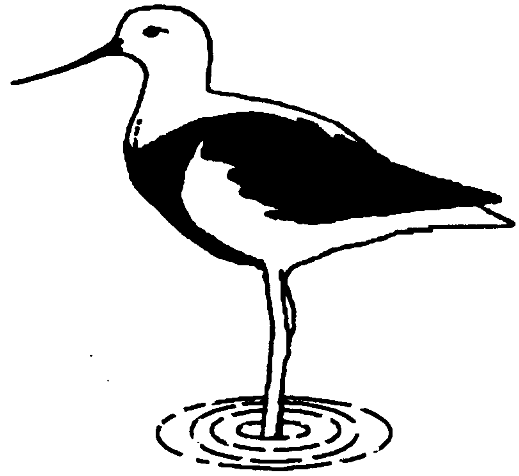
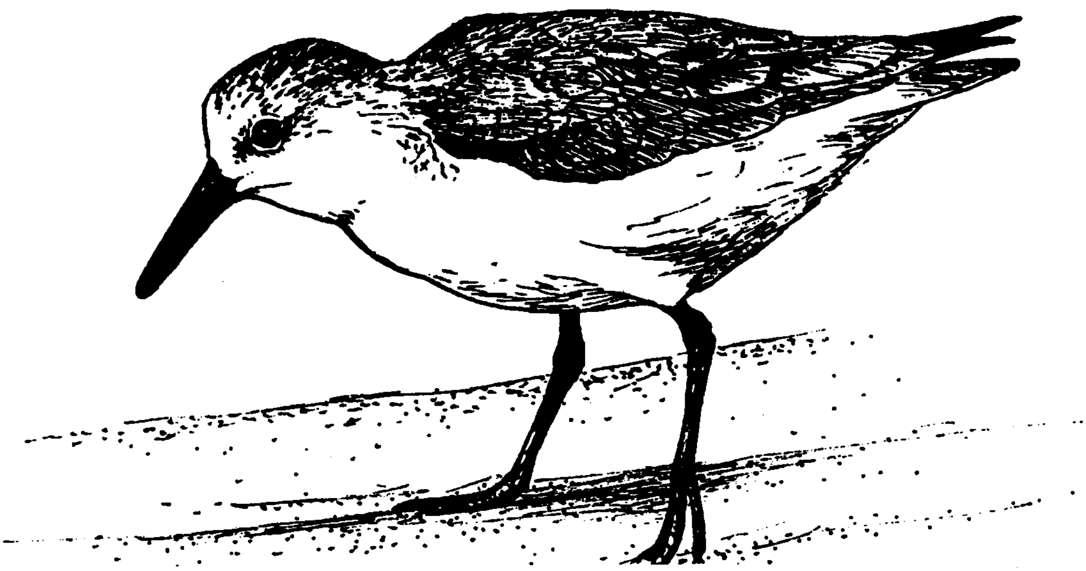
The Stilt



The Bulletin of the East Asian-Australasian Flyway



Australasian
Wader
Studies
Group

A special interest group of Birds Australia

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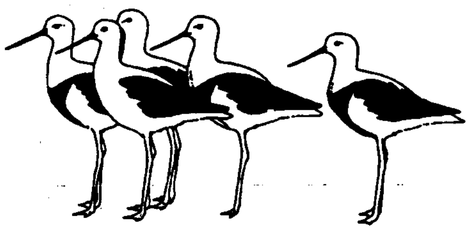

The Stilt

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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	$25.00
	New Zealand	$25.00
	Overseas	$30.00
	Institutions	$35.00

Cover Illustration: Stephen Davidson

EDITORIAL

This issue is a bumper one and it marks the end of my second year as editor. I have learnt a lot during that period and have enjoyed being more involved with studies of waders, albeit from a distance. I thank people who have given me feedback and I hope that our efforts to make the standard of articles more consistent and professional has improved the bulletin for you, the readers. One of the major items in this issue of the *Stilt* is the publication of the abstracts of the recent successful AWSG conference at Phillip Is in Victoria. Over seventy people attended and heard a large number of interesting and thought-provoking talks on the issues of conservation and biology of waders and their habitats. The abstracts from all talks have been reproduced in this issue, with minor editorial changes.

The range and coverage of articles in the *Stilt* continues to expand. We had a discussion at the AWSG committee meeting held in conjunction with the conference that focussed on expanding the role of the *Stilt*. It is an important method of bringing the results of wader studies in the East Asian - Australasian Flyway to members living throughout the region. Environment Australia has recognised the value of *Stilt* by agreeing to fund 200 complementary memberships and ensure that the results of wader studies reaches researchers throughout the region. The standard and range of articles being submitted to the *Stilt* is increasing and all contributors are to be commended for their efforts.

One article in this issue that is different from most of the material published recently is the economic analysis of international wader agreements by Harry Clarke. I hope readers take the time to read this article and digest its contents. It has some important messages that could influence planned expansion of AWSG activities into other parts of the Flyway and deserves careful reading.

Other important articles include the one on wader weight loss in northwestern Australia that suggests that previous studies of weight loss may have overestimated its significance. It presents data on species that have not been studied before and I hope the results get widely used throughout the world where waders are held in captivity after capture.

Most of all, I hope you enjoy reading the *Stilt* and please keep sending in the articles.

David Milton

AWSG ELECTIONS.

The following office bearers and members of the committee will have completed their term of office in June 2000 and have volunteered for re-election: Peter Driscoll, Rosalind Jessop, Hugo Phillipps, Sandra Harding, Ken Harris, Mark Barter, Clive Minton and Doug Watkins. If there are no other candidates put forward by members before 31 January 2000 these will be considered re-elected.

Jim Wilson's term of office is also completed in June 2000. As it seems at the moment he will be returning to Norway in June 2001 he will not be able to complete a full second term and we are looking for somebody to take over the Chair when Jim leaves. He is willing to continue as Chair until he leaves, but will probably not be able to stand for the two full years. If there are no candidates put forward for the Chair Jim will therefore continue and if necessary there will be a new election in about one years time.

Laurie Living and Brenda Murlis have stepped down.

Clive Minton has proposed Mike Bamford to join the committee. This proposal is seconded by Mark Barter. Jim Wilson has proposed David Close. This is seconded by Doug Watkins. Mike and David are long time members of the group and are well known in the wader world. Mike is chairman of the newly formed West Australian Wader Study Group. David has earlier been heavily involved in population monitoring in South Australia and is now involved in conservation there. These elections would be in line with the AWSG policy of spreading the committee through Australia.

Any additional nominations of the committee, seconded by a member of the group shall be sent to the Chair by 31 January 2000. Should an election be necessary ballot papers will be sent out with the April 2000 *Stilt*.

Jim Wilson.

MIGRATORY WADERS IN SOUTH - EAST ASIA, AUSTRALIA AND NEW ZEALAND : REFERENCE DATA AND THE RELATIVE ABUNDANCE OF EACH SPECIES

D.N. Crawford

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ABSTRACT

A summary of the data from counts in 37 districts throughout south-east Asia, Australia and New Zealand used in a previous study is presented. This database is derived from censuses of 52 species and a total count of 5.8 million birds. The data is presented as mean percentages of each species in each district. This and other data is used to estimate the relative abundance of migratory waders in the East Asian-Australasian Flyway. The two most abundant species are Red-necked Stint *Calidris ruficollis* and Bar-tailed Godwit *Limosa lapponica*. Some species that are rare in Australia such as Dunlin *Calidris alpina*, Kentish Plover *Charadrius alexandrinus* and Redshank *Tringa totanus* ranked relatively high in the list.

INTRODUCTION

An analysis of the distribution and diversity patterns of migratory waders in south - east Asia, Australia and New Zealand was given in Crawford (1997). The aim here is to present most of the data used in this analysis in a form which could prove useful for future study. The summarised data is derived from coastal district censuses of a total of over 5.8 million birds and represents about 85 % of the data used previously. Excluded is data from censuses which could not be regarded as district data because of their geographical dispersion.

The district data and state wide census material from Asia is used here to estimate the relative abundance of migratory wader species using coastal habitats in the East Asian-Australasian Flyway. This does not seem to have been previously attempted.

METHOD AND RESULTS

The primary sources of the data presented here are given in Crawford (1997). The criteria for the inclusion of census data in the analysis is given below:

1. All census had to be carried out between August to April in coastal habitat.
2. The minimum census size was set at 1800 birds. Census under this size are more likely to give a distorted picture of birds in the area (Alcorn *et al.* 1994, Crawford 1997). A census may result from a single count or from the summation of a series of counts over a period of time.
3. There had to be a minimum of four censuses in each district, taken over a period of at least two years.
4. Birds not identified to species were not considered as part of a census.

Two groups which represents a small fraction of the total number of were not included in the calculations. These were: Snipe *Gallinago* sp. because of difficulties with field identification in Asia and Pratincole *Glareola* sp. on ecological grounds because their association with wet coastal habitiats is tenuous. Records suggest that within the snipe, the Common Snipe *G. gallinago* is by far the most abundant species in this hemisphere.

Table 1 lists the district from which data was obtained, the number of census and the total birds counted or estimated. The sum of scores is a diversity index value. Its calculation and the association index which can be derived from it have been discussed previously (Crawford 1997). Table 2 shows the mean percentages for 49 species in 37 districts from southern China to southern Australia and New Zealand.The mean percentages are calculated by converting the numbers of each species in each census to a percentage of the total. The percentages for each species are then summed and divided by the number of census for the district (Table 1). It was not valid to assume that all census in the district had been carried out in the same way. In Table 2, the symbols '*' and '+' are used to denote ' < 0.1% seen once' and ' < 0.1% recorded more then once' respectively. These variables and the blank spots indicating no record, are influenced by the number of district census (Table 1). This has to be taken into account when using indices like species richness. In other situations this factor may not be significant.

In Table 3, an attempted has been made to estimate the relative abundance of migratory waders. Give the data, there are several ways this can be done. In addition to the district data shown in Table 1, state wide census data from some of the larger Asian countries have been incorporated. These have been

Table 1. The mean percentage value for each species in each district. '*' = < 0.1% recorded only once. '+' = < 0.1% recorded more than once. All data are from coastal areas. The location of each district, number of censuses and the total number of birds recorded appears in Table 2.

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Black-tailed Godwit	27.1	1.5	+	+	+	3.1	+	5.3	+	40.3	6.6	2.7	16.8	6.7
Hudsonian Godwit														
Bar-tailed Godwit	0.2	1.3	+	+	3.9	+	3.6	3.8	+	8.5	24.5	5.2	1.1	+
Little Curlew			+								+	+	*	2.9
Whimbrel	2.3	*	0.3	+	1.9	3.9	5.7	2.3	1.1	1.6	0.4	1.8	0.6	+
Eastern Curlew		+	+		0.2		0.4	2	+	0.4	0.3	1.1	0.7	+
Eurasian Curlew	2.1		0.9	+	0.2	+	1.6	1.4		4.4				
Spotted Redshank	10.1	3.8				*			+		*			
Common Redshank	4.7	0.9	0.5	2.1	3.6	12.9	13.6	13.9	1.8	13.7	+	*		0.2
Marsh Sandpiper	2.7	8.8	1.1	10.7		15.2	4.7	1.1	0.2	0.4	0.2	0.7	0.4	2.6
Common Greenshank	3.3	3.9	1.9	8.2	0.8	4.9	1.3	5.2	0.9	0.3	0.4	1.8	0.6	1.6
Spotted Greenshank	+	+	+			*	+			*				
Lesser Yellowlegs														
Wood Sandpiper	0.2		1.7	11.2	+	2.5	1.1	+	7.1	+		0.1		0.9
Green Sandpiper	+	0.3		+				*	+					
Terek Sandpiper	0.8	+	0.6	0.3	1.2	0.9	4.8	15.7	0.6	6.2	2.3	7.9	0.9	0.2
Common Sandpiper	+	0.2	1.2	2.3	+	3.6	1.3	1.1	3.2	0.2	+	+	+	1.6
Grey-tailed Tattler	3.5	*	0.8		6.1			0.3	0.6		4.7	2.5	0.4	1.2
Wandering Tattler														
Ruddy Turnstone	0.1	0.7	1.2	+	2.3	+	1.2	0.4	+	0.5	1.1	3.1	+	0.2
Long-billed Dowitch									*					
Asiatic Dowitcher	0.4	0.3	*	*	0.8	*	+	2.3	+	3.6	+	*		
Great Knot	0.5	3.9	+	+	3.6		0.6	0.5	+	0.7	18.3	38.3	33.3	*
Red Knot	*	0.3	+		0.7		+	1.3	+	0.3	7.9	0.4	20.9	
Sanderling	0.5	0.7	0.3	+	+	0.4		+	0.2	+	+	0.6	+	
Little Stint		1.9					*							
Red-necked Stint	11.8	14.5	5.3	25.1	23.7	2.1	5.1	10.3	12.5	+	16.3	10.9	13.4	25.6
Temminck's Stint	*	1.4	+				*	+	+					
Long-toed Stint	0.6	0.9	0.4	10.1		8.6	0.7	+	18.9					+
Spoon-billed Sandpiper	+	+												
Pectoral Sandpiper														0.2
Sharp-tailed Sandpiper	*	2.8	1.8	+	*			0.1	+		0.4	2.8	0.8	47.6
Dunlin	3.4	30.6	41.4											
Curlew Sandpiper	5.5		4	1.2	7.2	4.7	28.1	9.7	0.2	2.6	11.7	0.8	2.5	0.8
Stilt Sandpiper														
Buff-breasted Sandpiper														
Broad-billed Sandpiper	1.2	4.9	0.2	2.8		0.5	0.5	2.7	+	+	1.2	+	0.3	*
Ruff			+				*	*	*					+
Wilson's Phalarope														
Red-necked Phalarope		0.3	1.4					+	+		+	*		+
Common Avocet	+	+	0.2											
Pacific Golden Plover	0.4	+	2.1	6.6	1.1	29.4	3.7	0.7	29.9	+	+	1.8	0.3	5.7
Grey Plover	1.3	0.4	1.6	0.6	11.6	0.3	1.7	2.8	*	0.2	0.5	1.6	0.8	+
Ringed Plover		+				*	+		0.6					
Little Ringed Plover	+	5.9	4.4	8.3		1.9	0.6	+	11.8					+
Kentish Plover	4.9	11.7	23.9	0.4	1.8	0.7	0.9	1.8						
Long-billed Plover	+	+												
Lesser Sand Plover	8.4	3.7	1.1	8.9	19.8	14.9	11.1	7.3	5.4	15.5	0.6	5.9	1.6	0.8
Greater Sand Plover	6.7	0.3	1.8	+	8.1	2.1	9.1	8.4	2.5	0.3	5.8	9.8	2.9	1.8
Oriental Plover		+								+	2.6	+	+	+
Grey-headed Lapwing	+	+	+					+						

Table 1. cont.

Species	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Black-tailed Godwit	1.8	1.1	0.9	8.5	5.4	7.4	0.2	+	+	*	0.2	+	+	
Hudsonian Godwit														
Bar-tailed Godwit	7.6	27.9	32.3	32.4	28.8	35.7	45.1	21.1	0.9	0.9	1.8	+	1	2.9
Little Curlew	+	+	+		*			*					*	
Whimbrel	1.7	3.2	2.4	4.5	1.6	0.6	0.3	+	*	+	0.2	+	+	0.2
Eastern Curlew	2.1	5.7	7.3	8.8	6.7	6.6	9.6	3.7	*	+	0.4	1.3	0.3	9.1
Eurasian Curlew														
Spotted Redshank														
Common Redshank														
Marsh Sandpiper	+		0.2	0.2	2.2	0.5	0.2	+	*	+	0.4	0.4	0.3	*
Common Greenshank	1.4	0.5	0.8	1.6	2.1	0.9	0.4	1.8	0.9	4.4	2.9	0.6	1.4	1.6
Spotted Greenshank														
Lesser Yellowlegs														
Wood Sandpiper	*				*				*	+	+	*	+	
Green Sandpiper														
Terek Sandpiper	1.8	1.2	0.6	2.6	2.7	0.7		+	*	+	+	*		+
Common Sandpiper	+	*	+	+	+	*	*	+	+	+	+	*	+	+
Grey-tailed Tattler	3.2	1.9	9.9	5.2	0.5	2.1	*	+	*	0.3	+	1.5		0.3
Wandering Tattler	+		+							*				
Ruddy Turnstone	0.2	1.4	0.9	1.3	0.4	1.4	1.8	0.2	1.2	+	1.6	16.7	0.4	0.8
Long-billed Dowitch														
Asiatic Dowitcher														
Great Knot	4.9	17.5	5.6	5.8	0.2	*		0.7	5.9	6.7	1.2		0.3	*
Red Knot	1.1	*	0.6	2.2	0.5	+	*	7.6	0.9	6.1	1.4		0.8	0.2
Sanderling		0.2		+	1.2	0.2		0.3		3.4		2.3		
Little Stint										*	+			
Red-necked Stint	41.5	13.8	10.5	5.7	9.5	11.3	21.4	45.3	67.9	58.3	50.4	43.9	42.4	45.5
Temminck's Stint														
Long-toed Stint									*	*			+	
Spoon-billed Sandpiper														
Pectoral Sandpiper				*		0.8					+	*	+	
Sharp-tailed Sandpiper	10.6	1.4	2.6	4.3	6.6	4.1	4.8	4.6	4.7	6.8	23.1	16.5	30.9	3.2
Dunlin														
Curlew Sandpiper	1.2	2.3	7.9	4.4	20.6	22.3	0.3	10.5	12.3	8.5	13.9	13.2	20.5	35.1
Stilt Sandpiper													*	
Buff-breasted Sandpiper														
Broad-billed Sandpiper	2.7		*		1.1									
Ruff						*				*	+		*	
Wilson's Phalarope													*	
Red-necked Phalarope											+	+	+	
Common Avocet														
Pacific Golden Plover	1.7	0.5	3.3	5.3	6.2	4.2	9.8	0.4	0.4	0.4	+	2.5	0.3	0.5
Grey Plover	+	1.3	+	+		*		1.2	4.3	2.5	1.3	*	0.3	
Ringed Plover					*								*	
Little Ringed Plover										*				
Kentish Plover														
Long-billed Plover														
Lesser Sand Plover	13.7	18.4	11.4	4.2	3.1	0.6	5.2	1.5	*	+	+	+	+	+
Greater Sand Plover	1.6	0.3	1.1	1.5	*	*		0.5		1.2	+	*	+	+
Oriental Plover		*	*	*										
Grey-headed Lapwing														

Table 1. cont.

Species	29	30	31	32	33	34	35	36	37
Black-tailed Godwit			*	*				*	*
Hudsonian Godwit			*					+	
Bar-tailed Godwit	0.9	1.8	52.4	52.9	94.4	99.7	55.3	88.7	59.8
Little Curlew								*	
Whimbrel	+	+	+	+	+	+	+	+	+
Eastern Curlew	2.1	3.3	+	+	+		+	+	+
Eurasian Curlew									
Spotted Redshank									
Common Redshank									
Marsh Sandpiper			*	+	*			*	
Common Greenshank	0.6	1.9						*	+
Spotted Greenshank									
Lesser Yellowlegs			*					*	
Wood Sandpiper									
Green Sandpiper									
Terek Sandpiper		*	+	+				+	*
Common Sandpiper								*	
Grey-tailed Tattler		+	*	+	*	+	*	+	+
Wandering Tattler									
Ruddy Turnstone	22.6	2	5.3	2.1	2.8	*	3.4	0.8	27.6
Long-billed Dowitch									
Asiatic Dowitcher									
Great Knot	*	*							
Red Knot	2.5	0.3	4.9	41.6	1.9	0.2	40.3	2.4	9.5
Sanderling	+			+	*		+	+	
Little Stint		*							
Red-necked Stint	44.2	59.6	+	+	+	*	+	2.8	0.4
Temminck's Stint									
Long-toed Stint									
Spoon-billed Sandpiper									
Pectoral Sandpiper			*	+	*	+	+	+	+
Sharp-tailed Sandpiper	0.3	0.9	+	+	+	*	+	1.4	0.2
Dunlin									
Curlew Sandpiper	23.5	24.4	+	+	+		+	1.3	0.2
Stilt Sandpiper									
Buff-breasted Sandpiper		*							
Broad-billed Sandpiper									
Ruff								*	
Wilson's Phalarope									
Red-necked Phalarope									
Common Avocet									
Pacific Golden Plover	2.2	6.1	0.7	2.4	0.5		+	2.1	1.3
Grey Plover			+	+			*		+
Ringed Plover				+					
Little Ringed Plover									
Kentish Plover									
Long-billed Plover									
Lesser Sand Plover	*	+		+				*	
Greater Sand Plover				+				+	
Oriental Plover									
Grey-headed Lapwing									

used previously (Crawford 1997) although additional data from Myanmar (Burma), South Korea, Japan and China have been included (Perennou *et al.* 1991, Perennou and Mundkur 1991, Perennou and Mundkur 1992, JAPB & WBSJ 1993). The data from China includes figures from the Yangtze Estuary (Barter *et al.* 1997) and Hong Kong (Melville 1993). The total count for all censuses used in the calculations below is over six million birds. There was a need to reduce the effect of the different numbers of censuses in each regions when doing the calculations (Table 1). Also there is a need to give weighting to data from different regions which takes into account the extent of relative coast lines and the likely distribution of the birds major population centres, some of which are poorly known. Firstly, the district percentages for each species (Table 2) were grouped. These were group A China -Vietnam (Yangtze Estuary, Hong Kong and districts 1 to 3), group B South East Asia (4 to 10), group C North West Australia (11 to 13), group D North East Australia and P N G (14 to 18), group E South East Australia (19 to 22), group F southern Australia (23 to 30) and New Zealand group G (districts 31 to 37). The definition of regional boundaries was based on previous analysis (Crawford 1997). Secondly, the data from state wide Asian census date (regional date above not included) was grouped. These were group H (Peninsula Malaysia, East Malaysia, The Philippines and Indonesia), group I (Myanmar, Thailand, Vietnam, and China), group J (Japan and

Table 2. The names of 37 districts, the number of censuses in each (N), the total counts per district and the sum of scores (diverity index values).

District	N	Total	Sum of scores
1. Red River Delta, Vietnam	7	32746	47.67
2. Sheyang Saltworks, China	11	50942	42.50
3. Taiwan Island	8	201155	36.87
4. Pattani Bay, Thailand	7	30783	42.50
5. Olango Island, The Philippines	7	51558	38.12
6. Singapore Island	11	42278	42.00
7. Selangor area Malaysia	12	62895	42.50
8. Pulau Briut, Sarawak	5	38427	47.50
9. Coastal Brunei	9	22613	36.00
10. S.E. Sumatra	5	103635	34.62
11. Broome, Port Hedland NW Australia	52	1087264	41.00
12. Darwin, NT	13	65530	39.87
13. S.E. Gulf of Carpentaria Qld	9	73886	31.37
14. Central Province, PNG	4	22663	27.25
15. Cairns area, Qld	4	35492	35.25
16. Mackay area, Qld	9	44736	34.12
17. Morton Bay, Qld	17	168249	39.25
18. Clarence area, NSW	6	14974	46.50
19. Hunter Estuary, NSW	7	37026	39.25
20. Botany Bay, Parramatta River NSW	6	54979	34.12
21. Shoalhaven Estuary, NSW	4	7247	27.50
22. Corner Inlet area, Vic	25	473134	29.12
23. Swan River, WA	5	16937	23.75
24. Albany area, WA	14	86843	30.75
25. Gulf St. Vincent, SA	20	267866	26.25
26. S.E. South Australia	18	430281	29.50
27. Port Phillip Bay, Vic	52	606567	23.50
28. Western Port Bay, Vic	26	262275	25.00
29. Northern Tasmania	8	35251	23.75
30. S.E. Tasmania	26	89829	21.00
31. Far North, New Zealand	9	257504	15.25
32. Auckland, NZ	9	526028	18.75
33. Bay of Plenty, NZ	9	95285	12.37
34. Waikato area, NZ	8	35937	8.37
35. Nelson, NZ	9	332583	16.50
36. Canterbury, NZ	8	20705	17.37
37. Southlands, NZ	13	61860	18.50
Totals	471	5847956	

South Korea). The data from some census suggest that census material was not strictly coastal but included counts from rice paddies. This accounts for the higher than expected numbers of Wood Sandpiper *Tringa glareola*. The following formula was used to calculate the relative abundance index value for each species

$$A = \frac{W * X}{Ng}$$

where A = index of abundance for each species, X = the sum of district percentages (Table 2) in each group, Ng = the number of districts in each group or in the case of state wide censuses the number of countries, W = the weighting value given to the group based on factors discussed below. When deciding on the weighting value (W) two thing were considered. The relative length of the coast line and birds counted in Japan and South Korea during spring and autumn were most likely to be in passage and a higher rating was justified on the basis that these birds reflect some populations not covered by other census data. Groups A, B, C, H, I and J were given a weighting of 3 and all others were unweighted. The weighting value are subjective. On a regional basis the influence of Asia, Australia and New Zealand is in a ratio of 17: 6 :1. In this scheme north-western Australia (Broome to the Gulf of Carpentaria) is given a weighting three time higher than the rest of Australia. The index of abundance values for each species (A) were summed to give a grand total and

Table 3. The estimated relative abundance and frequency of 57 species of migratory waders as calculated from coastal censuses in the East Asia-Australasian Flyway. The total frequency is the total number of census in which the species was recorded (of 380 censuses). The adusted frequence is the percentage of censuses in which the species occurs after the data has been adjusted to mitigate the effect of uneven distribution of censuses within and between regions. Of the two frequency figures, the adjusted one is considered the more meaningful. Species marked * are known to have significant inland populations and are therefore under represented in the list below. Species of Snipe *Gallinago sp.* and Pratincole *Glareola sp.* are not listed.

