kneed Dotterel															
Banded Lapwing															
Masked Lapwing			21		48		26	10		8	58	66	11		
Long-toed Stint															
Redshank															
Broad-billed Sandpiper															
Ruff															
Swinhoe's Snipe															
Asian Dowitcher															
Red-necked Phalarope															
Unidentified small															
Unidentified medium															
Unidentified large															
Unidentified wader															18
TOTAL	0	0	369	0	2615	0	79	228	0	282	784	122	185	0	71
No SPECIES	0	0	10	0	18	0	8	8	0	11	9	8	4	0	4

WINTER 2000	VICTORIA							TASMANIA				SA	WEST AUSTRALIA					NT
	Corner Inlet East	Corner Inlet West	Westernport	East Pt Phillip	Altona	Wrrbee/Avalon	BilmeP/Mud Is	EDerw/Pittwater	Marion Bay	North-west	Cape Portland/ NNE	SE cst SA	Albany	Swan**	Rotnest Is**	80 Mile*	Broome	Darwin
Latham's Snipe																		
Black-tailed Godwit						1										8	4	
Bar-tailed Godwit	4110				1	7		44					3			313	471	
Little Curlew																		
Whimbrel																4	124	
Eastern Curlew	20							1		5	1					87	85	
Marsh Sandpiper																		
Common Greenshank	3				3	7												
Wood Sandpiper																		
Terek Sandpiper																164	152	
Common Sandpiper																		
Grey-tailed Tattler	5										1				2	64	278	
Wandering Tattler																		
Tattler Spp												1						
Ruddy Turnstone	5					1				116	35	46			68	30	90	
Great Knot	20															2525	5300	
Red Knot	320															343	366	
Sanderling												5			1	1		
Red-necked Stint	1892				891	1710		189	175	280	205	60			142	522	9	
Pectoral Sandpiper																		
Sharp-tailed Sandpiper										35								
Curlew Sandpiper	5				165	318		1		40	45				22	136	13	
Bush Stone-curlew																		
Beach Stone-curlew																		
Pied Oystercatcher	531				2	27		1040	65	224	50	7	43	2		2	47	
Sooty Oystercatcher	160							124		128	36		3				18	
Black-winged Stilt				24	356	262								12				
Banded Stilt					47										5			
Red-necked Avocet						9												
Pacific Golden Plover															1			
Grey Plover	10					6										31		
Red-capped Plover	36			12	147	153		193	36	82	123	49			45	5		
Double-banded Plover	330				65	258		70	78	210	115	19						
Lesser Sand Plover																		
Greater Sand Plover																28	26	
Oriental Plover																		
Black-fronted Dotterel				31	2	16					10							
Hooded Plover	8							4		70	5	11						
Red-kneed Dotterel				1														
Banded Lapwing											44				16			
Masked Lapwing				76	29	160		299	58	7	140	26						
Long-toed Stint																		
Redshank																		
Broad-billed Sandpiper																		
Ruff																		
Swinhoe's Snipe																		
Asian Dowitcher																	11	
Red-necked Phalarope						1												
Unidentified small																		
Unidentified medium																		
Unidentified large																		
TOTAL	7455	0	0	144	1708	2936	0	1965	412	1197	810	224	49	14	302	4263	6994	0
No SPECIES	15	0	0	5	11	15	0	10	5	11	13	9	3	2	9	16	15	0

Swan**Counts were also returned from Rotnest Island - It is thought that birds from the Swan Marine Park also move there.

80 Mile Beach* Anna Plains to 15 km south

ERRATUM

Figure 1 on p. 41 of the previous issue, *Stilt* 37, should have been the following figure. The caption is correct as stated and the figure represents the summer counts of Red-necked Stint at several sites in Victoria.