Species	Relative Abundance %	Total Frequency	Adjusted Freqency %
1. Red-necked Stint *Calidris ruficollis*	13.6	348	88
2. Bar-tailed Godwit *Limosa lapponica*	9.5	319	87
3. Dunlin *Calidris alpina*	8.3	58	22
4. Great Knot *Calidris tenurostris*	6.4	208	59
5. Lesser Sand Plover *Charadrius mongolus*	5.7	215	71
6. Curlew Sandpiper *Calidris ferruginea*	5.5	326	77
7. Kentish Plover *Charadrius alexandrinus*	5.0	117	41
8. Black-tailed Godwit *Limosa limosa*	4.9	197	62
9. Pacific Golden Plover *Pluvialis dominica*	3.7	292	77
10. Common Redshank *Tringa totanus*	3.1	140	46
11. Greater Sand Plover *Charadrius leschenaulti*	3.0	208	59
11. Red Knot *Calidris canutus*	3.0	237	54
13. Marsh Sandpiper *Tringa stagnatilis*	2.7	198	56
14. Common Greenshank *Tringa nebularia*	2.4	311	85
15. Wood Sandpiper *Tringa glareola*	2.3	116	35
16. Spotted Redshank *Tringa erythopus*	2.2	61	27
17. Sharp - tailed Sandpiper *Caldris acuminata**	2.1	241	51
18. Little Ringed Plover *Charadrius dubius*	2.1	105	33
19. Whimbrel *Numenius phaeopus*	1.7	284	79
20. Common Sandpiper *Actitis hypoleucos*	1.6	203	60
21. Grey Plover *Pluvialis squatarola*	1.5	238	68
22. Terek Sandpiper *Xenus cinerus*	1.5	211	57
23. Grey-tailed Tattler *Heteroscopus brevipes*	1.5	220	52
24. Ruddy Turnstone *Arenaria interpres*	1.3	293	72
25. Eastern Curlew *Numenius madagascariensis*	1.2	273	71
26. Long-toed Stint *Calidris sudminuta* *	1.2	75	22
27. Eurasian Curlew *Numenius aquata*	0.8	105	39
28. Broad-billed Sandpiper *Limicola falcinellus*	0.8	95	32
29. Sanderling *Calidris alba*	0.4	115	31
30. Green Sandpiper *Tringa ochropus*	0.3*	54	18

Table 3. continued

Species	Relative Abundance %	Total Frequency	Adjusted Freqency %
31. Grey-headed Lapwing *Vanellus cinereus*	0.3	30	12
32. Asiatic Dowitcher *Limnodromus semipalmatus*	0.2	59	22
33. Temminck's Stint *Calidris temmickii*	0.1	49	20
34. Red-necked Phalarope *Phalaropus lobatus*	0.1*	33	13
35. Long-billed Plover *Charadrius placidus*	<0.1	19	15
36. Little Curlew *Numenius minutus*	< 0.1*	22	13
37. Oriental Plover *Charadrius veredus*	<0.1*	36	11
38. Pectoral Sandpiper *Calidris melanotos*	< 0.1	44	9
39. Ruff *Philomachus pugnax*	<0.1	24	8
40. Spotted Greenshank *Tringa guttifer*	< 0.1	19	7
41. Spoon - billed Stint *Eurynorhynchus pygmaeus*	<0.1	17	7
42. Ringed Plover *Charadrius hiaticula*	<0.1	19	6
43. Least Sandpiper *Calidris minutilla*	< 0.1	14	3
44. Common Avocet *Recurvirostra avosetta*	<0.1	14	3
45. Wandering Tattler *Heteroscopus incana*	<0.1	10	3
46. Long-billed Dowitch *Limnodromus scolopaceus*	<0.1	19	3
47. Grey Phalarope *Phalaropus fulicarius*	<0.1	5	2
48. Hudsonian Godwit *Limosa haemastica*	<0.1	6	2
49. Little Stint *Calidris minuta*	<0.1	4	1
50. Baird's Sandpiper *Calidris bairdii*	< 0.1	2	1
51. Buff-breasted Sandpiper *Tryngites subruficollis*	< 0.1	2	1
52. Lesser Yellowlegs *Tringa flavipes*	<0.1	1	1
53. Bristle-thighed Curlew *Numenius tahitiesis*	< 0.1	1	1
54. Greater Yellowlegs *Tringa melanoleuca*	< 0.1	1	1
55. Western Sandpiper *Calidris mauri*	< 0.1	1	1
56. Wilson's Phalarope *Phalaropus tricolor*	< 0.1	1	1
57. Stilt Sandpiper *Micropalama himantopus*	< 0.1	1	1

the values shown in Table 3 are a percentage of this grand total. Two other schemes were also tried. In the first of these, all regions and state wide groups were given equal weighting. In the second, the influence of the Asia census data was even greater than that used for Table 3. Though some species changed places with these other method of calculation, the general pattern remained the same. Red-necked Stint *Calidris ruficollis* and Bar-tailed Godwit *Limosa lapponica* remained at the top of the list. Other species in the top third, middle and lower third rankings held their relative positions. Common Redshank *Tringa totanus* was higher on the list than Greenshank *Tringa nebularia.* Similarly, Curlew Sandpiper *Calidris ferruginea*, Dunlin *Calidris alpina* and Black-tailed Godwit *Limosa limosa* retained their relative positions.

Relative frequency is another measure of abundance, but suffers from the effects of the size differences of the census areas. It was found from the previous analysis that the numbers of species increase by about 30% from census of about 2500 bird to those of over 10,000 birds. The extra species from the larger census are always local rarities. This affect is thought to be significant, as there is an uneven distribution of small and large census between regions. I tried to mitigate this problem by balancing the numbers of large and small census between Australia and Asia. The total number of censuses used for frequency calculations was 380, and included all data from New Zealand. Also included were data from country-wide censuses in Asia that did not include district data.

Table 3 shows the total frequency of each species in the 380 censuses. The adjusted frequency which is shown as a percentage was calculated in a different way and is not directly related to total frequency (Table 3). For adjusted frequency, the frequency of each district was divided by the number of censuses for that district. Data from country-wide censuses was treated in the same way. Once these index values had been obtained, calculations were similar to those for relative abundance with two important difference. The values for each region or group of countries was given equal weighting and the final percentage was calculated using the maximum possible adjusted frequency. The result are two sets of frequency data, the second of which is largely independent of sample size and the uneven number of census between regions. It can be seen by comparing data in Table 2 with that in Table 3 that species with a comparatively even distribution through the regions will be favoured in frequency estimations. Species like Dunlin *Calidris alpina* with large populations but limited distribution have lower frequencies.

In Table 3 species marked ' * ' are known to have significant non-coastal populations and are therefore underrepresented on the list (Lane 1987, Smithies 1968). The most significant of these is the Little Curlew *Numenius minutus* which would probable rank somewhere in the top seven species if inland populations were also included (Burrows 1994). The Wandering Tattler *Heteroscopus incana* is probable under reported due to the difficulties of distinguishing it in the field from the common Grey -tailed Tattler *H. brevipes*. Records of Least Sandpiper *Calidris minutilla*, Long-billed Dowitcher *Limnodromus scolopaceus* and Grey Phalarope *Phalaropus fulicarius* are nearly all from Japan.

In conclusion, unless there are areas in the East Asian-Australasian Flyway with a significantly different population mix than have been described to far, then what is shown in Table 3 is a reasonable estimate of the overall abundance of each species in the coastal areas of this hemisphere. The diversity of waders in the hemisphere is such that no single area supports a migratory wader population which is typical of the hemisphere as a whole, although the wader populations in Japan during spring and autumn are the most representative.

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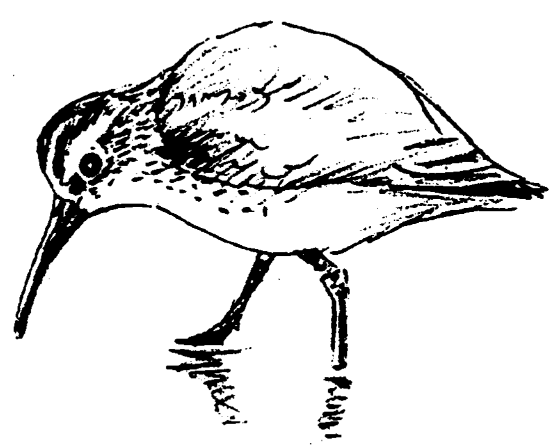

WADER CENSUSES ON THE CAIRNS WATERFRONT, QUEENSLAND FROM 1964 TO 1970

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ABSTRACT
The result of 48 wader censuses carried out on the Cairns waterfront, north Queensland, are summarised. A list indicating the relative abundance of the 22 species of waders recorded in the census are given. A comparison is made between this data and more recent figures from the Cairns region.

INTRODUCTION

Between September 1964 and October 1970 one of us (HBG) carried out a series of censuses on the Cairns waterfront. A total of forty eight censuses were carried out at irregular intervals over this six year period. The only other published census prior to the 1970s was that which resulted from a visit by Amiet (1957). Historical census are of interest because they can help to shed light on long term changes in wader populations. The most comprehensive recent data for the district comes from Driscoll (1997). Other censuses material of the area has been published by Hewish (1986, 1987, 1988, 1989, 1990), Anon. (1992), Harris (1994, 1995). We present the results of these early counts and compare them with the recent counts of waders from the same area.

METHODS AND RESULTS

The census area consisted of about half a kilometre of inter-tidal mud flat bounded on the landward side by a low concrete sea wall, a strip of park land and the town centre. Part of the mud flat had been covered by mangroves but these had been cut down to allow a better view of the sea from houses along the waterfront. All counts were made on the mud flat at low tide using binoculars. Table 1 shows the number of censuses carried out during each calender month and the monthly mean count for each species. The means are used in preference to maximum numbers per month because of the way in which the data was assembled.

The data indicates the waders seasonal use of the area, although year to year variations can not be ascertained. Table 2 shows the relative abundance of each species in terms of numbers and their relative frequency. A similar table has been compiled for the Darwin area (Crawford 1997). Other records from the Cairns area are Long-toed Stint, one on the mud flats 4 November 1965 (DC) and Little Curlew, one on the sports reserve on 11 October 1964 (HBG). Included in this table are the relative numbers for the Cairns district derived from Driscoll (1997). The two sets of data are not strictly comparable because although Driscoll's data contains material from the Cairn waterfront, there is also data from other sites in the district. There could be habitat related effects between the two sets of data as can be seem by the ratio of Lesser Sand Plover to Greater Sand Plover. The latter species prefers a firmer substrate that the former. The waterfront habitat in the 1960s favoured Lesser Sand Plover. The difference in the two sets of relative numbers for Broad-billed Sandpiper also needs to be viewed with caution. There seems to be a significant drop in their numbers in recent times but this is an under reported species that can be easily mistaken for a Red-necked Stint in the field.

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Table 1. The mean monthly counts of species recorded on the Cairns waterfront between September 1964 and October 1970. Values are rounded to the nearest whole number.

Species	Months											
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Black-tailed Godwit	3	4	19	49	20	21	20	20	38	18	7	
Bar-tailed Godwit	28	62	64	60	48	66	73	64	58	15	18	52
Whimbrel	5	18	12	9	6	8	10	7	7	9	11	7
Eastern Curlew	5	6	9	11	8	6	8	4	4	12	9	5
Marsh Sandpiper		1		1		1					1	
Common Greenshank	6	6	8	8	4	8	17	12	7	4	5	3
Wood Sandpiper	1			1		2						
Terek Sandpiper	4	10	25	29	11	27	22	7	17	37	11	
Common Sandpiper				1		1	2	1				
Grey-tailed Tattler	55	34	40	64	34	17	9	17	11	63	43	
Wandering Tattler					1							
Ruddy Turnstone			2	2	1	1						
Great Knot	6	16	15	13	30	3	4					
Red Knot			67	2	7	4	3	1		2		
Red-necked Stint	127	150	260	200	347	116	65				82	
Sharp-tailed Sandpiper	1	500	50	216	1	1	3	6				
Curlew Sandpiper		4	6	16	2	2	2					
Broad-billed Sandpiper		100	50	54	93	15	9	68	78	18	17	
Black-winged Stilt	3	1	3	3	10	2	4	1		2	2	
Pacific Golden Plover	4		14	10	8	10	34	2	2		1	
Grey Plover		1	1	1	1							
Red-capped Plover			2	12	1	1		1				
Double-banded Plover	2	3										
Lesser Sand Plover	98	30	118	174	191	67	54	39	135	230	56	
Large Sand Plover	4	5	7	3	2	2	1	4	16	9		
Black-fronted Dotterel		1			1		1			1		
Marsked Lapwing	6	1	5	4	2	3	5	4	6	2	3	5
Number of censuses	6	2	6	7	6	9	4	3	2	2	1	1

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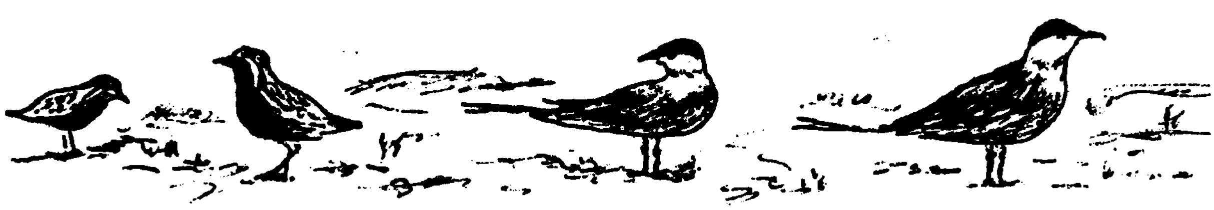
Table 2. The relative abundance of species recorded on the Cairns Waterfront and the total number of birds counted during 48 censuses from 1964 to 1970. N = the number of censuses where a species was seen. More recent data is taken from Driscoll (1997).

Species		Total	Relative numbers %	
	N	1960s	1960s	1990s
Red - necked Stint	46	8270	28.4	33.1
Lesser Sand Plover	41	5332	18.3	3.4
Sharp - tailed Sandpiper	28	4417	15.2	6.0
Bar - tailed Godwit	48	2737	9.4	6.4
Broad - billed Sandpiper	27	2037	6.9	0.5
Grey - tailed Tattler	38	1649	5.7	3.3
Black - tailed Godwit	35	1034	3.5	4.5
Terek Sandpiper	38	911	3.1	2.9
Red Knot	18	493	1.7	1.7
Greater Knot	18	457	1.6	8.9
Greenshank	46	379	1.3	1.1
Whimbrel	47	375	1.3	16.0
Eastern Curlew	41	355	1.2	3.4
Golden Plover	27	314	1.1	3.4
Large Sand Plover	18	160	0.5	1.7
Curlew Sandpiper	18	158	0.5	4.2
Rudy Turnstone	11	25	< 0.1	0.2
Common Sandpiper	7	13	< 0.1	0.9
Grey Plover	7	12	<0.1	< 0.1
Wood Sandpiper	4	10	<0.1	0
Marsh Sandpiper	4	4	<0.1	< 0.1
Wandering Tattler	2	2	< 0.1	0
Totals	29	144	100	100



QUEENSLAND COASTAL MIGRATORY WADER POPULATIONS: AN ASSOCIATION INDEX ANALYSIS

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ABSTRACT

Driscoll (1997) has published estimates of the numbers of waders found along the coast of Queensland. This and other data on palaearctic waders is analysed further using an association index. Within Queensland there seems to be two populations within a broader continuum. The northern population extends into north western Australia. Four censuses from northern Australia and New Guinea that are either small or the result of a single visit are examined using the index data. The association index is also used to examine the degree of dissimilarity in the Queensland districts. The Shoalwater Bay area was found to be the most unique area.

INTRODUCTION

Association indices are used to compare the species mix from different populations with the aim of detecting patterns in complex data. In a previous analysis it was shown that the migratory wader populations of coastal Queensland and New South Wales were significantly different from populations in southern Australia, New Zealand and south east Asia (Crawford 1997a). Since that time Driscoll (1997) has published more comprehensive estimates of the waders of coastal Queensland. This account includes a description of habitats and estimates of numbers of individual species and their distribution across the state. This data lends its self to further analysis. Apart from Driscoll's data, I have drawn on information used previously from south eastern and north western Australia and New Guinea in and attempt to show how the Queensland populations appear to fit within the broader context (Crawford 1997a).

METHODS AND RESULTS

The association index used was discussed in Crawford (1997a) and its salient points are reproduced here. The species data is reduced to a percentage of the total for the district and scored in the following way (Table 1).

The formula for association (AS) is calculated as:

$$AS = \frac{Minimum.scores * 100}{A + B}$$

where A and B are the sum of scores for the districts being compared and minimum scores are the sum of the lowest values for each species in the two lists. When the scores for the two districts are identical the index value will equal 100. Then the two districts have no species in common the index value will be zero. An index value greater that 70 is taken as showing a close association.

Driscoll (1997) gives estimates for thirteen coastal districts covering the whole of coastal Queensland. This data comes from a variety of sources including aerial surveys of remote areas. As Driscoll points out, some districts in the north of the state are still poorly known. Data outside Queensland is drawn from: Barter (1992) Barter *et al.* (1988), Burrows (1994), Crawford (1997b), Dann (1980, 1994), Fallaw and Hayward (1996), Harris (1994, 1995, 1996, 1997a, 1997b), Hewish (1986, 1987, 1989, 1990), Kendall and Van Gessel (1972), Klaspte (1975), Lane (1988), Lane and Jessop (1985), Martindale (1981, 1982), Minton (1982a, 1982b, 1987, 1993), Minton and Watkins (1989), Minton and Jessop (1994), Minton and Martindale (1982), Naismith (1992), Anon (1981, 1992, 1995).

Table 1. The association scores assigned to each species according to their percentage contribution to the count at a site.

Percentages	Scores
< 0.5 estimated as one bird	0.125
< 0.5 estimated as more than one	0.25
0.5 to 1	0.5
1.1 to 2	1
2.1 to 4	2
4.1 to 8	3
8.1 to 16	4
16.1 to 32	5
32.1 to 64	6
> 64	7

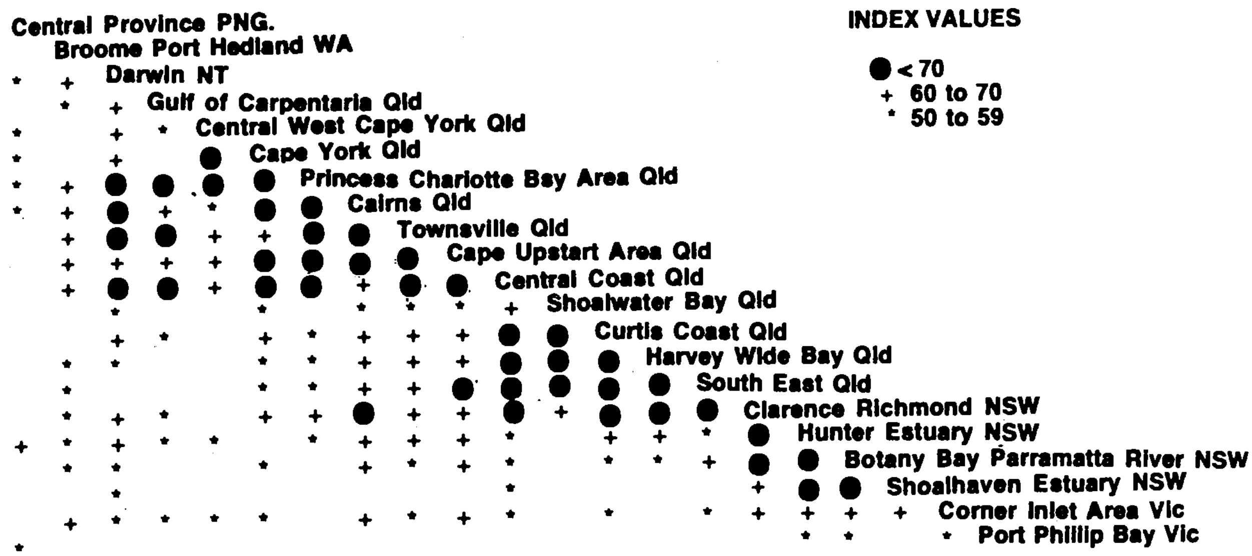

Figure 1. Association index values between districts. The index values shown here are for 21 coastal districts from Papua New Guinea and north western Australia to south eastern Australia.

Figure 1 shows the pattern of association index values for districts arranged from north to south. One of the Queensland districts, Cooktown (Table 3), is not included here because of small population estimates. Figure 1 shows three fairly distinct population groupings which fit within a broad north west-south east continuum. Within these groups there is some patchwork effect that may relates to local habitat influences. The influence of a north-south continuum can be tested for statistically. The hypotheses is that as distances increase from a given district, the association values will fall giving a negative correlation. In this analysis index values from all the Queensland districts, Darwin and Clarence-Richmond were used as the extreme points. There was no correlation between longitude and association index values but there was a relationship with latitude and the index values ($r^2 = -0.24$, $P < 0.05$, df = 103).

Small population samples or data that result from one visit to an area have to be approached with caution as they can sometimes give a misleading impression of its value for shorebirds. Table 2 shows the association index values for four such sets of data. The Cooktown section of the Queensland coast seems to be poor habitat for shorebirds (Driscoll 1997). The index values for the small population suggests a closer association with southern Queensland than with adjacent districts. This could be a true reflection of the situation because poor habitat can exclude some species and odd index values linkages can occur.

The Arnhem land data results from three census carried out in the Elco Island, Boucaut Bay and Millingimi areas in October 1986 (Lane 1987). The association index values (Table 2) are similar to that for Darwin to the west. Bamford (1990) carried out seven counts on the shore line of the Kakadu National Park, Northern Territory, as part of a much wider survey. The association index values in Table 2 suggest that more data is needed before any conclusions can be made about the coastal migratory shorebirds in the area. Over a period of a year, Heron (1980) carried out a series of censuses at Bereina PNG and the results in Table 2 show a close association between this area and the Cape York district populations.

In Table 3, an index of uniqueness was derived from the association index values. In these calculations, all the Queensland districts and Clarence-Richmond data was used. These fourteen districts cover a continuous stretch of coastline. Within this group, each district had thirteen index values linked with it and these values were summed. The largest sum of association indices was 1497 for Clarence-Richmond region. This was taken as the base line and the index of uniqueness was calculated as the difference between the 1497 and the sum of association values for each of the other districts. The Shoalwater area has the highest uniqueness value. Driscoll (1997) estimates the migratory shorebird population at over 23,800 birds. The area does appear to have to have an odd mix of species and this can be demonstrated by

Table 2. Association index values for four small or single sets of census data of migratory shorebirds. The data is from Cooktown district, Queensland (Driscoll 1997); Arnhem Land, Northern Territory (Lane 1987); Kakadu National Park, Northern Territory (Bamford 1990); Bereina, PNG (Heron 1980). The number of birds are an estimate (Cooktown), a single count (Arnhem Land) and the sum of a series of censuses (Kakadu and Bereina). They are not directly comparable, the index values depends on the proportions of each species in the censuses. Index values greater that 70 are considered to show a close association.