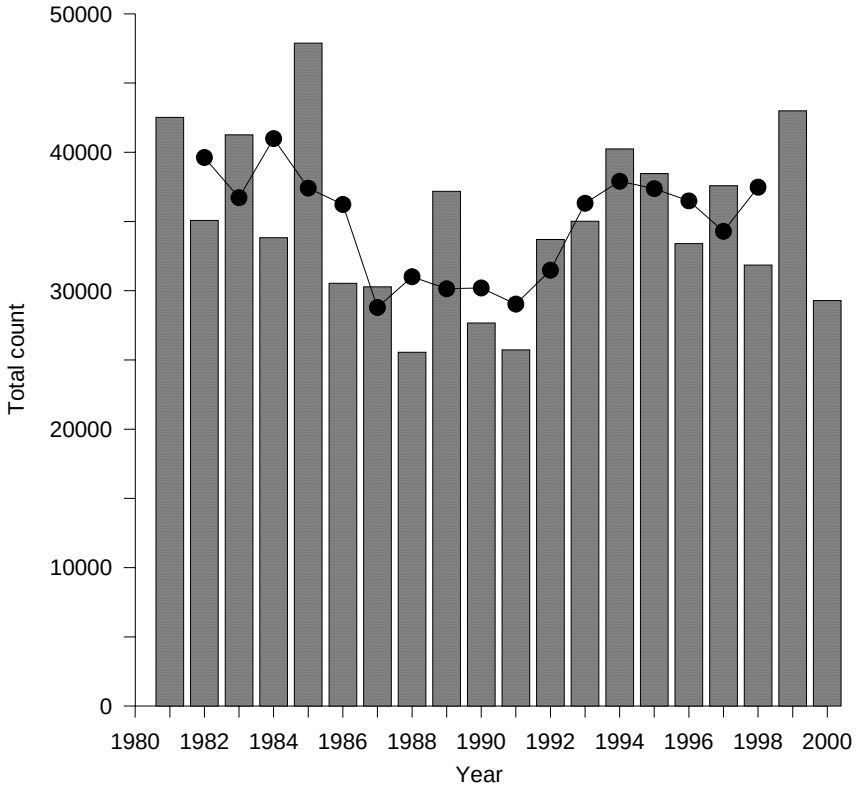


Figure 1. The combined summer counts of Red-necked Stint at six sites in Victoria (Altona, Bellarine Peninsula/Mud Is, Corner Inlet, eastern Port Phillip Bay, Werribee, Westernport Bay) since 1981 and the 3-year moving average. Data are from the AWSG population monitoring project.

INSTRUCTIONS TO AUTHORS

The Stilt is the bulletin of the Australasian Wader Study Group and publishes original papers, technical notes and short communications on all aspects of waders (shorebirds) of the East Asian-Australasian Flyway and nearby parts of the Pacific region. Authors should send an original and one hard copy of any manuscript plus the document saved on a 3 1/2" computer disc to the editor, Dr David Milton, 336 Prout Rd., Burbank Qld 4156 or by e-mail: *david.milton@marine.csiro.au*. Material sent to *The Stilt* is assumed to be original and must not have been published elsewhere. Authors are asked to carefully follow the instructions in the preparation of manuscripts and to carefully check the final typescript for errors and inconsistencies in order to minimise delays in publication. Suitable material submitted before **1st March** or **1st September** will normally be published in the next issue of *The Stilt* in April or October respectively. Late submissions may be accepted at the editor's discretion and he should be contacted to discuss the situation. Articles, including tables should be in 11 pt Times Roman font typed in MS Word 6.0 for PC or a wordprocessing package readable by Word 6.0. A disc copy of the figures is also preferred and can be included if they have been produced in MS Powerpoint or Excel, Harvard Graphics 3.0 or less, or Grapher 2.0 software. If photographs or greyscale images are to be included, either submit the photo to be scanned, or submit an electronic copy of the image as a graphic file in one of the following formats: pcx, bmp, gif, jpg or tiff. Please do not imbed photographic images within Word documents.

Full research papers of more than 6 typed double-spaced text should contain the following elements:
TITLE - in bold, capitalised type
Authors name and address - John Smith[1], Stephen Brown[2] and Max Well[3]

[1] 1 Main St., Melbourne 3001 Vic. AUSTRALIA
[2] Dept. Biology, Univ. Queensland, St Lucia 4068 Qld. AUSTRALIA
[3] Birds Singapore, National Univ., Jurong N4321 SINGAPORE

ABSTRACT - Usually less than 200 words summarising the most important findings of the study.
INTRODUCTION - This should be a short section of about half a journal page to "set the scene" and explain to the reader why the study was important. It should end with a clear definition of the aims of the study. The first reference to a species of bird should have the scientific name in *italics* after it.
METHODS AND MATERIALS - Clearly sets out the methods used in the study and should include sufficient detail to enable the reader to duplicate the research. First level subheadings should be **Bold and lower case** and further subheadings in *italics.*
RESULTS - Highlights the key points that came out of the study in relation to the objectives set out in the introduction. Data should be presented in figures or tables.
DISCUSSION - Puts the study in context with other previous research on the same topic and explains the significance of the major results presented in the **RESULTS** section.
ACKNOWLEDGEMENTS - Recognises the contribution of others to the completion of the study.
REFERENCES - Records all the literature cited in the text, tables or figures. They should be in alphabetic and chronological order with multi-authored references after single author citations by the same author. These should be formatted as follows:

Single author papers: Smith, F.T.H. 1964. Wader observations in southern Victoria, 1962-1963. Aust. Bird Watcher 2, 70-84.

Multi-authored papers: Dann, P., R.H. Loyn & P. Bingham 1994. Ten years of water bird counts in Westernport Victoria 1973-83. II. Waders, gulls and terns. Aust. Bird Watcher 15, 351-67.

Books: Kershaw, K.A. 1964. Quantitative and dynamic ecology. Edward Arnold, London.

Reports: Noor, Y.R. 1994. A status overview of shore birds in Indonesia. Pp. 178-88. *In:* Wells, D.R. & T. Mundur (Eds.) Conservation of migratory water birds and their wetland habitats in the East Asian-Australia Flyway. Asian Wetland Bureau, Malaysia.