Districts	Cooktown, Qld	Arnhem Land, NT	Kakadu, NT	Bereina, PNG
Central Province, PNG	17	42	34	46
Broome Port Hedland, WA	58	74	32	51
Darwin, NT	52	69	60	52
Gulf of Carpentaria, Qld	45	64	37	47
Central West Cape York, Qld	48	47	54	69
Cape York, Qld	57	45	61	74
Princess Charlotte Bay, Qld	47	64	53	58
Cairns, Qld	53	57	54	54
Townsville, Qld	58	70	53	47
Cape Upstart, Qld	59	61	53	59
Central Coast, Qld	75	70	57	55
Shoalwater Bay, Qld	59	44	43	39
Curtis Coast, Qld	66	52	67	53
Harvey Bay, Qld	66	49	56	44
South East, Qld	78	52	49	47
Clarence-Richmond, NSW	71	54	50	52
Hunter Estuary, NSW	45	47	47	52
Botany Bay-Parramatta River, NSW	52	54	34	39
Shoalhaven Estuary, NSW	45	41	34	39
Corner Inlet, Vic	56	51	41	42
Port Phillip Bay, Vic	26	36	26	36
Number of birds	575	20784	1178	2480

comparing the proportion of four species as a percentage with the estimated maximum percentage values of these species from 37 other coastal districts in Australia, New Zealand and south east Asia (Table 4) (Crawford, *this issue*).

The Morton Bay area is within the south east Queensland district and Mackay within Central Queensland Coast district. The second on the list of uniqueness (Table 3) is Cooktown, but the population is too small to be considered significant (Table 1). The third on the list is the Queensland section of the Gulf of Carpentaria which Driscoll estimated to hold about 50% of the 400,000 shorebirds found in coastal Queensland. In this district, the most common species was the Black-tailed Godwit *Limosa limosa* which was estimated to be 26.1% of the total migratory shorebird population. This suggested that the Gulf of Carpentaria is one of the most important sites for this species. South East Sumatra (40.3%) and the Red River Delta, Vietnam (27.1%) were the only

Table 3. Uniqueness index values for Queensland districts and the Clarence-Richmond district of New South Wales. The uniqueness values are given by U = 1497 - X, where X is the sum of thirteen association index values with all districts in Queensland and the Clarance - Richmond area of NSW. Index values are ranked from highest to lowest.

District	Uniqueness Index
Shoalwater Bay	403
Cooktown	364
Gulf of Carpentaria	316
Central West Cape York	308
Harvey Wide Bay	245
Cape York	202
South East Queensland	195
Princess Charlotte Bay	165
Curtis Coast	135
Townsville	98
Cairns	89
Cape Upstart Area	88
Central Coast Qld.	38
Clarence-Richmond NSW	0

Table 4. The percentage that each species contributes to the population counts in Shoalwater Bay and the mean of the 37 other districts examined.

Species	Percentage of district migratory population	
	Shoalwater	Other districts
Whimbrel	29.9	5.7
Eastern Curlew	12.5	3.2
Terek Sandpiper	14.3	15.7
Grey-tailed Tattler	12.6	9.9

districts that had a higher proportion of Black-tailed Godwits (Silvius 1988, Pederson *et al.* 1996).

Three aspects of diversity were measured in the Queensland data. These were species richness (number of species per district), Simpsons index (the difference in proportion between species) and the sum of scores. There was no statistical difference ($P<0.05$) between the mean values shown below for North Queensland (Gulf of Carpentaria to Central Coast) and Southern Queensland (Shoalwater to the South East) for Species Richness (21.1 vs 19.7), Simpson Index (4.4 vs 5.1) and Sum of Scores (33.9 vs 33.5). These values are comparible with those found in the previous study (Crawford 1997a).

DISCUSSION

The patterns shown in Figure 1 seem to fit within a broad continuum of migratory wader distribution in coastal areas that extends from southern Australia to the mainland of Asia (Crawford 1997a). The differences show between north and south in the region under review are due to fairly subtle changes within the shorebird population. The most significant of these is the partial replacement of Black-tailed Godwit *Limosa limosa* by Bar-tailed Godwit *L. lapponica* in southern districts and a reduction of the influence of Great Knot *Calidris tenuirostris* numbers from north to south. Driscoll's (1997) analysis of the numbers of waders in Queensland shows a large population of shorebirds in the Gulf of Carpentaria with comparatively small numbers through the rest of north Queensland and numbers again increasing in coastal areas in the southern half of the state. With the association index of the type used here, the pattern is divorced from the influence of the size of district population. What the index values indicate is that the north Queensland and Northern Territory populations fall broadly within the same group and that the difference between districts, in terms of numbers of birds, can be largely explained by the extent of suitable habitat.

One of the difficulties in ascertaining migratory shorebird numbers in northern Australia from observations made at irregular intervals, is the influence of the weather during the wet season from November to April. My own observations illustrated this point. In February 1971, a tropical low pressure area formed a few kilometres north east of Darwin. At one stage the system was threatening to become a cyclone but dissipated. Within hours of this episode a check of some Darwin beaches showed them completely devoid of all shorebirds. A count of waders was made a few days later (part of a regular count Crawford 1997b) showed that some birds had moved back into the area but the numbers were still low. Before this event on the 20 February, 947 birds were counted, but by the 28 February there was an 80% drop in this number. It seems possible that the wader populations of northern Australia are much more mobile in the October to April period than their southern Australian counterpart and that relatively low-grade habitat could be used more frequently in some years by birds moving out of the path of storm systems.

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INTERNATIONAL SPECIES PROTECTION AGREEMENTS: MIGRATORY SHOREBIRDS IN THE EAST ASIAN - AUSTRALASIAN FLYWAY

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ABSTRACT
The design of a species protection agreement for shorebirds in the East-Asian Australasian Flyway is addressed using the economic theory of 'public goods'. The paper emphasises conceptual rather than technical economic aspects. The strongest preferences for conservation in this Flyway are held by developed countries such as Australia and Japan. The areas of greatest conservation need however are developing country 'stopover' sites in Asia. Drawing on 'public goods' ideas and a 'benefits' approach to allocating funding responsibility, there are efficiency arguments for transferring conservation resources from developed to developing countries so that the former can seize desirable conservation opportunities in the latter. International agreements enhance the efficiency of conservation efforts by matching strong preferences for conservation in developed countries with highly productive conservation opportunities in developing countries.

INTRODUCTION

Suppose a group of nations seeks an efficient international agreement which conserves or protects animals (we take the case of migratory shorebirds) which live in, or migrate within, an area which could possibly cross international borders. Alternatively, at the national level, we could seek efficient regional species protection agreements *within* a nation – conceptually this is analogous. In each case, seeking an *efficient* agreement means trying to achieve a desired degree of conservation (defined in terms of numbers conserved) at minimum cost. Such an agreement is non-wasteful and given the many uses for scarce conservation resources, a basic property of any agreement is that it should be non-wasteful.

The notion of an international agreement here is specialised. An *agreement* is defined as a set of rules agreed to by a group of nations that define the required extent of conservation effort in each nation and how this effort is to be funded. Effort here includes determining and exchanging information about migratory shorebirds (for example staging areas, population trends), foregoing certain development options (wetland uses or hunting practices), restoring degraded habitats, developing and delivering educational programs to encourage conservationist ethics and conservation-friendly productive practices.

This conservation task has been partly analysed in Clarke (2000) using public economics. This general analysis there was given specific context by considering migratory shorebird species on the East Asian-Australasian Flyway (EAAF). This is of contemporary interest given current attempts to negotiate at least an informal multilateral conservation agreement for the EAAF (Watkins and Mundkur 1997). The point of the present note is to set out the basic ideas in that paper so key results can be understood by non-specialists in economists. I also emphasise practical issues of concern arising in this Flyway.

THE MODEL

In Clarke (2000), three steps were advanced for achieving global efficiency via an international species protection agreement. Conservation benefits in each country first need assessment. Then national conservation efforts need prioritisation in terms of their relative international effectiveness. Finally, globally efficient conservation programs need to be introduced so aggregated national conservation benefits (at the margin) are brought into line with conservation costs (again at the margin). These ideas are now discussed.

Identifying Conservation Benefits

It is first necessary to estimate the economic value of conservation benefits that different countries see themselves as enjoying from conserving species. This involves knowing how much citizens of each country (or public conservation agencies) would pay for extra (or 'marginal') levels of species conservation at each level of the conserved population. This schedule of marginal benefits for individual nations (visualised as a graph) shows their national *willingness-to-pay* for extra species conservation. In Figure 1 below, a willingness-to-pay schedule is provided for a hypothetical nation.

Here *marginal* benefits from species conservation (MB) are graphed as a line which decreases as more members of the species is conserved. If extinction is prevented by maintaining populations at just above their minimum critical level then the marginal conservation benefits from conserving these final members are high (and indicated on the graph by MB0). This reflects the idea that avoiding extinction is strongly sought. If the species is conserved at a larger viable population size S then marginal benefits from conserving extra units are lower (and indicated on the graph by MBS). The *total* benefits derived from conserving stock size S are the aggregated marginal benefits up to S or the *area* under the marginal benefits curve, namely A+B. Note that while marginal benefits are assumed linear in the stock size this may be unrealistic – benefits from preventing extinction may be even more disproportionately high than illustrated here. Only low (or even zero) extra conservation benefits may accrue to stocks increased beyond their minimum critical level. There are, however, sound conservation reasons for seeking to conserve populations at levels well beyond the minimum critical levels at which they can just survive.

Given this national benefit schedule, it is necessary to sum the benefits enjoyed by *all* countries at each conservation level in order to determine global conservation benefits. Note that the countries enjoying benefits need not be countries on the migration corridor – they may be countries elsewhere with conservation interests related to corridor species. The geography of the corridor is irrelevant to determining the incidence of benefits. Then the aggregated willingness-to-pay of all countries can be interpreted as a *global conservation demand schedule* (again, visualised as a graph) showing the price that interested countries of the world will pay for various levels of the conserved species stock.

These marginal benefits are *summed* to determine total benefits because conserved wildlife typically provides *nonrival* sources of value. If I enjoy looking at a migratory shorebird in Australia this does not limit someone else's opportunity to look at this same bird when it visits China – this source of pleasure is nonrival. This is not true for an apple eaten in Australia or for a bird that is shot for food or sport. This apple (or the shot bird) is a rival good since it can never be eaten (or shot) by another consumer!

Note that even if people do not derive consumption pleasure from viewing wildlife that any *existence value* they derive from knowing that wildlife survives is nonrival. (Existence value is a measure, in money terms, of the value individuals derive from knowing a species remains extant). Specifically, if I derive benefits from knowing a species is not extinct then that in no way detracts from the benefits someone else experiences from knowing the same species is not extinct. Therefore, *existence* value benefits enjoyed from conservation are nonrival and should

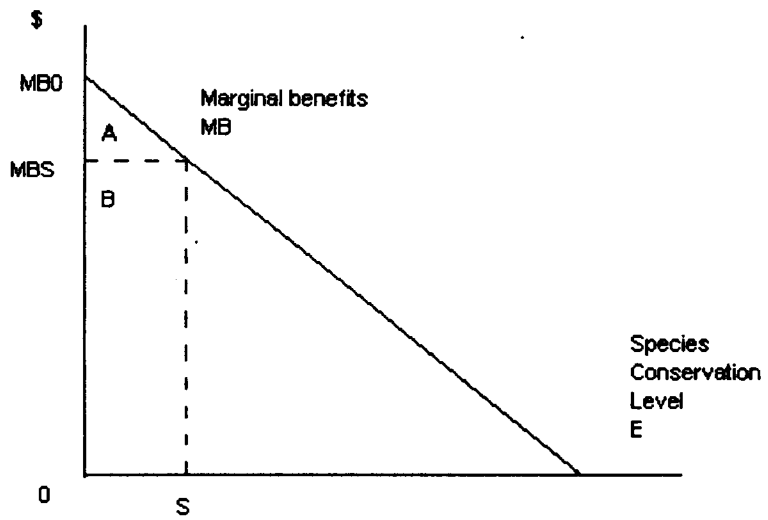

Figure 1: National Willingness-to-Pay for Species Conservation

be summed to derive aggregate marginal benefits.

Finally, note that conserving migratory shorebird species provides a *nonexcludable* source of value. Again, if I wish to eat an apple I must purchase it – consumption of it is excluded (or prevented) unless I pay. However, should I wish to view and enjoy migratory shorebirds I can do so without payment provided others have acted to ensure their survival. Conserving birds is nonexcludable. Since migratory birds provide nonrival and nonexcludable services, economists label these services *public goods*. Markets will undersupply such goods because private firms set up to provide such services are unable to recoup fully their investments in species protection because of nonexcludability and nonrivalry. If a species conservation service is provided it can be accessed without payment and, if provided to at least one individual at a price, others can access it without payment.

Nonexcludability implies that private firms and markets will not emerge to ensure the conservation of threatened shorebirds whereas they might develop for sedentary birds or mammals where excludability can be enforced. An Australian example of such a firm is that associated with John Wamsley's soon to be publicly-listed firm, *Earth Sanctuaries*.

How can the marginal conservation benefit estimates for individual nations be computed? The methods for estimating these benefits, such as *contingent valuation procedures*, ask people how much they will pay for conservation. These estimates are then aggregated. The estimated *aggregate* conservation benefits from such procedures are often surprisingly (and perhaps unrealistically) large and some have questioned their validity (Jacobson & Dragun 1996). However, the main points made here in relation to the aggregate benefits measure are conceptual and unrelated to precise estimates or methods used to infer them.

First, if conservation efforts in individual countries are determined purely by comparing the costs experienced *in* those countries with the benefits enjoyed *in* then these efforts will undersupply conservation effort because of a failure to account for the nonrival benefits accruing to other countries. Conservation effort may also be misdirected if more worthwhile conservation options in *other* countries are ignored by adopting this nationalistic perspective. Globally such independent actions will lead to global underprovision of conservation activity.

Moreover, a conceptual understanding of how benefits are aggregated is sufficient to understand, at least in part, how policies should be determined in important special cases. Clarke (2000), for example, emphasises instances where *most marginal benefits accrue to developed countries* (on the EAAF, Australia and Japan; off the EAAF, European countries and the US) so these developed countries provide most weight in this sum because marginal benefits accruing to developing countries are judged to be low.

Implicit here is the idea that the demand for conserving wildlife is strongly dependent on income (to use economics jargon it is *income elastic* and therefore a *luxury good*) so China and other countries with lower per capita incomes have less interest in conservation than do wealthier countries. Whether this is due to their inability to pay for conservation or for their preference for material consumption over conservation is irrelevant – the point is they will pay less for conservation. Clarke (2000) suggests it is *mainly* the marginal benefits of developed countries (MBD) that comprise the numerically important part of benefits.

More generally, there are tradeoffs facing a developing country with low current but potentially high future demands for a depletable resource such as wetlands. Intensifying resource use now increases current economic growth and reduces the time necessary to attain improved living standards. However, this increased resource use also reduces long-term amenity supplies sought at higher living standards (Clarke, 1995). In short, developing countries will come to value species more as their living standards improve although destroying species now can hasten their immediate achievement of improved living standards.

These observations are important. Even if precise estimates of benefits cannot be obtained, use of the 'public goods' approach shows how conservation preferences in different countries condition international conservation agreements.

Prioritising Conservation Efforts Globally

Conservation activity is a production process delivering conservation outcomes given effort. Highly productive conservation activities are those yielding improved conservation outcomes from limited effort. Given the nonrival nature of shorebird conservation, the most productive conservation activities should be always undertaken first. If this principle is consistently applied then *productive efficiency in conservation effort* requires that the marginal benefits of conservation effort be equated across countries and regions. This means that the last dollar spent anywhere in China should have the same effect in promoting desirable conservation outcomes as the last dollar spent anywhere in Australia. This follows simply from the requirement that conservation efforts should be allocated where they are most productive.

Corresponding to the instance where most benefits were enjoyed by developed countries Clarke (2000) emphasised a sub-case where the most productive conservation efforts could be made in precisely those countries whose nationals did not derive much utility from bird conservation. In particular, on the EAAF it is argued that most conservation effort should go to protecting dwindling wetland resources in staging areas relevant to bird migrations. A standard claim is that most wetlands in Asia are under development threat. In countries, such as China, although there may be low national interest in conserving waterbirds, there are significant international benefits from doing so. Population expansion and the pressures from economic growth provide substantial threats to species survival in Asian developing countries. The idea then is to focus conservation efforts primarily into those developing country areas where conservation needs are greatest and costs of achieving good conservation outcomes are low. As these good conservation opportunities are exhausted, the marginal conservation costs in developing countries (MCUD) are driven up towards those of developed countries forcing equalisation of conservation productivities across countries.

Note again that if countries independently equate their marginal benefits to their own national conservation costs that inefficiencies arise with *independent* national conservation programs that are additional to the inefficiencies stemming from ignoring nonrival benefits to other countries. Simply put, if a country with strong conservation preference which has already invested intensively in national conservation efforts equates its own marginal benefits with its own conservation costs then little additional effort will be exerted because conservation productivity will be low. Similarly, countries with weak conservation preference which have invested little in conservation effort will exert little additional effort even though conservation productivity may be high because of the low benefits which would follow.

International agreements can enhance conservation outcomes by matching strong conservation preferences with highly productive conservation efforts.

Determining Globally-Efficient Conservation Programs

Combining information from stages (i) and (ii), the globally efficient level of international conservation effort occurs when aggregated marginal benefits from conservation equal the uniform marginal conservation costs across countries as suggested by public economics (Laffont 1988).

When there is low national interest in conservation among developing countries but high productivity from conserving *in* these countries this implies pursuing the rule MBD=MCDC, namely, equating the aggregated marginal benefits of developed countries with the marginal conservation costs faced by developing countries. Then the conservation preferences relevant to an international agreement are mainly those of developed countries (Australia, Japan, US) but conservation efforts should be concentrated in Asian staging areas (countries such as China) where there is little conservation interest but high conservation productivity.

This is illustrated in Fig 2. below which shows a simplified, stripped-down version of the policy design problem for the EAAF. MBA* and MBJ* represent the marginal benefit curves for Australia and Japan respectively. Benefits for other countries are supposed small enough to be ignored. As before these benefit curves show the prices these countries would pay for extra species conservation. For simplicity, suppose conservation costs (MCDC) are constant across species levels – in practice, they might increase at low or high conservation levels.

In Figure 2, conservation level E_1 would be achieved at given marginal costs by Australia if it acted alone. Japan would offer zero conservation effort if it likewise acted independently since its marginal benefits (MBJ*) never attain the level of marginal costs. The globally efficient level of provision is E* which reflects aggregated marginal willingness-to-pay of both countries. Without an international agreement to secure this level of conservation effort, it would be undersupplied by individual national conservation efforts at level E_1.

The precise meaning of *efficient* conservation provision here has a simple interpretation. If a conservation effort level was made supporting less than species population E*, this provision would be inefficient since more effort could be expended in at least one country which would leave at least one of the two countries strictly better-off and neither worse-off (perhaps after the country gaining advantage appropriately compensates the country making the effort). Inefficiency in conservation effort is wasteful because it leaves open the prospects for additional efforts yielding more benefits than costs.

Clarke (2000) suggested a 'benefits approach' mechanism for funding an efficient conservation scheme. Taxes funding conservation effort should be set to equal the marginal benefits each country enjoys at the efficient level of conservation. In the case of Fig 2, the total conservation cost of achieving the desired level of conservation, E*, is the area under the marginal cost of conservation curve MCDC* up to E*. At E* Australia derives marginal benefits from conservation t_a while Japan gains marginal benefits t_j. Hence Australia, under this arrangement, should contribute t_aE^* to the conservation bill while Japan should contribute t_jE^*. Given the linearity of the conservation costs, these amounts add to the required total conservation cost. (If conservation costs were increasing (decreasing) in the species conservation level, this tax solution would over (under) finance conservation costs).

Reflecting the benefits they derive, developed countries should then fund conservation initiatives in poorer countries where there is lower conservation interest. There is a 'public economics' rationale for foreign 'aid' from wealthy to developing countries to fund conservation in the latter, to advance the conservation preferences of wealthier countries.

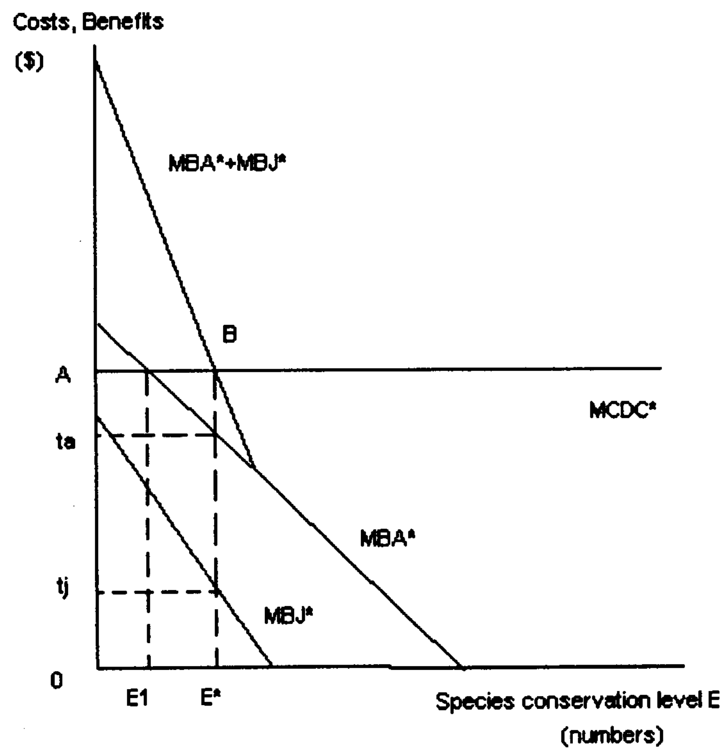

Figure 2: Efficient Global Conservation Programs

Indeed, the word 'aid' here is inappropriate since the purpose of the payment is primarily to advance developed country conservation preferences.

In the EAAF, this outcome reflects to a considerable degree what happens so that this rationale explains current policy settings. More than this, the rationale is interesting because it emerges from a pure efficiency-driven economics argument based on the nonrival nature of conserving wildlife. This therefore gives public conservation agencies a rationale based on efficiency-based economics, for doing what they do. This rationale is independent of humanitarian or other motives but simply stems from developed country self-interest.

FINAL COMMENTS

A major benefit of adopting a 'public economics' view of the process of negotiating an international species protection agreement is that it clarifies sources of efficiency gain when international cooperation replaces independent national action. One source of gain stems from divergences in conservation interest and another from differing national opportunities to make effective conservation efforts. Public economics shows how different preferences should be aggregated and how differences in productive opportunity should be addressed. In presenting this material to economists and conservationists, three major types of objections have been made that we now discuss.

One issue so far only touched on is determining how the marginal economic benefits from conservation are assessed. The idea of deriving precise numerical measures of the value citizens place on shorebird conservation is absurd. Many citizens are unaware that migratory shorebirds even exist. However, many citizens have general conservation concerns. For example, in Australia environmental movements now have larger memberships than all political parties combined (Hutton and Connors 1999). While surveys of public opinion towards conservation are few, politicians are aware of strong interest in conservation and citizens select politicians partly to reflect environmental concerns. Then political actions and expenditure decisions based on political judgements proxy for the aggregate of individual conservation demands. Moreover, even if precise marginal valuations are unobserved, individual national problems are identified using the public economics approach.

One can object that, while politicians have derived conservation demands based on public views, they have reasons for *concealing* these demands in negotiations. If politicians believe that revealed conservation demands will determine conservation costs in any negotiated cooperative agreement there are national self-interest reasons for understating demands to 'free ride' on the contributions of other nations. In some countries, the extent to which this can occur is limited by the need of governments to impress conservationist interest groups with 'green' credentials.

The understatement of conservation benefits is a more forceful criticism of public good approaches to agreement determination when there are many, rather than few, decision-makers. Understatement of conservation benefits is low when there are only a few decision-makers since then each nation can readily assess misrepresentation of benefits (Roberts 1976). On the EAAF there are only a few important decision-makers experiencing high marginal benefits. Thus, understatement may not be as severe as in other contexts.

Sensible long-term conservation strategies however also involve trying to promote conservation values in developing countries and here disincentive issues may be more serious. These countries may deny conservation interest to minimise their conservation efforts so that, as more such countries are drawn into agreements, incentives to 'free ride' increase. Again, some factors offset these adverse incentives. For example, among developing countries on the EAAF there are *peer group* effects (Sugden 1984). One view advanced is that, as more countries come to negotiate species protection, the pressure on individual countries to negotiate reasonably increases which limits incentives to free ride. Exploiting such pressures can be a useful tactic in seeking conservationist outcomes as can tying other forms of (non-conservation-related) aid to the achievement of species conservation.

Finally, I wish to comment in more depth on a crucial assumption regarding the EAAF namely that abundant cheap conservation opportunities exist in developing countries positioned on the Flyway. The intuitive idea is that small additional conservation expenditures in such countries substantially improve conservation outcomes at relatively low cost. However, while there are abundant opportunities to limit wetland destruction in these countries, this does not imply this can be done at low cost. Population growth and pressures for material development are strong in Asia suggesting high costs of *foregoing* development.

This has complex implications. Taken to its conclusion it suggests that sensible programs to conserve migratory shorebirds in the EAAF may be more difficult to identify than has been suggested. In developing countries it is important to clarify the nature of the costs arising in particular contexts and an inclusive and long-term view of costs and benefits should be adopted. While species conservation is a key objective so too is the retention of self-renewing fishery and other environmental resources. These environmental and other benefits, which occur with the conservation of wetlands, reduce effective conservation costs and in the longer term become important as living standards improve. In this case there may not only be numerous options to restrict the destruction of wetlands but the costs of doing so may be less high than is currently seen.

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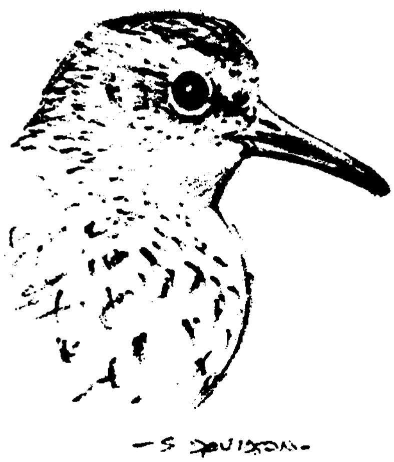

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WEIGHT LOSS BY WADERS HELD IN CAPTIVITY FOLLOWING CAPTURE BY CANNON-NETTING

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ABSTRACT.
Experiments on weight loss by five species of waders, held in captivity in Australia for up to 4 hours after being captured in cannon nets, showed that the weight loss per hour decreased with time and increased with temperature. Rates of weight loss varied between 1.6 and 3.1% h^{-1} in the first hour after initial weighing, falling to between 0.8 and 1.8% h^{-1} in the second and third hour. The percentage weight loss was also dependent on the physiological condition of the birds. Very heavy Great Knots caught in March when they were about to migrate lost proportionately less weight than lighter Great Knots in August to October. Also heavy adult Greater Sand Plovers lost proportionately less weight than lighter immatures caught on the same day and kept under the same conditions. We show that there were some differences between species, with Greater Sand Plovers initially losing proportionately less weight after capture than other species. Previous published studies claiming weight losses as high as 8% h^{-1} at temperatures above 30°C appear to have been incorrect due to erroneous extrapolation of short term data. Weight loss rates measured in this study ranged from 1.4-2.3% h^{-1} at temperatures above 30 °C during the first three hours after capture. These dropped to 0.9-2.1% h^{-1} during the second and third hour.

INTRODUCTION

It has long been known that waders lose weight while held for short periods in captivity, such as during banding (OAG Münster 1975, 1976, Lloyd *et al.* 1979, Wilson and Davidson 1982, Goede and Niebor 1983, Schick 1983, Davidson 1984, Davidson and Evans 1986, Zwarts *et al.* 1990, Castro *et al.* 1991). Davidson (1984) analysed what proportion of different body components contribute to the loss in birds held for up to 24 hours. Castro *et al.* (1991) showed that weight losses were temperature-related and claimed that in their study, increased dramatically to 8% h^{-1} at temperatures over 30°C. The other studies did not relate weight loss to temperature, although Wilson and Davidson (1982) suggested that losses could be dependent on temperature as well as the physiological state of the birds.

When analysing weight data it can be important to know how long after capture birds were weighed and therefore what factor to use to adjust measured weights for losses in captivity. This would enable meaningful comparisons to be made of the weights of individuals caught on more than one occasion and would also enable means of samples from different catches to be compared. It could also be important to identify whether these weight losses are entirely natural or if there are any capture conditions which affect weight losses.

If the results claimed by Castro *et al.* (1991) were confirmed for conditions in Australia, it may even be advisable to impose restrictions on holding birds in captivity when the temperatures are very high.

No weight loss studies on waders have been published for Australia. Also there have been no studies elsewhere in the world on many of the wader species which occur in Australia. Weight loss studies in Australia are of particular interest as birds there are often caught at high temperatures (> 30°C).

The aims of this study was to (1) examine the weight loss of several species of wader commonly banded in Australia held for up to five hours after capture and (2) determine the affect of temperature and initial bird weight on the rate of weight loss.

METHODS

Weight loss experiments were conducted from 8 August to 22 October 1998 on birds caught in cannon-nets during migration studies on the coast of north-western Australia at Roebuck Bay and Eighty Mile Beach. The species studied were Great Knot *Calidris tenuirostris* (6 samples), Curlew Sandpiper *Calidris ferruginea* (3 samples), Greater Sand Plover *Charadrius leschenaultii* (3 samples), Red-necked Stint *Calidris ruficollis* (2 samples) and Black-tailed Godwit *Limosa limosa* (1 sample). Additional experiments were conducted on Great Knots at

Roebuck Bay by D. Rogers and P. Battley working in conjunction with the Broome Bird Observatory on 21 March 1998, on Greater Sand Plovers at Eighty Mile Beach on 5 April 1996 by the AWSG 1996 expedition and by D. Rogers and P. Battley on 14 February 1998, and on Red-necked Stints in southern Victoria by the Victorian Wader Study Group on 27 December 1995 (Table 1).

The methods described below refer only to the August to October 1998 samples. However, the methods of earlier experiments were very similar. Birds were kept in captivity for between two to five hours after capture on 15 different days. In previously published studies, birds were often held in captivity for much longer time periods (often 24 hours or more). However, as birds caught for banding in Australia are usually released within five hours of capture, weight losses beyond five hours are mainly of academic rather than of practical interest.

All catches were made between 75 minutes before and 38 minutes after high tide (mean 23 minutes before)(Table 1). A sample of birds were taken immediately from the cannon-net and placed in a keeping cage. The cage was made of light hessian material. Each cage had four compartments 80 cms long x 50 cms wide x 50 cms high, two along each side. Ten or twenty birds were kept in a compartment. If the sand upon which the cage stood was hot due to it not having been covered by a recent tide, the top few centimetres were scraped away prior to the erection of the cage to remove the hot surface layer of sand. Birds were banded and weighed as soon as possible after capture. Ten to twenty birds were then weighed approximately hourly, for two to four hours after the initial weighing, and transferred into an empty compartment at each weighing. In some cases, a separate control sample of ten birds was weighed soon after capture, kept in a separate cage, and then only weighed again at the end of the experiment usually after three hours. The purpose of this control was to investigate if additional handling had any effect on the rate of weight loss. Birds were weighed on an electronic balance to the nearest 0.5 gram. The balance was kept out of the wind, usually in a car, as wind affected its accuracy.

A thermometer was placed in the cage and the temperature read at every series of weighings. Soon after birds were placed in keeping cages, 70% grade shadecloth was stretched over the top of the cage, but not over the sides. This reduced the amount of light in the cage and helped to keep the birds quiet. A double layer of 70% grade shadecloth was then erected about 1.5 metres above the cage (usually after the initial weighings) to protect the keeping cages, and the banders, from the sun.

The shading kept the cages cooler than they would otherwise have been under the almost constant sunshine prevalent in north-western Australia. On one occasion, the temperature in the cage was 38°C before the erection of shadecloth, but immediately dropped to 32°C when this was erected. On another occasion, when there was a hot land breeze, the shade temperature above the cage was 40°C, while the temperature in the cage was 32°C. In that instance, the temperature was probably reduced by water evaporating from wet sand on the floor of the cage. The light hessian material allowed a certain amount of air circulation into the cage, especially when there was a sea breeze blowing. Birds were kept in the same conditions as the rest of the catch, and were therefore exposed to people sitting, walking and talking constantly in the near vicinity of the cage.

RESULTS

The mean weight of each sample at each weighing for the five species are shown in Figs 1 to 5. All the samples in August to October 1998 were of "light" adult birds which had recently arrived in Australia on southward migration, or of "light" immatures which had spent the Australian winter there. For all species, the data confirms earlier studies that weight losses are greatest in the first hour after capture and occur at a decreasing rate over the next 2-4 hour period. As losses are probably greatest in the first minutes after capture and decrease at a decreasing rate, the losses measured in the first hour will be dependent on the time after capture at which birds were first weighed. Thus for Great Knots in August to October 1998, the greatest losses in the first hour after first weighing (6.7 g ±1.2) were measured on the 8 August (sample 2) when the average time of first weighing after capture was the minimum recorded (18 minutes), and the lowest losses in the first hour after initial weighing (3. 5g ±1.2) were on 11 September (sample 6) when the average time of first weighing after capture was the maximum recorded (28 minutes).

Table 1. The details of weight loss experiments on waders conducted in north-western Australia (SN = sample number, Ht = tidal height (in m) and N = number of birds in each sample).

SN	Species	Date	Catch Time	Tide time	Ht (m)	N	Mean time of hourly weighing					Hourly temperature (°C)				
							1	2	3	4	5	1	2	3	4	5
1	Great Knot	21.03.98	14:05	14:27	6.61	10	14:44	15:45	16:43	17:44	-	36	35	35	34	-
2	Great Knot	08.08.98	10:00	10:50	7.93	11	10:18	11:13	12:18	13:18	-	32	32	34	34	-
3	Great Knot	21.08.98	10:15	10:20	7.51	10		11:47	12:41	13:43	14:56	31	31.5	32	32	32
4	Great Knot	21.08.98	10:15	10:20	7.51	10	10:41	11:45	12:45	13:45	14:51	31	31.5	32	32	32
5	Great Knot	25.08.98	12:00	12:25	8.34	21	12:18	13:16	14:06	15:28	-	28	28	27	28	-
6	Great Knot	11.09.98	13:15	13:27	8.37	20	13:43	14:50	15:49	16:55	-	29	28	28	27.5	-
7	Great Knot	11.09.98	13:15	13:27	8.37	10	13:53	-	-	17:04	-	29	-	-	27.5	-
8	Great Knot	21.10.98	10:20	11:13	8.22	20	10:42	11:47	12:47	13:38	-	32	32	33	33	-
9	Great Knot	21.10.98	10:20	11:13	8.22	10	10:54	-	-	13:55	-	32	-	-	33	-
10	Great Knot	22.10.98	11:15	11:39	8.27	10	11:29	-	-	14:28	-	38	-	-	32	-
11	Great Knot	22.10.98	11:15	11:39	8.27	19	11:42	12:39	13:41	14:42	-	38	32	32	32	-
12	Curlew Sandpiper	23.08.98	11:50	11:27	8.28	20	12:11	13:16	14:51	15:13	16:08	35	31	33	26	27
13	Curlew Sandpiper	24.08.98	11:50	11:57	8.39	20	12:06	13:12	14:12	15:05	-	28	27	27	27	-
14	Curlew Sandpiper	08.09.98	12:03	11:44	8.97	20	12:29	13:27	14:27	15:26	-	32	28	30	28	-
15	Curlew Sandpiper	08.09.98	12:03	11:44	8.97	7	12:55	-	-	15:38	-	32	-	-	28	-
16	Greater Sand Plover[1]	05.04.96	12:10	11:30	8.84	5	12:23	13:25	14:25	15:25	-	34	35	36	36	-
17	Greater Sand Plover[2]	05.04.96	12:10	11:30	8.84	5	12:24	13:22	14:23	15:25	-	34	35	36	36	-
18	Greater Sand Plover	14.02.98	12:40	12:30	8.41	12	12:50	13:53	14:52	15:48	-	34.5	34.9	34.8	34.8	-
19	Greater Sand Plover	22.08.98	10:10	10:55	8.00	20	10:25	11:37	12:32	-	-	31	34	34	-	-
20	Greater Sand Plover	07.09.98	10:15	11:10	8.62	20	10:39	11:41	12:38	13:37	-	30	28	28	29.5	-
21	Greater Sand Plover	20.10.98	9:30	10:45	8.03	11	9:46	-	-	13:26	-	33	-	-	33	-
22	Greater Sand Plover	20.10.98	10:00	10:45	8.03	19	10:24	11:30	12:26	13:43	-	33	36	33	39	-
23	Red-necked Stint[3]	27.12.95	07:15	6:15	3.02	22	7:32	8:34	9:37	10:34	-	15	15	17	18	19
24	Red-necked Stint	28.08.98	14:15	13:44	7.40	20	14:40	15:42	-	-	-	-	28	-	-	-
25	Red-necked Stint	10.09.98	13:30	-	8.85	20	14:03	15:16	16:14	17:15	-	28	28	27	27	-
26	Red-necked Stint	10.09.98	13:30	-	8.85	10	14:12	-	-	17:23	-	28	-	-	27	-
27	Black-tailed Godwit	13.08.98	13:28	13:45	8.14	10	13:50	14:52	15:54	16:53	-	30	31.5	28	28	-

[1] adult birds
[2] juveniles
[3] from Victoria

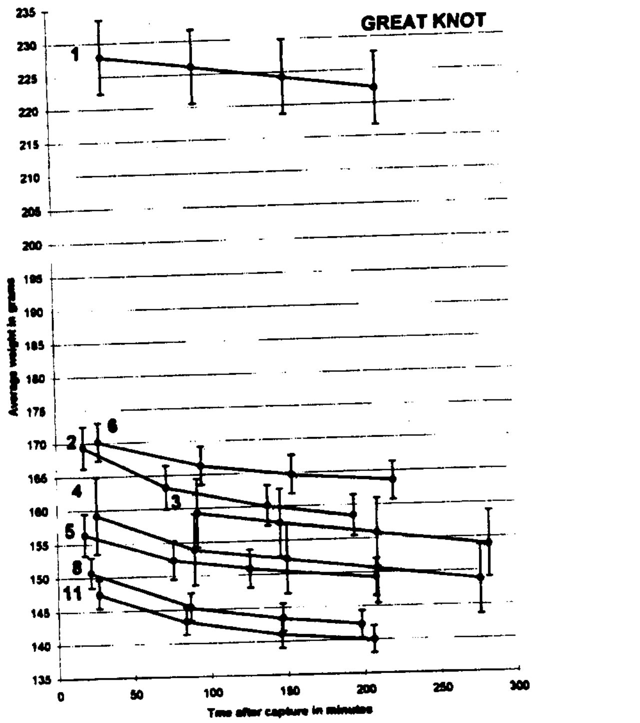

Figure 1. The loss in weight (g) of samples of Great Knot kept in captivity for up to 4.5 h. Lines join repeated weighings of the same sample. Numbers refer to the sample number given in Table 1. Vertical lines are ± 1 standard deviation.

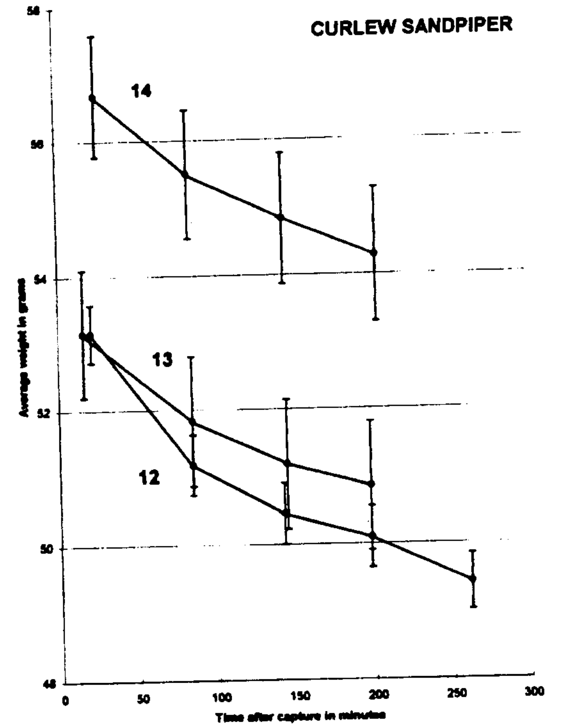

Figure 2. The loss in weight (g) of three samples of Curlew Sandpiper kept in captivity for up to 4.5 h. Lines join repeated weighings of the same sample. Numbers refer to the sample number given in Table 1. Vertical lines are ± 1 standard deviation.

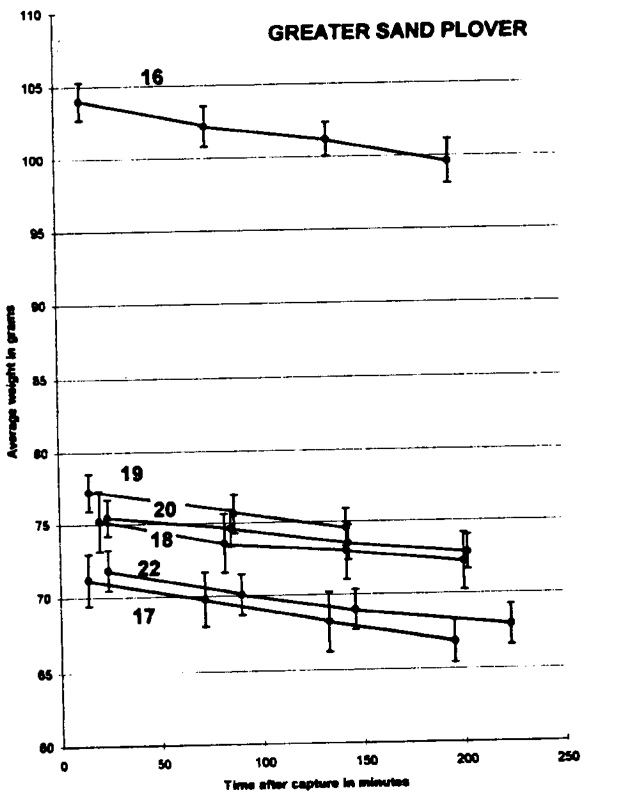

Figure 3. The loss in weight (g) of samples of Greater Sand Plover kept in captivity for up to 4.5 h. Lines join repeated weighings of the same sample. Numbers refer to the sample number given in Table 1. Vertical lines are ± 1 standard deviation.

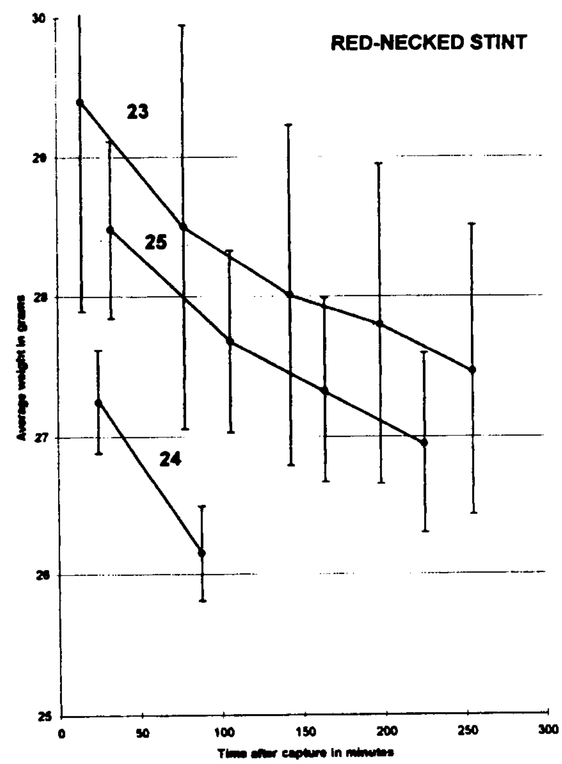

Figure 4. The loss in weight (g) of samples of Red-necked Stint kept in captivity for up to 4.5 h. Lines join repeated weighings of the same sample. Numbers refer to the sample number given in Table 1. Vertical lines are ± 1 standard deviation.

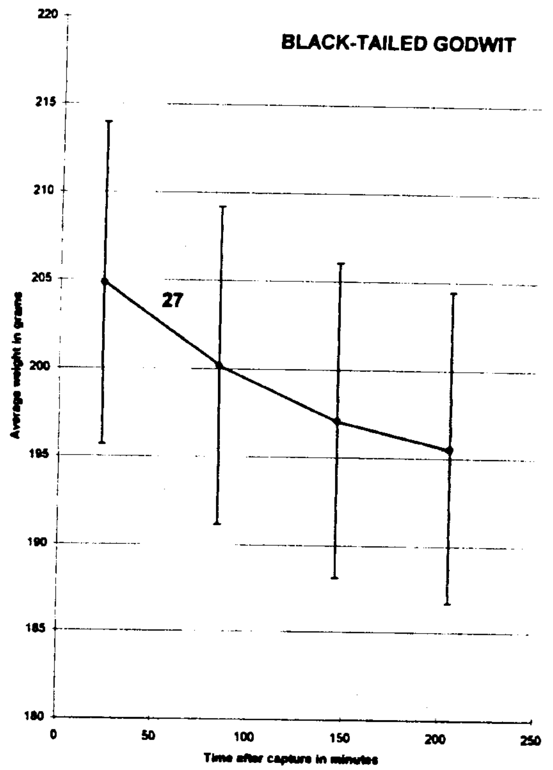

Figure 5. The loss in weight (g) of a sample of Black-tailed Godwit kept in captivity for up to 4 h. Lines join repeated weighings of the same sample. The number refers to the sample number given in Table 1. Vertical lines are ± 1 standard deviation.

The results of the experiments conducted in August to October 1998 are combined in Table 2. Also shown are individual samples from the other studies in February to April 1998. The temperatures in these experiments ranged from 27-36°C. A comparison of Great Knots, Curlew Sandpipers and Black-tailed Godwits in the August to October samples (samples A,C,and I in Table 2) shows that losses were greater in the larger species than the smaller species in absolute terms (grams), but they were generally similar when expressed as a percentage. However, Red-necked Stints and Greater Sand Plovers did not fit this pattern.

Red-necked Stints (sample H) seemed to generally lose a higher percentage weight than other species. This may be an artifact of the way the data was collected as birds were weighed to the nearest 0.5g, the combined error on two weighings could be 1g. For Red-necked Stints weighing a mean of 28g. this would represent 3.6% of their body weight.

Greater Sand Plovers (sample D) lost a lower percentage of their weight in the first hour than the other species (although the mean time of first weighing after capture was similar), but showed similar losses in the subsequent two hours.

A catch of very fat Great Knots on 21 March 1998 (sample B) which were preparing for northward migration had a mean initial weight of 227.9 g. This was much heavier than than the mean of birds in August to October (158g). There were several differences in the results that reflected the different handlibg conditions in the earlier experiments. The average time after capture of first weighing was longer in March than in August to October, the mean weight loss during all phases of the experiment were less (Table 2). The percentage weight loss in the first hour and in the second and third hour were also lower. Although the birds seemed to lose much less weight in the first hour than the August to October birds, this is probably partly (or wholly) an artifact of the former being first weighed so long after capture. Losses in absolute terms in the second and third hours were broadly similar to the August to October birds, but in percentage terms were lower.

Comparisons between these experiments are complicated by temperature differences (see below) and also by the effect of the time of first weighing after capture on measured initial weight losses. These complications do not arise in a sample of adult and immature Greater Sand Plovers caught on 5 April 1996 (samples E and F) which contained heavy adult birds about to migrate (mean weight = 104.0 g) and immature light birds which would not migrate that season (mean weight = 71.2 g). These birds were kept together under the same temperature conditions and weighed at the same time. The adults were first weighed at an average of 13 minutes after capture and the immatures 14.4 minutes after capture. In the first hour the heavy adults lost 1.7 g h^{-1} and the immatures lost 1.5 g h^{-1}. In the second and third hours combined, the adults lost 1.3 g h^{-1} and the immatures lost 1.5 g.h^{-1}. In percentage terms, the adults lost 1.7 % h^{-1} in the first hour and 1.3 % h^{-1} in the second and third hours combined, compared to immatures which lost 2.1 % h^{-1} in the first hour and 2.1 % h^{-1} in the second and third hours combined. Thus losses were similar in the adults and immatures in absolute terms, but the heavy adults lost less in percentage terms. Comparisons with the August to October samples are difficult because these were first

The Stilt **35 (1999)**: 25–33

Table 2. The absolute (g) and relative weight loss (%) of five species of wader during a series of experiments conducted between August to October 1998 in north-western Australia and other studies of the same species (Mins = minutes, Wt = weight, std = standard deviation).