Authors should look at previous issues of *The Stilt* for the formatting of other reference combinations.

Tables - Captioned as **Table 1.** The list of suitable names of Australian waders.

There should be no lines in the table except for above and below the column headings and at the bottom of the table. All tables should be laid out in the same document as the text but located after the **REFERENCES** using the table

facility in the word processing package. Wide tables can be set out in a separate, suitably titled document. All measurements should be in metric units (e.g. mm, km, °C etc) and rates should be recorded thus: $.d^{-1}$ rather than /day or per day. Lists of species names in tables should follow the common and scientific names and taxonomic order of Christidis and Boles (1994). Where a species has not been recorded in Australia, the order and names in Hayman *et al.* (1986) should be used.

Captions to Figures

Lists the captions of all the figures sequentially on a separate page. They should be captioned as:
Figure 2. The number of hunters of each age class interviewed in Shanghai during April 1998.

All maps should have a border, distance scale, reference latitude and longitude and/or inset map to enable readers unfamiliar with the area to locate the site in an atlas.

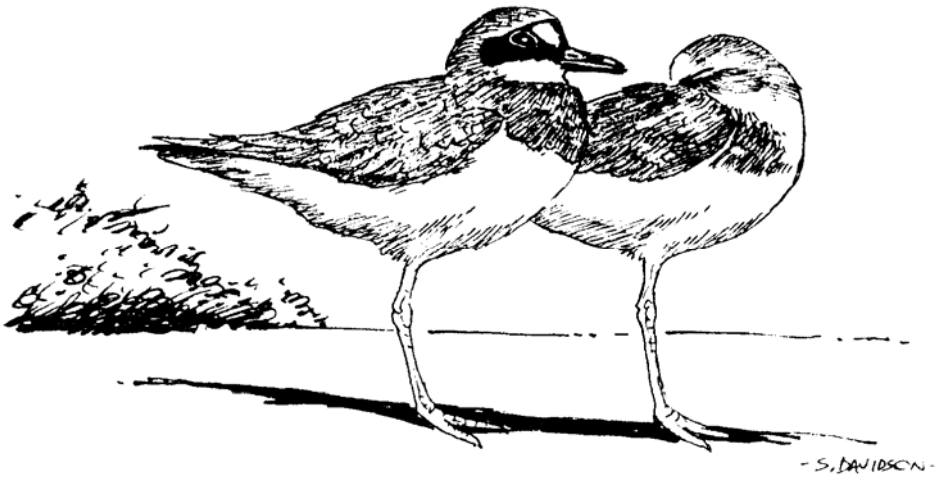
Other figures should have axis numbers and labels of sufficient size to be at least 1.5 mm high after 50% reduction. This usually corresponds to 14 - 16 pt or larger. Multi-graph figures should all be separately identified as (a), (b) etc. Legends should be located at the outer edge of a graph at the bottom or top right and in 12 pt.

SHORT COMMUNICATIONS and REPORTS usually are not subdivided like RESEARCH PAPERS and do not have a separate abstract. These sections usually include less technical material, often of a non-scientific nature. For example, unusual behaviours, leg-flag sightings or conservation issue statements. Authors are encouraged to look at the format of articles in these sections of previous issues of *The Stilt*.

REFERENCES

Christidis, L., & W.E. Boles 1994. The Taxonomy and Species of Birds of Australia and its Territories. RAOU monogr. 2. 112pp.

Hayman, P., J. Marchant & T.Prater 1986. Shorebirds: An Identification Guide to the Waders of the World. Christopher Helm, London.



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- Views and opinions expressed in *The Stilt* are those of the author(s) and not necessarily those of the AWSG or RAOU.
- Publication of data in *The Stilt* does not constitute permission for the commercial use of those data. All such inquiries should be directed to the Editor.
-
- The Editorial Team does its best to ensure the accuracy of information published in the *Stilt*, but it is recommended that anyone wishing to cite material within the *Stilt* contact the relevant authors.

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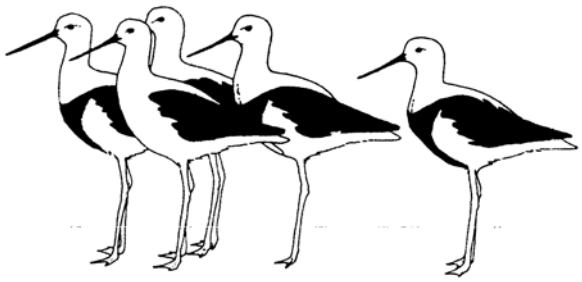
Volumes Indexed	Volume containing Index
1-6	7
7-12	13
13-18	19
19-24	25
25-30	31

Deadlines:

The closing dates for submission of material have been revised. They are **1 March** and **1 September** for the April and October editions respectively. **Extensions to these dates must be discussed with the Editor.** Contributors are reminded that they will probably have some comments to consider, and possibly incorporate, at some time after submission. It would be appreciated if this could be done promptly.



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