Species		N	Mean time btwn capture and first weighing	Mean initial weight (g)	Mean weight loss between weighings (g) 1st	2nd	3rd	Mean percentage loss between weighings 1st	2nd	3rd
			Mins ± std	Wt ± std	Wt ± std	Wt ± std	Wt ± std	% ± std	% ± std	% ± std
Great Knot	A	101	23.2 ± 6.36	158.0 ± 14.87	4.57 ± 1.57	1.93 ± 0.88	1.32 ± 0.79	2.89 ± 0.94	1.26 ± 0.61	0.87 ± 0.55
Great Knot[1]	B	9	39.8 ± 4.06	227.9 ± 16.76	1.99 ± 0.70	1.98 ± 1.23	1.75 ± 0.68	0.87 ± 0.32	0.88 ± 0.58	0.78 ± 0.30
Curlew Sandpiper	C	60	21.1 ± 5.71	54.3 ± 3.90	1.42 ± 0.62	0.70 ± 0.33	0.43 ± 0.32	2.64 ± 1.16	1.34 ± 0.65	0.87 ± 0.63
Greater Sand Plover	D	58	21.2 ± 6.54	74.9 ± 6.10	1.22 ± 0.61	1.14 ± 0.41	0.79 ± 0.25	1.64 ± 0.84	1.54 ± 0.51	1.11 ± 0.36
Greater Sand Plover[2]	E	5	13.0 ± 2.00	104.0 ± 2.90	1.70 ± 0.40	1.00 ± 1.10	1.60 ± 0.90	1.70 ± 0.40	0.90 ± 1.10	1.60 ± 1.00
Greater Sand Plover[3]	F	5	14.4 ± 1.30	71.2 ± 3.90	1.50 ± 0.60	1.60 ± 0.90	1.30 ± 1.20	2.10 ± 0.90	2.30 ± 1.30	1.80 ± 1.70
Greater Sand Plover[4]	G	6	20.2 ± 4.00	75.2 ± 5.10	1.50 ± 0.90	0.60 ± 0.40	0.80 ± 0.30	2.10 ± 1.10	0.90 ± 0.50	1.20 ± 0.40
Red-necked Stint	H	40	28.7 ± 5.74	27.9 ± 2.38	0.87 ± 0.61	0.37 ± 0.30	0.36 ± 0.27	3.12 ± 2.16	1.36 ± 1.11	1.30 ± 0.99
Black-tailed Godwit	I	10	22.9 ± 4.78	204.8 ± 30.31	4.55 ± 1.77	2.99 ± 0.96	1.55 ± 0.82	2.25 ± 0.95	1.50 ± 0.49	0.78 ± 0.44

[1] 21.03 98 (Sample 1)
[2] 05.04.96 adults (Sample 16)
[3] 05.04.96 immatures (Sample 17)
[4] 14.02.98 (Sample 18)

weighed much longer after capture and this would affect calculated initial weight losses. They were generally also caught at lower temperatures.

However, a sample of Large Sand Plovers caught on 14 February 1998 (sample G) with a mean initial weight of 75.2g. lost an even smaller percentage weight than the fat adults in the second and third hour (1.1 % h^{-1}) despite the birds being kept at similar temperatures.

The relationship between temperature and percentage weight loss is shown for Great Knot, Curlew Sandpiper and Greater Sand Plovers in Figs. 6 to 8. The measured loss over the first three hours in captivity (closed squares in Figs. 6 to 8) is affected by the time after capture of the first weighing. This effect can be removed by calculating weight losses in the second and third hours in captivity as a percentage loss after the second weighing.

In Great Knots and Curlew Sandpipers, there was a trend of increasing weight loss with temperature. The exceptions to this were the very fat Great Knots which lost proportionately less weight than all other samples in spite of the high temperatures of 35°C (note that the 0 to 3 hour figure will be affected by the time of initial weighing, but not the 1 to 3 hour). The trend appears to be linear rather than exponential, although there are too few samples to test if this is true. For Great Knots in the 1 to 3 hour period, the loss rate increased by about 40 % between 28°C (0.9 %) and 33°C (1.3 %). Such a trend was not so clear in Greater Sand Plovers. Fat adult Greater Sand Plovers (circled) lost proportionately less weight compared to the light immatures caught on the same day (Fig. 8).

With the exception of these fat birds and the sample of immature Greater Sand Plovers the percentage losses were otherwise broadly similar for the three species, although Greater Sand Plovers did lose less than the other two in the first hour in captivity. For the three species kept at temperatures below 30°C, the losses ranged from 1.2-1.5% h^{-1} over the 3 hours and from 0.8 % -1.2 % h^{-1} over the second two hours. At temperatures above 30°C they ranged from 1.3-2.2 % h^{-1} over the 3 hours and from 0.7-1.4 % h^{-1} over the second two hours.

DISCUSSION

Our experiments confirm earlier findings that weight losses occur at a reducing rate over the first 3 to 4 hours after capture. They show that the time of initial weighing after capture is very important when comparing samples and that smaller species should be weighed to the nearest 0.1g. for accurate results. They also suggest, for the first time, that weight loss in percentage terms (but not in absolute terms) could be dependent on the physical condition (fatness) of the birds as heavy birds of the same species seem to lose proportionally less weight than light birds. Our data also suggests that Greater Sand Plovers may lose less weight initially than the other species we studied. However, these experiments do confirms that there is a correlation between temperature and weight loss, but that the losses at high temperatures are very much

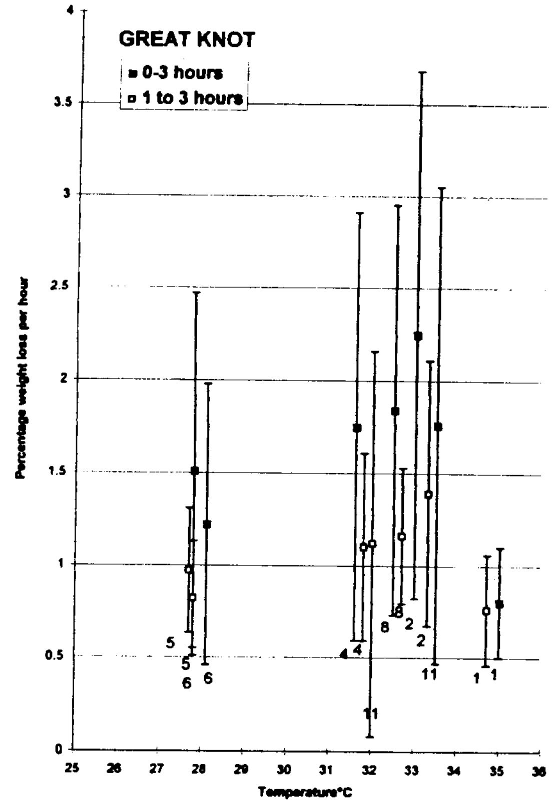

Figure 6. The relationship between the mean percentage weight loss per hour of Great Knot and temperature in the keeping cages during the first three hours after the first weighing (filled squares), and the first two hours after the second weighing (open squares). Vertical bars equal one standard deviation. The heavy sample of birds caught on 21 March 1998 are circled. Numbers refer to the sample number given in Table 1.

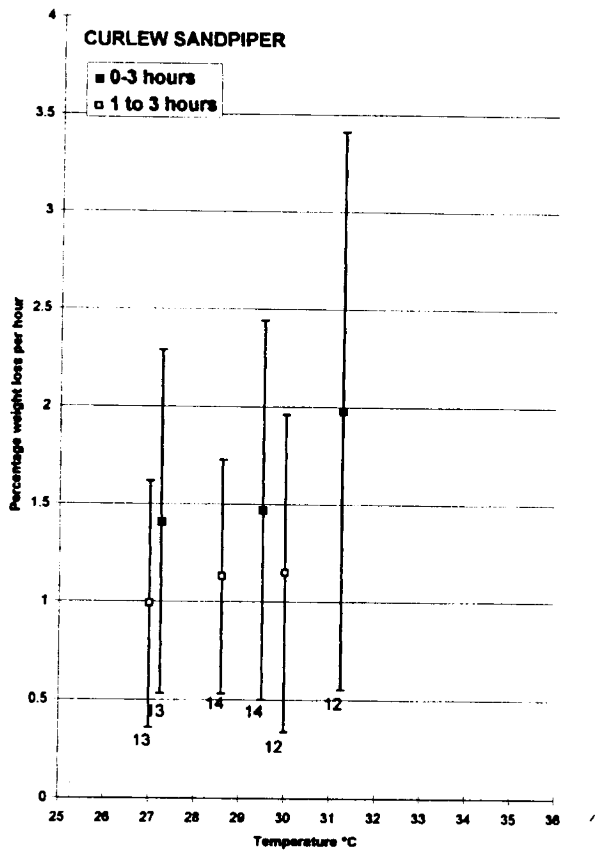

Figure 7. The relationship between the mean percentage weight loss per hour of Curlew Sandpiper and temperature in the keeping cages during the first three hours after the first weighing (filled squares), and the first two hours after the second weighing (open squares). Vertical bars equal one standard deviation.

lower than those quoted by Castro *et al.* (1991) for North American species.

Davidson (1984) found that weight loss in Dunlins *Calidris alpina*, and Red Knots *Calidris canutus* over a 24 h period was due to four components: water, pectoral muscle mass, lean dry mass and fat mass. In the first four hours of captivity, Dunlins lost water at 0.47-0.49 g h^{-1} and Red Knots at 2.9 g h^{-1}. The figures suggested that in this period 73 % of mass loss in Dunlins and 86 % in Knots was due to water loss. The high proportion of water loss probably explains why there is a positive correlation between ambient temperature and weight loss in the data from Australia.

One purpose of the experiments was to investigate if the very high weight losses at temperatures above 30°C recorded by Castro *et al.* (1991) also occurred under Australian conditions. For Great Knots, Curlew Sandpipers and Greater Sand Plovers at temperatures between 30°C and 35.5°C, the losses in the first three hours of captivity ranged from 0.8-2.3 % h^{-1} and in the second and third hour from 0.7-1.4 % h^{-1}. At temperatures between 27°C and 30°C the losses were 1.2-1.5% h^{-1} and 0.3-1.2 % h^{-1} for the first three hours and second two hours in captivity respectively. None of these losses approached the estimated 8 % h^{-1} recorded by Castro *et al.* (1991).

Castro *et al.* (1991) do not explain how they arrived at the 8 % h^{-1} figure. However, examination of their data suggests that it was derived from measured weight losses up to 4 % in the first half hour after capture. Because this study, and other work, clearly shows a rapid reduction in the rate of weight loss over time, especially following the first hour after capture, it is not justifiable to extrapolate the initial weight loss rates for longer periods. Castro *et al.* (1991) did not record any bird losing 8% of its

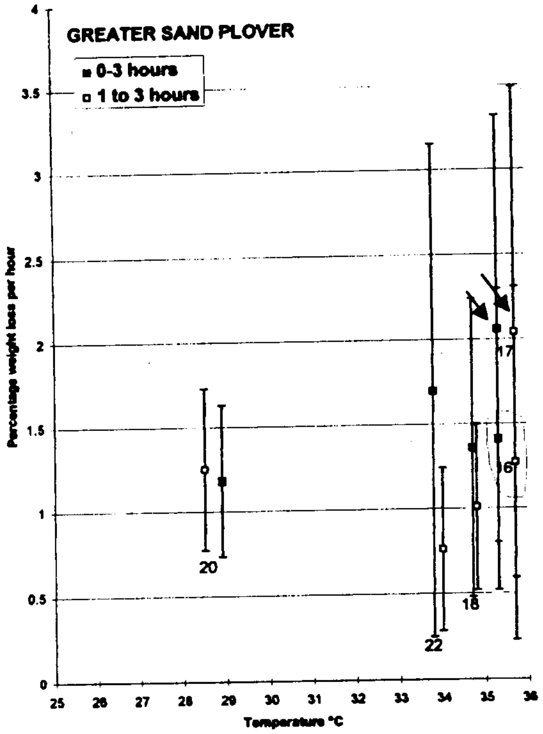

Figure 8. The relationship between the mean percentage weight loss per hour of Greater Sand Plover and temperature in the keeping cages during the first three hours after the first weighing (filled squares), and the first two hours after the second weighing (open squares). Vertical bars equal one standard deviation. The heavy sample of adults caught on 5 March 1996 is circled and the lighter immatures caught at the same time are arrowed.

weight in an hour and thus this figure must be an error. The higher weight losses they recorded in the first hour compared to this study could be due to their weighing birds within 5 minutes of capture. Also, as the birds were mist netted in daylight, they may have been feeding (as opposed to our roosting) birds and would probably have had a higher initial water content.

Although some of the causes of weight loss have been attributed to capture stress (Davidson 1984), presumably birds roosting undisturbed on the shore for several hours during the high tide also lose weight. The higher weight loss in the first period after capture is probably mainly due to defecation, natural metabolism and evaporative cooling. Zwarts *et al.* (1990) showed that waders lost less weight per hour the greater the time elapsed since feeding. Subsequent losses of 0.3-1.4 % h^{-1} (depending on temperature and the physiological condition of the birds) is probably mainly due to the latter two factors. The losses may be little different to those experienced by roosting birds. Indeed the latter can be exposed to much higher temperatures than birds held in keeping cages as they often stand or sit in the direct sunlight in temperatures in excess of 40°C. On corresponding days the temperature in the keeping cages is usually 30-35°C because of the shading. However, behavioural adaptations may help to keep the roosting birds cool.

Our experiments suggest that "fat" birds lose similar amounts to "lean" birds, in terms of absolute weight, but a smaller percentage of their body weight. This finding needs further confirmation with more experiments. However, it suggests that most of the losses could be due to factors that are independent of the "fatness" of the birds, such as the emptying of the gut contents and loss of water by evaporative cooling.

Greater Sand Plovers also seemed to lose less weight in the initial period after capture than other species. This finding also needs more testing with further experiments. Greater Sand Plovers generally stopped feeding and began roosting earlier than other species and therefore may have less to lose from their gut at capture as has been found by Zwarts *et al.* (1990) for other species.

If birds in the natural state lose weight at similar rates to those held in captivity, then birds caught roosting two hours before high tide will be heavier than birds caught roosting two hours after high tide by as much as 4-6 %. For a Great Knot weighing 180 g, the difference would be 7-11g. If this is the case, then it will be important to make adjustments for the time of weighing relative to the stage in the tidal cycle when comparing the mean weight of different catches, or retrapped individuals. This requirement may be more important than adjusting for the time of capture in some circumstances. This is not usually a problem when cannon netting as most catches are made near high tide. However, it should be considered when comparing, for example, birds caught in mist nets while feeding with birds caught in cannon nets while roosting.

When catching birds in cannon nets in Australia, no bird is usually weighed until half an hour to one hour after capture when the largest losses have already occurred. Processing is usually finished a maximum of four hours after capture and usually well before this time. In the first to third hour after capture, the mean losses ranged from 0.7 g for Red-necked Stints to 4.5 g for Black-tailed Godwits. Any calculated adjustments to mean weights when comparing catches would therefore normally be small and could usually be ignored. Similarly any adjustments to compare weights of an individual captured more than once would also be small for most species.

The results from the control experiments to see if handling affected weight loss were inconclusive. This is because control birds were generally weighed as a group before or after the other experimental birds. When they were weighed before they tended to lose more weight; when they were weighed after they lost less weight. This is probably an artifact of the effect of time of initial weighing after capture on calculated weight loss. Alternate birds should therefore be taken as controls in such experiments.

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MIGRATION OF RED-NECKED STINT (*CALIDRIS RUFICOLLIS*) THROUGH TRANSBAIKALIA (RUSSIA) AND ADJACENT REGIONS OF NORTH-EASTERN MONGOLIA

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ABSTRACT
Red-necked Stints from more than one breeding ground migrate through Transbaikalia (Russia, Eastern Siberia) and adjacent territories of Mongolia enroute to their breeding grounds. The main staging areas are located on Lake Baikal and in the Torey Depression. Birds that cross Transbaikalia during northward migration stop mainly in the Torey Depression. During southward migration, Red-necked Stints usually stop along the eastern shore of the Baikal and fewer birds stop in the Torey Depression. This means that either birds have different migration routes on northward and southward passage, or they prefer to stop in different areas. Northward migration takes place from 24 May to 13 June, with most birds migrating at the end of May-beginning of June. Southward migrants were recorded from 12 July to 25 September, they were more numerous at the end of July and first two weeks of August. The number of Red-necked Stints that stop in the Torey Depression fluctuate widely between years and this appears to be related to the heights of lakes in the region and the amount of available feeding habitat.

INTRODUCTION

Red-necked Stints *Calidris ruficollis* use both coastal and inland migration routes (Minton 1996). One inland flyway crosses Siberia and Mongolia with important stopover sites in Transbaikalia (area to the east of Lake Baikal) and north-eastern Mongolia. However, there are few data published about the species in these areas. Some information about migration schedule and numbers of birds can be found in Russian literature about birds in the Torey Depression (Leontyev 1972), on the southern Lake Baikal (Tupitsyn and Podkovyrov 1990), middle Baikal (Belyaev 1984) and northern Baikal (Tolchin 1975, Tolchin *et al.* 1977). There are also several records of migrating and non-breeding Red-necked Stints in other parts of southern Transbaikalia and north-eastern Mongolia (Stegmann 1929, Izmailov and Borovitskaya 1973, Shkatulova 1973, Ostapenko *et al.* 1980, Smirensky *et al.* 1991), but only one record from northern Transbaikalia (Popov 1988).

The northern part of the Transbaikalia is covered by mountain forests, so the numerous rivers of that part of the region have very few places with open sandy shores or mudflats. In contrast, southern Transbaikalia comprises mainly steppe and forest-steppes, and has many lakes with open sand and muddy shores. These lakes are more common in the steppe zone, especially within the large Torey Depression (about 10,000 km^2) that is located in south-eastern Transbaikalia and north-eastern Mongolia (Fig. 1). The Torey Depression is a single natural region that is a very important stopover site for many species of migratory waterbirds.

METHODS

We collected data on migratory waders in south-eastern Transbaikalia and adjacent areas of north-eastern Mongolia from 1990-1996 and in 1998. Car surveys were used to assess the distribution and numbers of Red-necked Stints over large areas of the region. During the period from May to September, 49 surveys were made covering a total of 10,200 km. All birds visible on their staging sites on small wetlands and lakes were counted with binoculars and telescope (x20) during the surveys (250 counts were made on 54 lakes in total). Besides these regular censuses, counts were made of birds on the shores of the large lakes in the Torey Depression (58 censuses in 210 km) and along the Onon River near Nizhny Tsasuchey (25 censuses in 110 km).

The Torey Depression was explored in more detail in comparison with other areas of south-eastern Transbaikalia. On 5-14 June 1996, daily counts (for 2-4 hours before sunset) were made on a stopover site on the Torey lakes. Only in 1996 was the whole period of northward migration covered by observations in habitats important for Red-necked Stint. Data on duration of staging, timing and numbers of birds on northward migration in other years and on southward migration are incomplete as

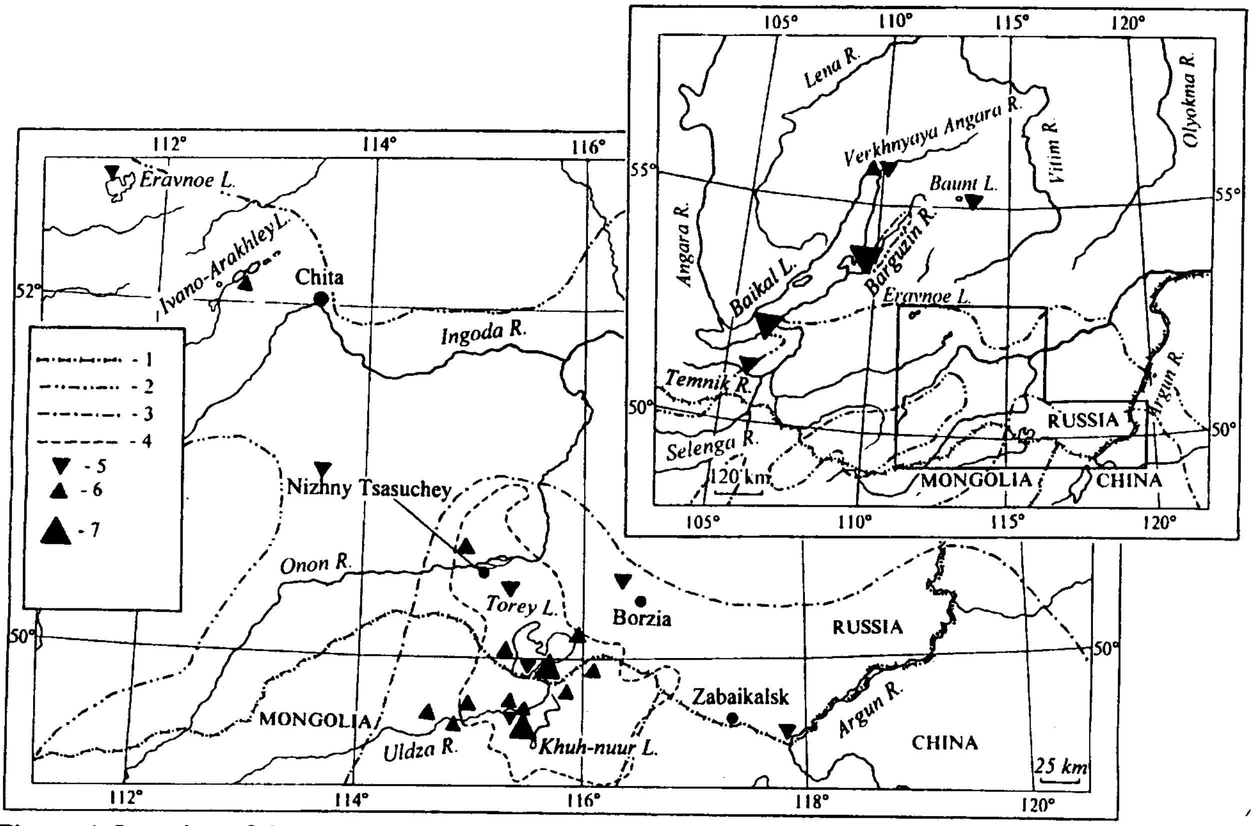

Figure 1. Location of the stopover sites of the Red-necked Stints in Transbaikalia and adjacent territories of Mongolia. 1 - state border, 2 – border between forest and forest-steppe zones, 3 – border between forest-steppe and steppe zones, 4 – border of the Torey Depression, 5- stopover sites of southward migrants, 6- stopover sites of northward migrants, 7 – important stopover sites.

in 1990-1992 and 1997 only a few observations were made.

Birds in the collection of the Chita Museum of Local Nature, History and Economy were measured to provide additional information on the racial composition of birds migrating through the region. There are four Red-necked Stints collected by A.N. Leontyev on the Torey Lakes in the collection. Details of about 24 sandpipers from Lake Baikal and Transbaikalia held in the collection of Zoological Museum of Moscow State University were kindle sent by Dr P.S. Tomkovich. There are a number of published studies in Russian whose results could also be incorporated. Some unpublished data were kindly given by B.V. Schiokin. To assess the racial origin of the museum birds, wing length was measured by the maximum chord method ± 0.5 mm and bill length (from bill tip to the start of feathering) ± 0.1 mm were also measured.

RESULTS

Northward migration

Dates of northward migration in different regions of Transbaikalia are presented in Table 1. In 1996, migrating Red-necked Stints were recorded in the Torey Depression from 25 May to 18 June, with most intensive passage from 29 May to 5 June. A total of 26,411 Red-necked Stints were counted in the Torey Depression (in both Russian and Mongolian parts). Most of them (23,850 birds) were recorded in daily counts from 5-14 June in the Borokholoy River delta (branch of the Uldza River), Torey lakes. Waders were roosting and feeding at this site on a mudflat of about 7.5 ha. An estimated 15,000 Red-necked Stints stopped at this site during this period and the daily fluctuation in numbers during this period are shown in Figure 2. No counts were made after 14 June.

Leontyev (1972) found that Red-necked Stints are numerous on the Torey lakes during northward migration and his observations are consistent with our data for 1996. An additional 2,561 stints were

Table 1. Dates of northward migration by Red-necked Stints through Transbaikalia and the Torey Depression.

Location	Dates of migration	Source
South-eastern Transbaikalia and adjacent regions of Mongolia	24 May-13 June, most intensive passage from 31 May-8 June (1990-1998)	This study
South-eastern Transbaikalia (Torey lakes)	First half of June	Leontyev 1972
South-western Transbaikalia	End of May	Izmailov and Borovitskaya 1973
Northern Lake Baikal (delta of Verkhnyaya Angara River)	Passage started on 28 May and was most intensive on 29 and 30 May, 1973	Tolchin 1975

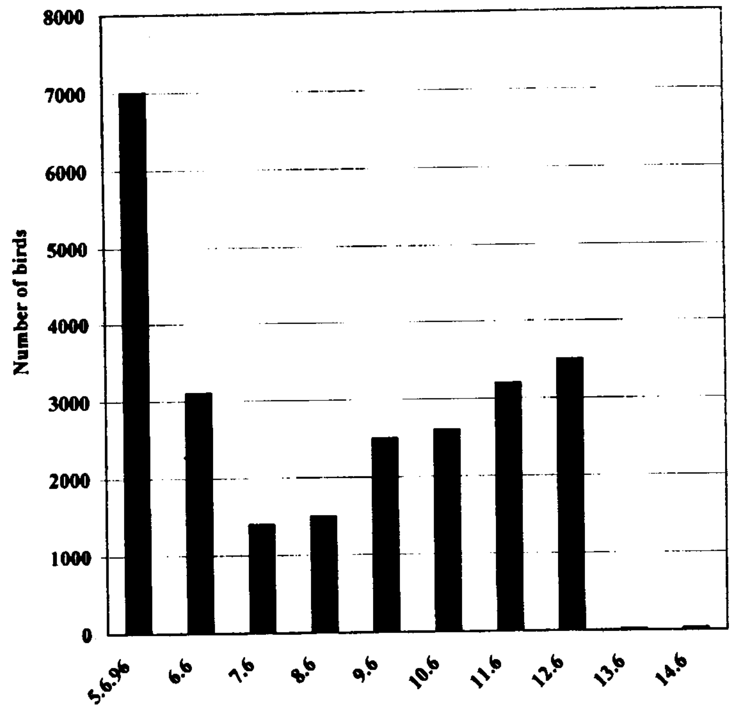

Figure 2. Daily changes in the number of Red-necked Stints on the Borokholoy River delta, Torey lakes during 5-14 June 1996.

counted during single visits to other lakes in the Torey Depression during May and June 1996. About 1000 birds were recorded on 2 June 1996 in the Teliyn-gol River delta region of Lake Khuh-nuur (about 40 km^2 in size) in the Mongolian part of the Torey Depression. In the Mongolian part of the depression, between 29 May and 14 June 1996, 10 lakes under 1 km^2 and 15 lakes 1-8 km^2 were also surveyed. No stints were found on the small lakes, while 1,161 birds in total were counted on the medium-size lakes. During migration in 1996, flocks at the staging sites in the Torey Depression consisted of up to 5,000 birds, and migrating flocks included 10-300 birds.

The number of Red-necked Stints that stop in the Torey Depression during northward migration fluctuate widely between years. These stints were numerous migrants in 1996, but rare or common in 1990-1995. In 1990-1995, only 350 birds in total were recorded there annually during migration. On 28 May to 4 June 1993, 77 Red-necked Stints were counted during single visits to nine different medium-size lakes in the Mongolian part of the Torey Depression. On 29 May to 4 June 1996, 1,630 stints were counted on the same lakes during similar single visits. The dates of the species' migration did not differ significantly between 1993 and 1996.

In all other sites that were checked in southern Transbaikalia, Red-necked Stints were very rare and

Table 2. Dates of southward migration by Red-necked Stints through Transbaikalia.

Location	Dates of migration	Source
South-eastern Transbaikalia and adjacent regions of Mongolia	12 July-15 September, most intensive passage in 25 July-20 August (1990-1998)	This study
South-eastern Transbaikalia (Torey lakes)	First half of August	Leontyev 1972
South-western Transbaikalia	Mid July	Izmailov & Borovitskaya 1973
South-western Transbaikalia (Eravnoe lakes)	13 July-19 September (9 collected skins)	Izmailov & Borovitskaya 1973; collection of the Zoological Museum, Moscow State University
Southern Lake Baikal (delta of Selenga River)	15 August-25 September	Zhuravlyov *et al.* 1991
Central Lake Baikal (Barguzinsky Nature Reserve)	29 July-26 August	Belyaev 1984
Northern Lake Baikal	29 July-18 August 1972	Tolchin *et al.* 1977
Northern Lake Baikal	18 July 1929 and 11 August 1934 (2 collected skins)	Collection of the Zoological Museum, Moscow State University

they were never recorded in northern Transbaikalia. Stegmann (1929) wrote that accordingly to L. Taczanowskii, Red-necked Stints were not rare on the Onon and Argun Rivers, but were rare near Chita City in south-eastern Transbaikalia. However, there has been only one record of this species in this region since: between 11-29 June 1969, Red-necked Stints were recorded at a density of $8.1.km^{-2}$ on Lake Shaksha (one of the Ivano-Arakhley lakes, 50 km westward from Chita) (Shkatulova 1973). There were no records of Red-necked Stint in south-eastern Transbaikalia outside the Torey Depression in the period 1990-1998. In south-western Transbaikalia, Red-necked Stints are rare migrants (Izmailov and Borovitskaya 1973). On Lake Baikal, they were recorded only on the northern part of lake in the delta of Verkhnyaya Angara River: Two hundred and fifty-six Red-necked Stints were counted during migration in 1973 (Tolchin 1975).

Southward migration

Dates of southward migration in different regions of Transbaikalia are presented in Table 2. According to observations in the Torey Depression and data from skins (collection of the Zoological Museum of Moscow State University) all birds in July are adult. Juveniles appear in the Torey Depression in August (earliest date - 9 August 1998). In south-western Transbaikalia on the Eravnoe lakes, all 3 specimens collected by I.V. Izmailov in 12 August 1956 were adult and a juvenile bird was collected in 26 August 1959. All 7 birds collected by O.K. Gusev and G. Kaplina on the central Baikal (Barguzinsky Nature Reserve) during the period 11-15 August 1957 were adult. Whereas juvenile birds predominated at the end of August on the southern Baikal in the Selenga River delta (Zhuravlyov *et al.* 1991).

In the Torey Depression (in both Russian and Mongolian parts) between 1990-1995 and in 1998, no more than 121 Red-necked Stints were recorded during each migration. Their flocks consisted of a maximum of 25 birds. Leontyev (1972) found that Red-necked Stints were rare on the Torey lakes during southward migration and his observations agree with our data. In the period 1990-1998, no records were made in south-eastern Transbaikalia outside the Torey Depression. This is contrary to the findings by Stegmann (1929) who found that, according to L. Taczanowskii, Red-necked Stints are not rare on the Onon and Argun Rivers or near Chita City. Stegmann had two birds collected on 11 August near Baldzino (100 km south of Chita, in the Ingoda River basin). There have been no records of this species from this region in the literature but there are some unpublished data and collected skins. Ten birds were recorded on 10 September 1971and one of them was collected on Lake Kharanor (10 km north-

Table 3. Some measurements of Red-necked Stints collected on the Torey Lakes.

Sex	Date	Wing length (mm)	Bill length (mm)	Gonads	Source of measurement
Male	12 June 1996	104.0	15.0	8.0 x 4.0; 6.0 x 3.7	dead bird
Male	14 June 1996	108.0	18.2	7.5 x 5.0; 7.5 x 5.1	dead bird
Sex unknown	5 June 1965	106.5	18.1	-	skin in collection
Sex unknown	4 June 1965	103.0	17.0	-	skin in collection
Female	12 June 1996	102.0	18.4	Max. follicle 1 mm	skin in collection
Female	3 June 1969	105.0	17.6	-	skin in collection
Female	4 June 1967	105.0	17.3	-	skin in collection

west of Borzia City, near the Torey Depression) and some small groups were seen there on 14 September 1971 (Schiokin per.com). There are also two skins collected on this lake by V. Belik in 5 August 1973 (collection of Zoological Museum of Moscow State University). One bird (skin is kept in same collection) was collected in 13 July 1944 by V.I. Bibikov near Abagay, in the Argun River basin, about 35 km east of Zabaikalsk (former Borzinsky).

In south-western Transbaikalia, Red-necked Stints are rare migrants (Izmailov and Borovitskaya 1973). Ten collected skins show that the species is more common in south-western Transbaikalia compared to south-eastern Transbaikalia. One bird was collected in 22 July on the Temnik River (Selenga River Basin) and two birds were collected on the Eravnoe lakes in 13 July (collection of Ulan-Ude Museum according to Izmailov and Borovitskaya 1973). There are also 7 skins of birds collected on these lakes by I.V. Izmailov on 23, 24 July and 12 August 1956, 19 September 1958 and 26 August 1959 (collection of Zoological Museum of Moscow State University). In northern Transbaikalia, Red-necked Stints were seen only in the Baunt Depression. Ten birds were recorded there on 8 and 9 September despite observations over the period from April through to September 1982 (Popov 1988).

Many records are from Lake Baikal where stints are common on the north of the lake: 287 birds, in flocks up to 20 birds, were counted there between 29 July and 18 August 1972 (Tolchin *et al.* 1977). The species was also common along central Baikal (Barguzinsky Nature Reserve) (Belyaev 1984). In the Selenga River delta, southern Baikal, Red-necked Stints form up to 10% of the total number of all migrating waders and their flocks consisted of 5-8 birds (Zhuravlyov *et al.* 1991). In 1986, Red-necked Stints had density of 453 birds km^{-2} in the Selenga delta (Tupitsin and Podkovirov 1990).

Band recoveries

On 31 May 1994, one Red-necked Stint with an orange leg-flag was seen among 35 birds feeding on the Torey lakes. At least 10 different orange and one yellow leg-flagged stint were seen there between 5 and 14 June 1996. The yellow flag was put on the bird in the north of Western Australia, whereas orange flags come from Victoria, Australia. Ringing details are available for two of these birds collected on 12 June 1996: a female was ringed on 17 June 1995 as a young bird in its second calendar year (38° 42' S; 146° 23' E) and male was ringed on 28 December 1994 (38° 5' S; 144° 31' E). The leg-flagged individuals represented approximately 0.2% of all Red-necked Stints that were staying on the Torey lakes.

Behavioural observations and morphology

Red-necked Stints stop on mudflats or sandflats of the lake shore usually in deltas or sources of rivers. In the Torey Depression, the Red-necked Stints were never recorded on river banks. Monitoring of some localised flocks and individually recognisable birds, indicates the short duration of staging by Red-necked Stints on the Torey lakes in June 1996: 1 day (n=4), 2 days (n=1) and 3 days (n=2) only. All three birds that were collected on 12 and 14 June 1996 were very fat and 12 June was the day of mass departure of Red-necked Stints from the area. Almost all stints that had stopped on the Torey lakes between 5-14 June 1996 flew directly north during the last hour before sunset.

The measurement of seven Red-necked Stints collected on the Torey lakes are presented in Table 3. Four of these birds were collected by A. N. Leontyev and preserved in the Chita Museum and the others were collected during 1996. One of the males collected in 1996 had the long wings characteristic of birds from the Yakutian breeding ground. It is difficult to determine whether the other birds are also from that population because of the shrinkage after skinning.

DISCUSSION

The main staging areas of migrant Red-necked Stints in the region are located on Lake Baikal and in Torey Depression, possibly because of the distribution of the species' preferred habitats. In the Torey Depression, the most important stopover sites are located on large lakes: on the Torey lakes in the Borokholoy River delta (50° 0' N; 115° 41' E) and on Lake Khuh-nuur in Teliyn-gol River delta (50° 0' N; 115° 41' E). Many medium-sized lakes in the Torey Depression are also important roosting and feeding sites for stints. Birds that cross Transbaikalia on northward migration mainly stop in the Torey Depression. That may occur because water in shallow steppe lakes gets warmer early in spring and as a result, the lakes are rich in wader food. The large and deep Lake Baikal is an accumulator of cold in spring, thus causing surrounding wetlands to take longer to warm than the steppe lakes. The absence of records further north of the Torey Depression possibly indicates that birds cross northern Transbaikalia non-stop during migration. Records from the northernmost parts of Lake Baikal are only during northward migration and are possibly birds that missed stopping in the steppe areas.

During southward migration, Red-necked Stints stop more readily along the eastern shore of the Baikal. Most stop on the stretch of shoreline between the northernmost point of the lake and the Selenga River delta in the south. Many fewer birds stop in the Torey Depression. This suggests that either birds have different migration routes on northward and southward passage, or prefer to stop in different areas at different times of the year.

Northward migration takes place from 24 May to 13 June, with the most intensive passage at the end of May and the beginning of June. Southward migrants were recorded from 12 July to 25 September and were more numerous from the end of July and the first two weeks of August. During southward migration in July, only adult birds were recorded and they predominate up to the middle of August. Juvenile birds appear in the first week of August and begin to predominate after the end of August.

It has previously been shown that the Red-necked Stints breeding in northern Yakutia are significantly larger than birds breeding further west (Taimyr Peninsula) or east (north of the Far East) (Tomkovich 1986). On the basis of measurements taken from six skins of females collected in south-eastern Transbaikalia, Tomkovich suggested that Red-necked Stints of different breeding populations migrate through the region and that some of them originate from Yakutian breeding grounds. He found the mean wing length of males from Yakutia was 102.3 mm (range 98.5-105, n=14), females -104.4 mm (100-108, n=9). Our measurements of wing length confirm the hypothesis that Red-necked Stints from Yakutia stop in south-eastern Transbaikalia. The mean wing length of five skins (2 unsexed and 3 females) collected on the Torey lakes is 104.3 mm (range 102-106.5). It is difficult to compare the wing length measured on live birds and skins because the wing length decreases during the drying out of skins. However, the male with wing 108 mm is very large and is obviously from the Yakutian population.

The number of Red-necked Stints that stop in the Torey Depression show large-scale fluctuations between years. This is probably a result of changes in the suitability of the region for staging by waders. The number and fullness of regional lakes and the availability of feeding habitat depends on the cyclic fluctuation of climatic factors. The largest complete cycles typical of the region last about 30 years and include dry and wet periods. Even the Torey lakes that are up to 900 km^2 and reach a maximum depth 7 m can become completely dry in some years (Obiazov 1994). During dry periods, dropping steppe lakes have wide open sandy and muddy shores. In wet periods, water of rising lakes floods grasslands along the shore resulting in a lack of habitat suitable for Red-necked Stints. The Torey Depression may contain over 1,500 lakes in wet periods (eg. 1995). The most recent wet period was recorded from 1984 to 1995. The years 1996 and 1997 were dry, but 1998 was wet again. Thus, it seems that the number of

Red-necked Stints that stop in the Torey Depression increases in dry periods and decreases in wet years. It is possibly that birds cross the Torey Depression non-stop during unfavourable periods.

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ALBINISM AMONGST BLACK-WINGED STILTS IN NEW ZEALAND

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The Black-winged Stilt (*Himantopus himantopus leucocephalus*) or Pied Stilt as it is better known in New Zealand, is a common native wader with an estimated population of ca. 30,000 (Heather and Robertson 1996). Although dark individuals are often encountered, these are descendants of hybridisation with the endemic Black Stilt *Himantopus novaezelandiae*. Albinistic birds are seldom reported.

On 8 December 1996 AC and Sarah Gibbs (from the Department of Conservation, Twizel), found an unusual juvenile stilt feeding amongst a flock of 395 Black-winged Stilts at Lake Ki-Wainono, South Canterbury, New Zealand. The difference in plumage between this bird and other stilts was striking: instead of the characteristic dusky crown, dark ear coverts, and dark-brown mantle of juvenile Black-winged Stilts, this bird had an all white head, neck, mantle and back. In flight, instead of a small white V opening toward the tail, a much larger V opened in the opposite direction, toward the head. A pale wing-bar was also evident, crossing the outer greater coverts and the inner greater primary coverts.

Initially we considered the possibility that this bird might be a juvenile Banded Stilt (*Cladorhynchus leucocephalus*), a species to yet recorded in New Zealand. However a number of factors clearly discounted this hypothesis. Firstly, the bird's legs were extremely long; in fact they appeared to be proportionately longer than those of any surrounding Black-winged Stilt. Secondly, although the bird had a white wing bar (highly unusual for a Black-winged Stilt), its position and extent were not consistent with juvenile Banded Stilt, which has a long, white trailing edge along the secondaries and inner primaries. Thirdly, and most conclusively, this bird had a blackish underwing, identical to that of a Black-winged Stilt and quite different to the largely whitish underwing of Banded Stilts (Hayman *et al.* 1986).

We concluded (reluctantly) that the bird before us was a partial albino Black-winged Stilt and not New Zealand's first Banded Stilt! Later the same day, approx. 45 km further north at Washdyke Lagoon near Timaru, we found a very similar stilt feeding amongst a mixed assemblage of Black-winged Stilts, Double-banded Plovers (*Charadrius bicinctus*), Black-fronted Plovers (*Charadrius melanops*), South Island Pied Oystercatchers (*Haematopus ostralegus finschi*), and Masked Lapwings (*Vanellus miles*). This bird too had a white head, neck, mantle and back, but the wing bar was more obvious and covered more of the greater primary coverts. A second visit on 9 December with Phil Battley and Mark Sanders confirmed that like the Ki-Wainono stilt, this bird had long legs and a black underwing, and therefore was also a partial albino Black-winged Stilt.

On 14 October 1997, AC and DS visited Washdyke Lagoon and found another unusual stilt feeding amongst a group of Black-winged Stilts, Double-banded Plovers and Wrybill (*Anarhynchus frontalis*). This bird appeared to be a full albino, having a totally white head and body, with very faint fawny-coloured wings. This bird was watched for some time on 14 October and also on 29 October 1997. It was observed interacting with other stilts without any obvious intra-specific aggression. The bird was however, occasionally mobbed by Red-billed Gulls (*Larus novaehollandiae scopulinus*), a species which often harasses solitary white-plumaged egrets in New Zealand (pers. obs.). The feeding, flocking, and predator-response behaviour of the albino stilt seemed identical to that of the other Black-winged Stilts with which it associated.

Avoiding confusion between aberrant New Zealand "Pied" Stilts and juvenile Banded Stilts

Hayman *et al.* (1986) state that a "white mantle is [a] simple distinction" between Black-winged and Banded Stilts. Clearly in New Zealand at least, this is not always the case. A partial albinistic "Pied" Stilt can have a white mantle which looks identical to that of a Banded Stilt and could easily lead to misidentification at a distance. Any acceptance of a Banded Stilt record in New Zealand would have to rely on other, more reliable features. The most crucial would be pale underwing colour, white trailing edge, short leg-length and the distinctive wing beat pattern of Banded Stilts.

Acknowledgments

We wish to thank Sarah Gibbs, Phil Battley and Mark Sanders for their company when stilt watching, and particular thanks to Phil for reviewing this manuscript.

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HOODED PLOVER REPORT NO. 2: 1996-1999

THE SEARCH CONTINUES...

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The results of an on-going project to monitor populations of Hooded Plover *Thinornis rubricollis* in southern Western Australia has recently been published (Singor 1999). This is the second report of the project which began in 1994 and aims to conduct seasonal surveys of Hooded Plover populations in coastal and inland sites in southern Western Australia. The first report, Newbey (1996), highlighted the presence of large aggregations of birds at inland sites during summer, identified four new sites with internationally significant numbers of Hooded Plover and 18 locations where breeding occurred.

The second report presents the results of two surveys for Hooded Plover undertaken in 1998. The first, in February 1998, attempted to cover likely sites throughout south-western Australia. The second, in September 1998, concentrated on the extensive lake systems between Esperance and Norseman, Western Australia. Birds were only found at coastal sites during the February 1998 survey, with the highest concentrations in Jerramungup Shire and the lakes around Esperance. The survey of the lakes inland from Esperance in September 1998 proved more difficult than anticipated and fewer lakes were visited than planned. However, 54 Hooded Plover were seen at 14 of the 103 sites visited. Fifteen nests were found during the surveys. Most were in coastal areas, but four were at inland sites.

Another objective of the 1998 surveys were to try and identify the primary determinants of Hooded Plover habitat. Sites with apparently similar aspect, water depth, exposed shoreline and surrounding vegetation varied in the presence and density of Hooded Plover. Dietary studies and sampling of the shoreline at sites where Hooded Plover occurred found that bivalves, *Coxiella* species, were a major component of the fauna and the birds' diet.

The relationship between rainfall and Hooded Plover distribution and seasonal movements is also discussed. The data available suggests that the onset of autumn rain stimulates Hooded Plovers to move inland and that the distance birds move depends on the quantity and distribution of these rain events. Some of these birds remain at these inland sites during summer while they provide suitable habitat. The remainder appear to migrate back to the coastal lakes and beaches.

A number of recommendations for future studies of Hooded Plover in south-western Australia are also presented, including a banding and flagging program to help monitor dispersal, investigations of the relationship between *Coxiella* and Hooded Plover distribution at inland sites and an awareness program for government environmental management staff and the public similar to that developed by Parks Victoria.

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SIGHTINGS OF LEG-FLAGGED WADERS FROM VICTORIA, AUSTRALIA REPORT NUMBER 7

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An orange plastic leg-flag has been placed on the right tibia of most migrant and some resident waders banded in Victoria since 1990. This has led to a significant increase in the rate at which data has been generated on migration routes and key stopover regions in the flyway.

Lists of sightings of orange flagged birds away from the banding areas have been published in previous editions of the *Stilt,* the most recent (report number 6, *Stilt 33*) in October 1998.

Bar-tailed Godwit

7.11.98	Kaipara Harbour, NZ	G. Grant
22.11.98	"	G. Pulham
1.5.99	"	G. Grant & M. Twyman
4.12.98	Manukau Harbour, NZ	R Clough
7.6.99	"	"
8.2.99	Waikawa Harbour, Southland, NZ	D. Seay
03.5.99	Shirakawa River Mouth, Kumamoto, Japan. 32° 47'N 130° 37'E	Kyoichira Imamura
02.5.99	Yalu Jiang Nature Reserve, China 39° 49N 123° 38'E	J. Wilson, M. Barter
29.4.98	Yatsu Tidal Flat, Chiba, Japan 35° 40'N 139° 55'E	Tsutoma Ishikawa
19.5.98	"	"
10.5.98	"	Takashi Miyazaki
12.4.98	Torinoumi, Watari, Miyagi, Japan 38° 02'N 140° 55'E	Hiroshi Ikeno
03.5.98	"	"
05.10.98 10.10.98 25.10.98 07.11.98 21.11.98	Manly Boat Harbour, Moreton Bay, Qld " " " "	D. Edwards, A. Keates " " " "
25.10.98	Mackay, Qld	L. Thyer
06.11.98	Jack Smith's Lake	D. Fraser

It is especially notable that all the sightings in Japan were on northward migration (see also previous editions of the *Stilt*). This suggests that Bar-tailed Godwits either follow a different route on southward migration or fly over Japan without normally stopping.

The increased number of sightings in New Zealand may in fact be a reflection of more godwits being banded in Victoria in the last couple of years.

Sightings in Queensland on southward migration are typical. There have not been any orange flagged Bar-tailed Godwits seen in NW Australia. This supports the biometric data which suggests that the NW Australian and eastern Australian birds are different sub-species from different breeding areas.

Jack Smith's Lake is an inland site about 10 km from the nearest part of Corner Inlet.

Eastern Curlew

9.3.97	Sone, Kitakushu-shi, Japan 33° 49'N 130° 58'E	Kuruhiko Hatano
19.3.97*	"	Kazuo Samoto
12.3.98	Fuji River mouth, Shizuoka, Japan 35° 07'N 138° 39'E	Hideaki Nakano
11.8.98 2 birds	Dux Creek, Moreton Bay, Qld	T. Ford
15.8.98	Pine Rivers, Moreton Bay, Qld	D. Edwards
31.12.98	Georgetown, Tas.	R. Cooper
27.4.99**	Dux Creek, Moreton Bay, Qld	T. Ford

*This is an additional bird to the one, on the same date, detailed in the *Stilt* 33.

**This bird also carried a satellite transmitter (see separate report).

Japan continues to be a prominent location for sightings during northward migration. Queensland is also a popular stopover site, particularly on southward migration. The bird in Tasmania was either one which had changed its non-breeding area or had been on passage when banded in Victoria.

Grey-tailed Tattler

8.9.98	Boonooroo, QLD	C. Barnes

Another nice indication of the migration route and timing of a Grey-tailed Tattler, identified by plumage as an adult, on its way back to Victoria. One, possibly the same bird, considering that only three have been flagged in recent years, was seen in Moreton Bay on 2 October 1997 (*Stilt* 33).

Ruddy Turnstone

18.8.98	Sanbanze Tidal Flat, Funabashi, Japan 35° 40'N 139° 59'E	Harutaka Takubo
3.5.99	Peng-Hu, Taiwan 23° 40'N 119° 39'E	Chien-Hsuin Cheng & Dr Fang
20.2.99	Karaka, Manakau Harbour, NZ 37° 05'S 174° 50'E	B. Woolley
20.9.98	Port Hedland Saltworks WA	D. Watkins et al.

Taiwan seems to be a preferred stopover location for Ruddy Turnstone on northward migration from Victoria. The sighting in Japan is our first for that country. The bird seen in New Zealand could well be the same individual as reported at the same site in February 1997 (see *Stilt* 33). It was also nice to have a record of a bird returning via north west Australia. Four more orange flagged birds were seen in winter (26 May 1999) at Seal Rocks, Phillip Island (by Peter Dann). These were presumably immature one year old birds from the flock which spends much of the summer around Flinders.

Great Knot

11.9.98	Sandgate, Moreton Bay, Qld	F. Armbrust
21.11.98	Cabbage Tree Creek, Moreton Bay, Qld	J. & I. White
25.10.98	Darwin, NT	C. Doughty
12.9.98	80 Mile Beach WA (18km south of Anna Plains Station)	R. Ward

The four Great Knot sightings illustrate the wide spread of southward migration routes back to Victoria.

Red Knot

30.4.99	Mai Po Marshes, Hong Kong 22° 29'N 114° 19'E	G. Carey
09.1.99	Ashley Estuary, Christchurch, NZ 43° 17'S 172° 43'E	T. Croker
12.10.98 to 5.10.98	Pautahanui Inlet, Paremata, NZ 41° 05'S 174° 54'E	R. Morrison
03.11.97	Manawatu River Estuary, NZ 40° 28'S 175° 14'E	M. Snowball
30.11.97	"	R. Slack
07.11.98	Tapora South, Kaipara Harbour, NZ 36° 21'S 174° 18'E	G. Grant
30.1.99	Awarua Bay Bluff, Invercargill, NZ 40° 35'S 168° 28'E	G. Grant
1.2.99 (4 birds)	Papakanui Spit, Kaipara Harbour, NZ 36° 26'S 174° 12'E	G. Pullen
6.2.99	Jordans, Kaipara Harbour, NZ 36° 34'S 174° 21'E	D. Melville
4.5.99	Tapora, Kaipara Harbour, NZ 36° 21'S 174° 18'E	NZ banding office
27.9.98	Mangawhai Estuary, Auckland, NZ 36° 5'S 174° 36'E	G. Grant
1.1.99	"	T. Habraken
17.10.98	Miranda, Firth of Thames, NZ 37° 10'S 175° 19'E	T. Habraken
18.10.98	"	"
1.1.99 (3 birds)	"	B. Seddon
6.1.99	"	A. Riegen
13.9.98	Karaka, Manukau Harbour, NZ 37° 5'S 174° 50'E	T. Habraken
6.12.98	"	"
2.1.99 (4 birds)	"	C. Hassell & J. Sparrow
20.2.99 (2 birds)	"	B. Woolley
29.5.99	"	G. Pulham
25.11.98	Conifer Grove, Papakura, Manukau Harbour NZ 37° 2'S 174° 56'E	E. C. Warr
26.12.98 (4 birds)	Kiwi Esplanade, Manukau Harbour, NZ 36° 58'S 174° 40'E	N. Anthes
24.1.99	Darwin, NT	G. O'Brien
14.2.99	"	"
31.3.99	near Karumba, SE Gulf of Carpentaria, Qld	J. Wilson
12.4.99	"	A. Riegen, P. Driscoll
13.4.99 (2 birds)	"	"
12.9.98	Manly Boat Harbour, Moreton Bay, Qld	A. & S. Keates
13.9.98	"	D. Edwards
17.9.98	Sandgate, Moreton Bay, Qld	F. Armburst
1.6.99	Roebuck Bay, Broome, WA	A. Boyle, BBO

Another fine selection of Red Knot flag sightings including one in Hong Kong. It is more usual for Red Knot from NW Australia to be linked with Hong Kong by banding recoveries or flag sightings.

Thirty-four sightings in New Zealand must be a record. It reflects increased success in catching Red Knot in Victoria in the last two or three years and the extremely active and diligent search and recording of leg-flag sightings in New Zealand. The list contains several birds further south than previously recorded, including one near Invercargill at the bottom of the south island.

The records in northern Australia are unusual in that some refer to birds stopping off there on their northward or southward migration from Victoria, while others may have a different explanation. The Gulf of Carpentaria sightings could even be birds which had been in New Zealand – several NZ-flagged birds were seen at the same time. The Darwin bird would appear to have changed its non-breeding area. The Broome bird, which was in full breeding plumage, may well have been a two year old which was only travelling part way back to its breeding grounds.

Sanderling

Position of flag on leg	Date	Location	Observer
	1.8.98	Shin Maiko, Iwaki, Fukushima, Japan 37° 40'N 140° 57'E	Kinjiro Ono
	2.8.98	Kahoku Beach, Ishikawa, Japan 36° 39'N 136° 39'E	Tonio Nakagawa
	2.8.98	Tokyo Bay, Japan 35° 35'N 139° 49'E	Ken Hatsuno
	11.8.98	Sanrikama Beach, Fukui, Japan 36° 9'N 135° 5'E	Yoshito Ohsako
	12.8.98 2 birds	Ichinomiya River, Chiba, Japan 35° 23'N 140° 24'E	Yasuo Suzuki
	23.8.98 2birds	"	Kenzo Tomiya
	24.4.99	Ling Hekou Nature Reserve, China 40° 54'N 121° 17'E	J. Wilson, M. Barter
lower	29.12.98	120 km east of Esperance, WA	A. Rose
	29.8.97	Cable Beach, Broome, WA	H. Sitters
lower	9.8.98	80 Mile Beach, Anna Plains Station, WA	AWSG
lower	8.9.98	"	AWSG
lower	10.9.98	"	AWSG
1 upper 2 lower	7.10.98	Bush Point, Roebuck Bay, Broome, WA	AWSG
lower	8.10.98	"	AWSG
2 upper 1 lower	16.11.95	30 km SE of Murray Mouth, SA	I. Stewart
several lower	5.11.96	"	"
18 upper 1 lower	18.11.98	"	"
35 upper 1 lower	19.11.98	Murray River Mouth, SA	"
	31.1.99	Perkins Island, Tas	T. Reid
	2.1.99 6 birds	Nelson	R. & K. Gay
	28.10.98 3 birds	Nobles Rocks, east of Nelson	C. Collins
8 upper	16.11.98	Canunda Beach, SA	A. Boyle
5 lower	7.9.98	Yambuck, west of Port Fairy	M. Schultz

6 lower	18.10.98	"	M. Schultz, P. Tyler
2 lower	8.9.98	Discovery Bay	M. Schultz

In addition to the above list, a number of tarsus flagged (lower leg) Sanderling, from South Australia, were seen by Susan Taylor at Sandy Point. These were on 12 October 1998 (4 birds), 12 January 1999 (one bird), 11 February 1999 (2 birds).

Since flagging of Sanderling commenced in 1991 (mainly since 1993) they have consistently given a high proportion of leg flag sightings, both overseas and away from the banding areas in Victoria (Port Fairy, Sandy Point and Corner Inlet) and SE South Australia (Canunda Beach, Brown Bay, Stoney Point). Birds from the two sites can be differentiated because the orange flag was placed on the right tarsus (lower leg) in South Australia and on the right tibia (upper leg) in Victoria.

Overseas sightings are again predominantly from Japan, with almost all continuing to be during southward migration. It was nice to get our first report of a Sanderling from China.

For the first time, a really strong link with NW Australia as a stopover location on southward migration, became apparent. Seven birds from SE Australia were seen at 80 Mile Beach or Roebuck Bay in August to October and seven birds banded there during that period were subsequently seen in SE Australia.

Sightings of Sanderling flagged at Broome/80 Mile Beach, NW Australia (yellow flags) in south eastern Australia

16.11.98 2 birds	Canunda Beach, SA	A. Boyle
18.11.98	30 km SE of Murray Mouth, SA	I. Stewart
1911.98 2 birds	Murray Mouth, SA	"
12.1.99	Sandy Point (near Wilson's Promontory)	S. Taylor
11.3.99	"	"

The mobility of birds along the coast of southern Australia, with permanent changes in non-breeding locations of hundreds and even thousands of kilometres, is apparent from the long list of sightings within Australia. Because the orange flag was placed in different positions on the leg in Victoria and South Australia it was possible to determine the origin of birds if the flag position was recorded. This is why there are records of birds at main banding sites in the table, those which have moved interstate being recorded. Birds with the flag on the tibia (upper) were originally marked in Victoria and those with the flag on the tarsus (lower) in South Australia.

Red-necked Stint

A surprisingly low number of only four Red-necked Stints were observed at Mai Po Marshes Hong Kong (23° 16'N 120° 7'E) during northward migration in 1999. These sightings were all by Geoff Carey and are detailed below:

Date	Number of birds
21.4.99	2
30.4.99	1
13.5.99	1

In addition Chris Doughty saw one there on 27 April.

7.6.99	Buir Nuur, NE Mongolia. 47° 48'N 117° 53'E	A. Braunlich & B. Batdorj
19.4.97	Chin-Shan, Taipei County, Taiwan	Chung-Ming Chang
20.5.99	Wu-Chiang-Hsi Estuary, Chin-men, Taiwan	Chung-Wei Yen

2 birds	24° 30'N 118° 30'E	
20.5.99	Szu-Tsao, Tainan City, Taiwan 23° 1'N 120° 8'E	Yung-Tsang Fu
31.5.99	Han-Pao, Changhwa County, Taiwan 23° 3'N 120° 22'E	Chih-Yuan Tsai
15.6.99	Tatu River Estuary, Taiwan	Chiang Chung Yu
4.9.98	Broome, WA	AWSG/BBO
8.9.98	80 Mile Beach, Anna Plains Station, WA	AWSG
16.9.98 2 birds	Port Hedland Saltworks, WA	"
23.9.98	Broome, WA	AWSG/BBO
25.9.98	"	"
7.10.98	Bush Point, Roebuck Bay, WA	AWSG
18.10.98	Cape Keraudren, 80 Mile Beach, WA	"
3.1.99	Lake McLarty, Peel Yalgorup wetlands WA	J. Darnell et al.
26.1.99 2 birds	"	T. Kirkby
17.4.99	Eyre Bird Observatory, WA	The wardens
3.7.99	Fitzgerald River NP, WA	D. Sullivan
27.2.99	Manly Boat Harbour, Moreton Bay, Qld.	A. Keates, D. Connolly
1.7.99	Cape Bowling Green, Townsville, Qld	J. Lowry
28.11.98	Adelaide Saltfields, SA	C. Rogers, J. Cox
15.3.99	Tolderol, Lake Alexandrina, SA	R. Reid
7.4.99 2 birds	Brown Bay, SA	P. Collins, R. Jessop
2.11.98	Georgetown, Tas.	R. Cooper
9.11.98	Claverts Lagoon, Hobart, Tas.	A. Fletcher
13.1.99	Cape Portland, NE Tas.	R. Cooper
22.1.99	Marion Bay, SE Tas.	E. Woehler
30.1.99	Robins Island, NW Tas.	T. Reid
31.1.99	Perkins Island, NW Tas.	"
22.2.99	Barilla Bay, Hobart, Tas.	P. Park
12.3.99	Orielton Lagoon, Hobart, Tas.	"
6.9.98	Kurnell, NSW	J. Pegler
20.2.99	"	"
22.1.99	Lake Wollumboola, Culburra, NSW	R van der See
26-29.4.99 4 birds	Lake Victoria, SW NSW	P. Robertson

The highlight of the Red-necked Stint sightings was a bird seen in NE Mongolia on 7 June, on northward migration. This is our first Australian flag sighting or recovery of any species of wader from Mongolia. The location was close to the Russian and Chinese borders in the same marshes complex in which ten Red-necked Stints were observed in early June 1996 (Daursky Marshes, southern Siberia). The area is obviously a key inland stopover region for birds making their way from the Chinese coastline across the continent to their Arctic breeding grounds. There were few Red-necked Stint sightings from Hong Kong in 1999, but in contrast a record showing from Taiwan. As usual, all were on northward migration, one very late bird still being in Taiwan in mid-June.

The array of sightings within Australia was the largest ever reported. Dominant were birds in NW Australia on southward migration and sightings in Tasmania of birds which had either been banded during migration through Victoria or had changed their non-breeding areas. There is also obviously a dedicated team of wader watchers throughout Tasmania!

Other birds which had clearly changed their non-breeding area away from Victoria include those observed at Lake McLarty (WA), Moreton Bay (Qld), Lake Wollumboola (NSW) and one of the Kurnell (NSW) sightings. Examples of the wanderings of first year birds, which are not going to return to the breeding grounds until the subsequent year, include the sightings at Fitzgerald River NP (WA) and off Townsville (Qld). Both were seen in early July and the lack of breeding plumage was noted.

Sharp-tailed Sandpiper

27.4.98	Mankyung Estuary, Korea 35° 52'N 126° 43'E	Per Korean Banding Scheme
14.9.98	Sandy Point (nr Wilson's Promontory)	S. Taylor

Our first Sharp-tailed Sandpiper from Korea. The Victorian sighting is some way from any location at which Sharp-tailed Sandpipers have been flagged.

Curlew Sandpiper

International Sightings

14.7.98	Daursky Nature Reserve, Russia. 50° 5'N 115° 30'E	Oleg Goroshko
4.5.99	Pu-tai, Chiayi, Taiwan 23° 21'N 120° 10'E	per Taiwan Bird Banding Centre
11.5.99*	Cheng-hsi-li, Tainan City, Taiwan 23° 2'N 120° 3'E	"

* This bird was marked with the new South Australian flag code (orange over yellow). It would have been banded in South Australia in the first week of April 1999.

The regular, almost daily, examination of the waders at Mai Po Marshes, Hong Kong (23° 16'N 120° 07'E) was continued by Geoff Carey, and others, in 1999. Inter alia this produced another 47 sightings of orange flagged Curlew Sandpipers.

Dates of sightings were:

Date	Number of birds	Date	Number of birds
22.3.99	1	21.4.99	6
31.3.99	1	22.4.99	2
7.4.99	1	24.4.99	1
8.4.99	2	26.4.99	2
9.4.99	1	29.4.99	3
10.4.99	1	30.4.99	5
14.4.99	2	3.5.99	5
16.4.99	3	6.5.99	5
17.4.99	1	30.5.99	1
20.4.99	4		

In addition to the above, Chris Doughty saw an orange flagged Curlew Sandpiper at Mai Po on 27 April. Arthur and Sheryl Keates also saw one there on 28 and 29 April.

Australian sightings

4.97	nr Karumba, Gulf of Carpentaria, Qld	P. Driscoll
31.1.99	Luggage Point, Moreton Bay, Qld.	A. Keates, D. Connolly

27.4.99	Lake Wyara, Currawinya, NP, Qld	D. Secomb
2.5.98 2 birds	Roebuck Bay, Broome, WA	C. Hassell, BBO
12.7.98	"	T. Wheller
14.7.98	"	C. Hassell, BBO
14.9.98	80 Mile Beach - 25 km south of Anna Plains Station, WA	AWSG
17.10.98	"	"
16.9.98	Port Hedland Saltworks, WA	"
19.9.98	"	"
25.11.95	Botany Bay, NSW	J. Pegler
8.11.98	Carpenters Rocks, SA	A. Boyle
7.4.99	Brown Bay, SA	P. Collins, R. Jessop
28.10.98	Georgetown, Tas	A. Fletcher
13.2.99	"	R. Cooper

It was nice to have a sighting from inland southern Siberia of a bird which had just commenced its return (southward) migration. This is the same site at which 10 orange flagged Red-necked Stints were seen (on northward migration) in June 1996.

The passage through Mai Po, Hong Kong, was again excellently documented by Geoff Carey and his team of dedicated observers. For the third consecutive year an orange flagged bird from Victoria arrived in Hong Kong (this year on 22 March) ahead of yellow flagged Curlew Sandpipers from NW Australia. The median date for sightings in 1999 was 23 April - almost identical to 1998 and previous years.

The records within Australia are in a multiplicity of categories. Many relate to birds on passage to and from Victoria - with NW Australia again producing several examples. But one of the 2 May birds and both the July sightings at Broome were of first year immature birds, in non-breeding plumage. This is further evidence that some of the one year old birds are traversing the whole continent even though they are not intending to return to the breeding grounds. The Moreton Bay, Botany Bay and possibly the Carpenters Rocks records refer to birds which probably changed their non-breeding area from Victoria.

Grey Plover

8.8.98	Yatsu Tidal Flat, Chiba, Japan 35° 40'N 139° 0'E	Sohei Samejima
11.8.98	"	Harutaka Takubo
13.8.98	"	Tsutomu Ishikawa
14.8.98 2 birds	"	Yasuo Suzuki
16.8.98	"	Harutaka Takubo
18.8.98	"	Hideko Hayashi
22.4.99 2 birds	"	Yasuo Suzuki Ayako Asano
30.4.99	"	Yasuo Suzuki
20.5.99	"	"
12.8.98	Tama River Mouth, Tokyo, Japan 35° 32'N 139° 47'E	Akiko Yoshizawa

These are the first sightings of Grey Plover away from the banding location. There were no overseas recoveries of Grey Plover either. Clearly Japan is a key stopover location on both northward and southward migration. At least six individual birds seem to have been involved. All probably emanated from 23 Grey Plover flagged in NW Swan Bay on 18 October 1997.

Double-banded Plover

21.9.98 Male nesting	Upper Tekapo River, NZ 44° 7'S 170° 26'E	A. Crossland

A sighting in a typical nesting area in New Zealand. It was a male bird, at the nest.

In addition an orange flagged bird was seen by Barbara Garrett at Killarney Beach on 23 July 1998. It would have been banded further east in Victoria – at Barry Beach, Shallow Inlet or Werribee SF.

Lesser Sand Plover

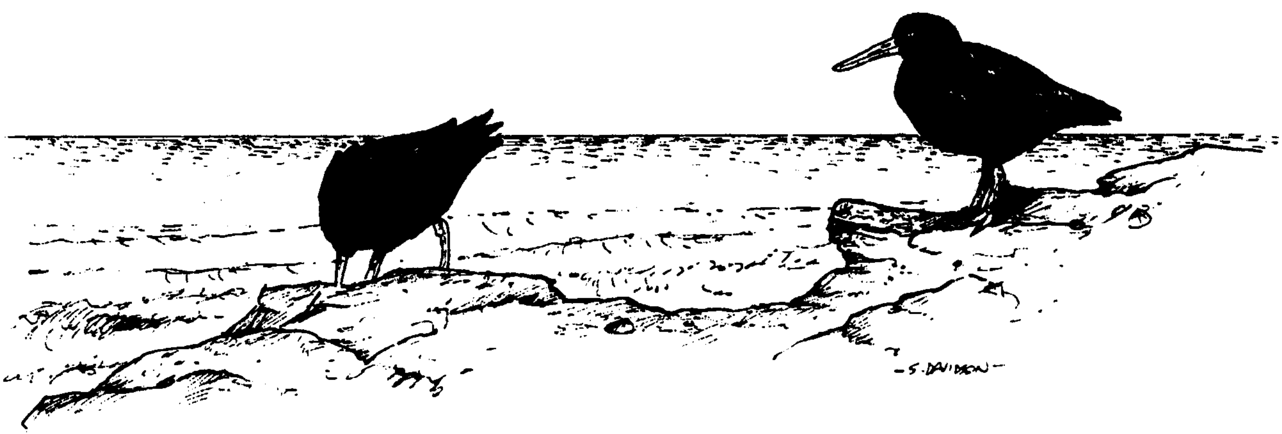
21.11.98	Manly Boat Harbour, Moreton Bay, Qld.	A. Keates
28.3.99	"	D. Connolly, A. Keates

These records could possibly be of a bird (s) on passage but more likely of a bird which has changed its non-breeding area away from Victoria.

Greater Sand Plover

22.6.98	Chong Bin, Tatu Estuary, Taiwan	Wei-ting Liu
8.10.98	Manly Boat Harbour, Moreton Bay, Qld.	D. Edwards
20.12.98	"	A. Keates
10.1.99	"	"

The sighting in Taiwan was thought to be an early bird on return migration after an excellent 1998 breeding season. The Queensland sightings could all refer to the same bird – one which looks to have changed its non-breeding area away from Victoria.



SIGHTINGS OF WADERS AND TERNS LEG-FLAGGED IN NORTH-WESTERN AUSTRALIA REPORT NUMBER 6

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Yellow flagging of waders and terns was commenced in NW Australia (Broome, 80 Mile Beach and Port Hedland) in 1992. Since then approximately 36,000 waders have been marked. Lists of all sightings away from the flagging locations have been published almost annually in the *Stilt*, the last appearing in April 1999 in *Stilt* 34 (Report Number 5). This list details all reports received since then up until the end of July 1999. Especially noteworthy are further long series of sightings from Hong Kong (Geoff Carey) and Korea (Jin-Young Park). A good collection of sightings from Taiwan is also most welcome. All observers are profusely thanked for their efforts in sighting, recording and forwarding details of flagged birds.

Please forward any future sightings to either of the authors listed above.

Black-tailed Godwit

2.5.99	Asan Bay, Korea 36° 54'N, 126° 54'E	Jin Young Park
20.4.99 (2 birds)	Cheng-Hsi Li, Tainan City, Taiwan 23° 3'N, 120° 6'E	Yung-Tsung Fu
2.5.99	Li-Shui, Long Chin, Taichung, Taiwan 24° 12'N, 120° 29'E	Tung-Chuan Chiang

There have now been five overseas sightings of Black-tailed Godwits from NW Australia - three in Taiwan and two in Korea. There have not yet been any recoveries from the 403 birds banded. It is interesting that the sightings on 20 April in Taiwan followed shortly after the visible migratory departures of Black-tailed Godwits from Broome. These commenced on 13 April and were complete by 21 April.

Bar-tailed Godwit

1.5.99	Yellow River Delta, China 37° 20'N, 119° 0'E	Mark Barter & Dale Tonkinson
19.4.99	Shuangtaizihekou Nature Reserve, China 40° 52'N, 121° 42'E	Jim Wilson & Mark Barter
20.4.99	"	"
22.4.99	"	"
24.4.99	Shuangtaizihekou Nature Reserve, China 40° 50'N, 121° 40'E	"
27.4.99 3 birds	Ling Hekou Nature Reserve, China 40° 54'N, 121° 17'E	"
9.5.99	Yalu Jiang Nature Reserve, China 39° 50'N, 124° 5'E	"
16.4.99	Mankyung Estuary, Korea 35° 52'N, 126° 43'E	Jin-Young Park
19.4.99	"	"
30.4.99	Kangwha Island, Korea	Jeong-Yeon Yi & Jin-Young Park

(3 Birds)	37° 34'N, 126° 23'E	
1.5.99	Namyang Bay, Korea 37° 5'N, 126° 45'E	Ki-Seop Lee
2.5.99	Asan bay, Korea 36° 54'N, 126° 54'E	Jin-Young Park
23.8.98	Lake Komuke, Monbetsu, Hokkaido, Japan 44° 44'N, 143° 29'E	Kazuhiro Oodate
26.8.98	"	"
21.4.99	Kang-Nan, Hsin-Chu City, Taiwan 24° 48'N, 120° 54'E	Shih-Min Mao
25.10.98	Miranda, Firth of Thames, New Zealand	Tony Habraken

Another excellent series of Bar-tailed Godwit sightings in Asia. As always the majority were on northward migration. Those seen by Jim Wilson and Mark Barter in the far north of the Chinese coast are thought to be at their last staging area before cutting inland across Siberia to their Arctic breeding grounds.

It may be relevant that the southward migration sightings were in Hokkaido, northern Japan. This is on a direct route from the Sea of Okhotsk, on the Siberian coast, to northern Australia - a flight route which appears to be taken on the southward migration.

A further sighting in New Zealand (there were four in the previous year) suggests there may be a little mixing of populations in NW Australia. The New Zealand birds are thought to be from the separate Alaskan/north east Siberian breeding population (*Limosa lapponica baueri*).

Eastern Curlew

31.3.99	Kanghwa Island, Korea 37° 34'N, 126° 23'E	Jeong-Yeon Yi
14.4.99 2 birds	"	Jin-Young Park

Only 88 Eastern Curlew have been banded/flagged in NW Australia. These have produced five sightings in Korea (four on northward and one on southward migration). There has also been a recovery on the breeding grounds in the Amur River region in SE Siberia.

Terek Sandpiper

7.4.99	Wen-Ti, Ilan County, Taiwan 24° 48'N, 120° 49'E	Mu-Chi Hsiao
1.5.99	Kang-Nan, Hsin-Chu City, Taiwan 24° 48'N, 120° 54'E	Cheng-Ming Wu
6.4.99	Mai Po, Hong Kong 22° 29'N, 114°19'E	Geoff Carey
7.4.99	"	"
8.4.99	"	"
9.4.99	"	Paul Leader
17.4.99	"	M.L. Chalmers
20.4.99	"	Geoff Carey
21.4.99	"	"
22.4.99 (2 birds)	"	"
24.4.99	"	"
30.4.99 (2 birds)	"	"

6.5.99	"	"

These are the first sightings of yellow leg-flagged Terek Sandpipers in Taiwan. Previous reports have all been from Hong Kong and Russia

Grey-tailed Tattler

29.5.99	Mai Po Hong Kong 22° 29'N, 114°19'E	Geoff Carey
9.8.98	Saigawa River, Fukuoka, Japan 33° 37'N, 131° 11'E	Yuji Tomitaka
29.5.99	Sutsu Bay, Hokkaido, Japan 42° 46'N, 140° 17'E	Umeki

Japan always features strongly in overseas reports of Grey-tailed Tattlers. It is clearly on a significant migration route, especially on southward migration.

Ruddy Turnstone

8.4.99	Mai Po, Hong Kong 22° 29'N, 114°19'E	Paul Leader
1.4.99	Brown Bay, Port MacDonnell, SA	Clive Minton

Turnstones produce remarkably few overseas recoveries or flag sightings. There has been only one other previous flag sighting - in Taiwan - of a bird flagged in NW Australia (from 700 flagged). There have been only two recoveries from 1327 Turnstones banded - one at Shanghai, China and one on the breeding grounds in the Yakutia region of northern Siberia. The sighting in South Australia, in conjunction with a SE Australian flagged bird at Port Hedland in 1998, are the first indication of the use of NW Australia as a staging area for birds en route to SE Australia.

Great Knot

6.5.99	Yalu Jiang Nature Reserve, China 39° 48'N, 124° 1'E	Jim Wilson & Mark Barter
7.5.99	"	"
15.4.99 (3 birds)	Namyang Bay, Korea 37° 5'N, 126° 45'E	Jin-Young Park
16.4.99 (7 birds)	Mankyung Estuary, Korea 35° 52'N, 126° 43'E	"
19.4.99 (4 birds)	"	"
3.5.98	Nakashima reclaim, Himeji, Japan 34° 40'N, 134° 40'E	Toshifumi Miki
7.4.99	Wen-Ti, Ilan County, Taiwan 24° 48'N, 120° 49'E	Mu-Chi Hsiao
21.4.99	Kang -Nan, Hsin-Chu City, Taiwan 24° 48'N, 120° 54'E	Shih-Min Mao
31.3.99	Mai Po, Hong Kong 22° 29'N, 114°19'E	Geoff Carey
4.4.99	"	"
5.4.99 (5 birds)	"	"
6.4.99 (3 birds)	"	"

7.4.99	"	"
8.4.99 (4 birds)	"	Paul Leader
10.4.99	"	Geoff Carey
17.4.99	"	Paul Leader
18.4.99 (2 birds)	"	R. Morris
20.4.99 (2 birds)	"	Geoff Carey
21.4.99	"	"
24.4.99 (2 birds)	"	"

The sightings in China were on the northernmost coast. This is the area now thought to be an important final staging area for Great Knot on northward migration before a direct flight to the NE Siberian breeding grounds. Korea is also a major staging area.

The sightings in Taiwan are the first for Great Knot from NW Australia. The large number of reports in Hong Kong was attributed to adverse weather conditions which forced many migratory Great Knot to land before reaching their normal destination of the Yangtse Estuary, near Shanghai.

Red Knot

29.11.98	Avon-Heathcote Estuary, Christchurch, New Zealand 43° 33'N, 172° 44'E	Scott Butcher
15.12.98	"	"
17.10.98	Miranda, Firth of Thames, New Zealand	Tony Habraken
20.12.98	"	"
22.11.98	Mangere, Manukau Harbour, New Zealand	R. Clough
25.11.98	Papakura, Manukau Harbour, New Zealand 37° 02'N, 174° 56'E	E.C. Ward
6.12.98	Kidds, Karaka, Manukau Harbour, NZ	Tony Habraken
26.12.98	Kiwi Esplanade, Manukau Harbour, NZ	Nils Anthes
2.1.99	Kidds, Karaka, Manukau Harbour, NZ	Chris Hassell & Janet Sparrow
20.2.99 (2 birds)	Kidds, Karaka, Manukau Harbour, NZ	Bev Wooley
14.7.98	Barry Beach, Vic	Pete Collins
6.11.98	Jack Smiths Lake, Woodside, Vic	Duncan Fraser
6.12.98	Peel Inlet, WA	Mike Bamford

An amazing series of flag sightings - none in Asia but 11 in New Zealand. Until the last two years it was thought that the NW Australia Red Knot population was discrete from that in Eastern Australia/ New Zealand. Clearly, (as in Bar-tailed Godwit) that is not the case. It appears that some of the birds passing through NW Australia, especially on southward migration, have New Zealand as their ultimate destination. The 580 Red Knot flagged during the August/October 1998 NW Australia expedition probably contributed significantly to this sudden plethora of sightings.

Sanderling

6.9.98	Obitsu River, Kisarazu, Chiba, Japan 35° 25'N, 139° 54'E	Kiyoaki Ozaki
8.4.99	Mai Po, Hong Kong 22° 29'N, 114°19'E	Paul Leader
10.4.99	"	Geoff Carey

16.11.98 (2 birds)	Canunda Beach, SA	Adrian Boyle
18.11.98	Murray R mouth, SA	Iain Stewart
19.11.98 (2 birds)	"	"
12.1.99	Sandy Point, Vic	Susan Taylor
11.3.99	"	"

A nice result from the significant expansion of Sanderling banded in NW Australia during the August/October 1998 expedition (including one catch of 377 birds - the previous NW Australian total was only 61).

The sighting in Japan is the third from NW Australia. Sanderling from SE Australia are also mainly observed in Japan during migration. The sightings in Hong Kong are also a first for that site.

The onward movement of birds through NW Australia to SE Australia is obviously significant, especially since the big catch was not made until early October by which time many would have passed through.

Red-necked Stint

25.4.99	Hadori, Jeju Island, Korea 33° 31'N, 126° 54'E	Jin-Han Kim et al
12.5.99	Wu-Chiang-Hsi Estuary, Chin-Men, Taiwan. 24° 30'N, 118° 30'E	Chong-Wei Yen
31.5.98 (2 birds)	East Port, Tomakomai, Hokkaido, Japan. 40° 36'N, 151° 50'E	Hiromi Sato
9.5.99	Suminoe, Osaka, Japan 34° 38'N, 135° 24'E	Hiroshi Takada
2.4.99	Mai Po, Hong Kong 22° 29'N, 114°19'E	Geoff Carey
27.4.99	"	Chis Doughty
4.11.98	Peel Inlet, WA	Ros Jessop, Pete Collins and Mavis Russell
3.1.99	Lake McLarty, Murray Shire, WA	Tony Kirkby and John Darnell
5.9.98	Werribee SF, Vic	C.F. Smith
11.10.98	Inverloch, Vic	Jim and Anthea Whitelaw
31.10.98	Lake Ranfurly, Mildura, Vic	Alex Hawtin
16.12.98	Werribee SF	Martin Hulzebusch

The sightings in Korea are the first reports of Red-necked Stints from NW Australia. They tie in well with the further reports in late May from the Hokkaido region of northern Japan and support the hypothesis that Red-necked Stints from NW Australia tend to mostly breed at the eastern end of the breeding range.

There seems to be a continuing dearth of sightings from Hong Kong, especially in relation to the number of Curlew Sandpiper reports. Apparently Red-necked Stints are more difficult to view. However, there is a good series of onward migratory movements within Australia, most probably from birds marked during the August/October 1998 NW Australia Expedition.

Sharp-tailed Sandpiper

9.5.99	Kang-Nan, Hsin-Chu City, Taiwan 24° 48'N, 120° 54'E	Shih-Min Mao
10.10..98 2 birds	Werribee SF	Mark Barter and Ken Harris
3.1.99	Lake McLarty, Murray Shire, WA	Tony Kikby and John Darnell

The Taiwan sighting is only the second from NW Australia which has been reported from overseas. It is nice to have three onward movements to other parts of Australia of birds marked on passage through NW Australia in August/September 1998.

Curlew Sandpiper

20.5.99	Cheng-Hsi-Li, Tainan City, Taiwan 23° 3'N, 120° 6'E	Yung-Tsang Fu
31.3.99	Mai Po Nature Reserve, Hong Kong 22° 29'N, 114° 19'E	Geoff Carey
14.4.99 (2 birds)	"	"
16.4.99 (3 birds)	"	"
17.4.99 (2 birds)	"	"
19.4.99	"	"
20.4.99 (2 birds)	"	"
21.4.99 (4 birds)	"	"
22.4.99	"	"
24.4.99 (3 birds)	"	"
30.4.99 (2 birds)	"	"
3.5.99 (3 birds)	"	"
6.5.99 (3 birds)	"	"
10.5.99	"	"
13.5.99	"	"
16.5.99	"	"
16.10.97	Chickita Lake, Ballina, NSW	David Rohweder
25.9.98	Cheetham Saltworks, Laverton, Vic	Bernie McCarrick
10.10.98	Werribee SF, Vic	Mark Barter & Ken Harris

Another wonderful series of sightings in Hong Kong of Curlew Sandpipers from NW Australia. For the third consecutive year (a) the first birds from NW Australia arrived in Hong Kong later than those from SE Australia and (b) the median sighting date was around 22-23 April.

The sighting in NSW could relate to a bird using an alternative route on its way to SE Australia. Only two sightings in southern Australia is a disappointing result from the additional 1700 Curlew Sandpipers flagged (and some were yellow dyed also) during the August/October 1998 NW Australia expedition.

Broad-billed Sandpiper

24.4.99	Mai Po Nature Reserve, Hong Kong 22° 29'N, 114° 19'E	Geoff Carey
2.5.99	"	"

These bring to a total of 15, the number of sightings in Hong Kong of Broad-billed Sandpipers from NW Australia. There have also been single sightings in China and Korea.

Grey Plover

15.5.99	Kanghwa Island, Korea 37° 34'N, 126° 23'E	Hwa-Jeong-Kim

This is the first overseas report of a Grey Plover marked in NW Australia.

Lesser Sand Plover

20.4.99	Mai Po Nature Reserve, Hong Kong 22° 29'N, 114° 19'E	Geoff Carey
30.4.99	"	Arthur and Sheryl Keates, Geoff Carey

These are the first overseas reports of Lesser Sand Plovers marked in NW Australia.

Greater Sand Plover

7.4.99	Wen-Ti, Ilan County, Taiwan 24° 48'N, 120° 49'E	Mu-Chi Hsiao
1.5.99	Kang-nan, Hsin-chu City, Taiwan 24° 48'N, 120° 54'E	Cheng-ming Wu
22.3.99	Mai Po Nature Reserve, Hong Kong 22° 29'N, 114° 19'E	Geoff Carey
25.3.99	"	"
31.3.99	"	"
3.4.99	"	"
19.4.99	"	"
21.4.99	"	"
26.4.99	"	"
3.5.99	"	"

Greater Sand Plovers' northward migration starts early and only crosses the southern parts of the Asian coastline. This is because the breeding grounds are further south and west than most other migrant waders from Australia. Thus there were three sightings in Hong Kong before the end of March. Taiwan is the furthest north of any reported flag sighting (or recovery) so far. Birds probably move inland to the breeding grounds from their initial landfalls on the Asian mainland.

Little Tern

1.9.98 (2 birds)	Lacepede Islands, WA	Jim Wilson et al
9.5.99	South Ballina, NSW	Bo Totterman

Common Tern

9.5.99	South Ballina, NSW	Bo Totterman

These are the first NW Australia flagged terns to cross to the east coast of Australia. They could have been banded in previous seasons and migrated along a different route in 1998/99. But given the numbers banded during the August/October 1998 expedition (359 Little Tern, 30 Common Tern) it is perhaps more likely that they actually worked their way around the coast in the same season. Amazing also that two different species were involved.

The Little Terns observed on the Lacepedes Is were exhibiting courting behaviour. If they were breeding, this would represent only the second documented colony in WA.

ABSTRACTS

AUSTRALASIAN WADER STUDIES GROUP CONFERENCE PHILLIP ISLAND, VICTORIA. 12 TO 13TH JUNE 1999

Compiled by

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Following the success of the first Australasian Wader Studies Group Conference in 1996 in Brisbane, Queensland, Australia, the second conference was held at Banfields Conference Centre, Cowes, Phillip Island, Victoria, Australia from the 12 to 13th June 1999. Over 70 delegates from Australia and New Zealand attended with participants from all states represented apart from South Australia and the Northern Territory. Abstracts of the twenty-seven papers and five posters dealing with a wide range of wader biology are given below.

The organisers would like to take this opportunity to thank the committee members of the AWSG for their support and their presence during the conference. In particular Phil Straw and Jim Wilson for their numerous phone calls. The organisers also thank the Phillip Island Nature Park Board of Management for their assistance in providing access to e-mail and computer facilities, stationary and photocopying and numerous other aspects that helped to make the conference run smoothly. The Phillip Island Nature Park also sponsored visits by delegates and their families to the Penguin Parade, Koala Conservation Centre and Churchill Island. Finally we would like to thank all the people who attended the conference without whose support the conference would not have been as enjoyable or as worthwhile.

MAPPING BUSH STONE-CURLEW HABITAT PREFERENCES AROUND TOWNSVILLE, NORTH QUEENSLAND 1998-2000

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The non-migratory Bush Stone-curlew *Burhinus grallarius*, is present in reduced numbers across much of its former range. In coastal north Queensland it is still relatively common and readily found close to urban areas. A Geographic Information System (GIS) was used to establish the presence or absence of the bird across the urban landscape based upon 40 sites generated by a random number system. These sites were categorized on land use and land management, vegetation cover, drainage patterns and disturbance factors and compared to 40 sites where birds occurred. Seasonal factors governing the movements of the Bush Stone-curlew within and between suitable habitat are also monitored. This will help identify habitat preferences and generate base-line data on the local population.

BREEDING BIOLOGY OF HOODED PLOVERS ON PHILLIP ISLAND AND METHODS OF INCREASING BREEDING SUCCESS

Bob Baird and Peter Dann

Phillip Island Nature Park, P. O. Box 97, Cowes, Phillip Island 3922 Vic. AUSTRALIA

The breeding biology of Hooded Plovers *Thinornis rubricollis* was studied on Phillip Island in Victoria between 1993-99. Breeding extended from August to March and usually peaked in December or January. A total of 27 breeding sites on 17 beaches were used and the types of nesting site were flat beaches (43%), stony terraces (33%) and ledges on eroding dunes (24%). Forty-four percent of breeding attempts occurred on only three of the beaches on the island.

The mean clutch size was 2.4 and hatching success was 17%. Predation by dogs and foxes, inundation by storm tides and trampling by sheep were the major causes of egg failure. Fledging success was 0.18 chicks per clutch and predation by dogs and foxes seemed the main cause of chick mortality.

In 1995, we started an experiment to determine if excluding predators and stock from nest sites would improve hatching success and have a corresponding effect on overall breeding success. We tested three types of exclosures and have developed what we believe to be an optimal design for excluding predators and stock as well as permitting access by the birds.

Twenty exclosures have been deployed to date and hatching success has been substantially increased as a result. So far overall breeding success has not been improved by the deployment of cages but the combination of the cages, improved enforcement of dog regulations and a dedicated team of volunteers has improved the plovers' breeding success substantially.

DIFFERENTIAL ORGAN REDUCTION DURING BIRD MIGRATION

Phil F. Battley[1], Theunis Piersma[2], Maurine W. Dietz[3], Sixian Tang[4], Anne Dekinga[2] and Kees Hulsman[1]

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The 'aircraft refuelling paradigm', stating that migratory birds build up and deplete only their fat stores before and during long-distance flights, remained largely uncontested from its proposal in 1964. Recent work has demonstrated substantial changes in organ sizes before departure, but only one study has attempted to determine whether organs are broken down during flight.

To investigate changes in organ size and fat content in migratory birds, we studied Great Knots *Calidris tenuirostris* before and after a non-stop flight of 5,400 km from north-west Australia to coastal China. On average, birds lost 85% of the stored fat. They also lost 16% of lean tissue mass, with significant decreases in pectoral muscles, skin, intestine, liver, kidneys, salt glands and the remainder of the carcass. All other organs except the brain showed the same directional change. Reduction of functional components is reflected in a 46% decrease in basal metabolic rate. Organ reductions free nutrients for use in flight, but also decrease the mass carried aloft. For long trans-oceanic flights such organ savings may be imperative. The implications of these findings for the latest models of fuel use in migrating birds will be discussed.

THE MOVEMENTS OF PIED OYSTERCATCHERS FROM WINTERING SITES IN VICTORIA

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In order to understand the biology of Oystercatchers in south eastern Australia Pied and Sooty Oystercatchers have been individually colour banded since 1989 by the Victorian Wader Study Group. Birds are caught at traditional winter roosts using cannon-nets, banded with stainless steel bands supplied by the Australian Bird and Bat Banding Schemes and colour banded with spiral darvic rings. The first phase of the study is looking at movements of individual birds. Individual colour banding is an essential element of the study and allows the movements of different age classes from different winter roosting sites to be followed.

In the past it has been assumed that individuals return to favoured wintering areas and that generally birds are 'site faithful' to that area. It has also been assumed that Oystercatchers are not 'long distance travellers'. This study shows that both these assumptions are incorrect. With the help of individuals and bird club members, over 4000 resighting have been gathered and the preliminary analysis of this data is presented.

FEEDING ECOLOGY OF EASTERN CURLEW IN WESTERN PORT BAY, VICTORIA

Peter Dann

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Eastern Curlew are conspicuously sexually dimorphic in bill length and have the longest bills of all the curlew species. It has been speculated that the functions of both these attributes are related to habitat and sexual selection on the breeding grounds or to mechanisms of resource partitioning on the non-breeding grounds. In this study, the foraging ecology of curlews was examined at Rhyll Inlet on Phillip Island for three years. Their diet was determined from observations of feeding birds, regurgitated pellets and prey remains. The curlews foraged largely on burrowing intertidal crabs and shrimps and showed both territorial and non-territorial patterns of dispersion while feeding. Territorial behaviour was related to habitat use and sex. Females were much more territorial than males. Both bill length and bill length dimorphism appeared to be related to feeding habitats during the non-breeding period.

Prey selection and habitat preferences were examined in relation to their profitability in terms of energy intake. The profitability of the frequented habitats varied and curlews were found to be more territorial in the more profitable ones. These preferred habitats were limited in size and prone to be rendered unusable by environmental conditions. The foraging of curlews appeared to be consistent with the theory that the net rate of energy intake was being maximised.

MANAGING A BREEDING POPULATION OF HOODED PLOVERS *THINORNIS RUBRICOLLIS* IN A HIGH USE NATIONAL PARK

Bernice Dowling

Ranger, Mornington Peninsula National Park, PO Box 400, Rosebud 3939 Vic. AUSTRALIA

The Mornington Peninsula National Park is located 70 km south east of Melbourne and has an estimated 2.5 million visitor days annually. A breeding population of Hooded Plovers coexists with recreational users of the Park, which include walkers, surfers, swimmers, fishermen and dog walkers. In 1991, Parks Victoria, with assistance from a volunteer group 'The Friends of the Hooded Plover', commenced a monitoring program of the Hooded Plovers within the Park to determine if the Hooded Plover population was stable. The program also monitored breeding success and identified causes of breeding failure. Since 1991, The Friends have conducted 164 surveys along 24 km of ocean beaches to monitor the adult population. Two hundred and eleven clutches were monitored to determine clutch fate and fledging success. The information gathered during monitoring is used by Parks Victoria to implement management to protect breeding sites and increase fledging success.

Breeding success increased after the introduction of holistic management to breeding sites along the ocean breaches. In the five breeding seasons from 1991/92 to 1995/96 a total of 12 Hooded Plover juveniles survived to fledge. In the three breeding seasons from 1996/97 to 1998/99 a total of 31 juveniles survived to fledge, a 158% increase in breeding success. The adult Hooded Plover population increased by 30% from an average of 33 adult Hooded Plovers in the Park in the 1991/92 survey year, to an average of 43 adult Hooded Plover in the 1998/99 survey year. Colour banding of juveniles fledged from the Park identified a number remained within the Park to breed in subsequent breeding seasons.

Management introduced by Parks Victoria aimed to decrease nest trampling and decrease disturbance by Park visitors in breeding areas. Management actions included fencing walking tracks from car parks to the beaches and closing informal tracks. A small number of beaches with breeding Hooded Plovers have been temporarily closed to the public using signs and regular ranger patrols. Restricted access for dogs and diligent enforcement of dog regulations by parks staff have limited the influence of dogs on the birds. In conjunction with these management action, a community awareness program has been under taken. Posters and brochures have been provided to park visitors to assist them to identify Hooded Plovers and to understand management objectives. 'Friends of the Hooded Plover' talk to park visitors while conducting surveys and undertaking nest monitoring work. Excellent media coverage of the program has resulted in two television segments being broadcast and regular newspaper articles in the Melbourne and the local papers.

THE PLIGHT OF WADERS AROUND THE MOUTH OF THE BRISBANE RIVER. HOW BRIGHT IS THE FUTURE ?

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There is massive development of seaport and airport facilities at the mouth of the Brisbane River, yet about a fifth of the waders in Moreton Bay (8,000), occur within 12 kilometres of the River mouth. There is a high of diversity of wader species and feeding habitats in the area, but the birds are threatened by a scarcity of roosting sites. Since intensive monitoring of wader numbers began in 1992, Black-tailed Godwit, Bar-tailed Godwit and Great Knot have shown statistically significant declines in numbers around the mouth of the river. Grey-tailed Tattler and Pacific Golden Plover appear to have increased over the same period. In such a highly-impacted environment, there may be many reasons for local population changes but "cleaner" sewage discharge from the mouth of the Brisbane River appears to have had major consequences. Local radio-tracking of ten species has shown their movements vary greatly, but have helped clarify appropriate management options.

HOW SHOULD WE VIEW THE GULF OF CARPENTARIA FOR WADERS? RESULTS FROM AN ONGOING SURVEY

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After the second year of a three study on waders in the south east Gulf of Carpentaria, it is still unclear why fewer birds, notably Black-tailed Godwit, are using the area than was the case ten years ago.

We are beginning to understand why local bird movements are more complex than elsewhere along the Australian coastline. Does this understanding suggest reasons for long term changes in numbers ? For some species, is the Gulf a regular and reliable overwintering site and for others variable, at times unacceptable or second best, or at times ideal ? Perhaps to understand monsoonal coastal habitats of the Gulf we must reflect upon inland Australia.

THE LOW TIDE DISTRIBUTION OF EASTERN CURLEW AT FEEDING GROUNDS IN MORETON BAY

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In order to identify and protect key feeding habitats of declining shorebirds, it is crucial to first develop an understanding of what types of intertidal environment are being utilised by the birds on their feeding grounds. We assessed the Eastern Curlew's use of feeding grounds in Moreton Bay by conducting low tide surveys in November 1998 and in January 1999. A total of 160 sites consisting of tidal flats of varying characteristics (eg. size, substrate, topography) were surveyed. A substantial proportion of Moreton Bay was covered, spanning a north-south distance of approximately 115 km, from the top end of Pumistone Passage to the southern Moreton Bay islands. Data were collected by 51 skilled volunteers who counted the number of curlew within each site, during two days within each month. All site locations were predetermined on the basis of accessibility and coverage of the bay, and the sites varied in area from 0.44 to 310.75 ha. A site typically comprised a section of flat from high water to low water, or a sandbank or collection of banks.

The results from this survey provide the most comprehensive count of Eastern Curlew on their feeding grounds ever completed. There were 2388 and 2357 birds on 28-29 November 1998, 2216, and 2067 curlew counted on 30-31 January 1999 respectively. Curlew numbers at individual sites varied from zero to 160 with heterogeneity of flat area accounting for some of this variation. The relative numbers of curlew across different flats corresponded closely. There was a strong and significant correlation, across sites, between the counts on day 1 and day 2 in both November (Pearson's $r=0.93$) and January ($r=0.89$), and between the average number of curlew counted in November and January ($r=0.92$). This constancy of curlew numbers across sites may occur for several reasons, including the possibility that they are faithful to particular sites. It also suggests that short surveys can give fairly reliable results. Factors that may underlie the differences in curlew numbers among different sites will be discussed.

OBSERVATIONS OF FEEDING AND ROOSTING BEHAVIOUR OF LITTLE CURLEW *NUMENIUS MINUTUS* OVERWINTERING IN THE NORTH-WEST OF AUSTRALIA

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Most Little Curlew spend their non-breeding season in northern Australia and southern New Guinea. They have been seen on passage in Japan, The Philippines, eastern Indonesia and the Hung He delta in China. No detailed work has been conducted on the behaviour of Little Curlew on their non-breeding grounds.

We studied the feeding and roosting behaviour of Little Curlew in Broome, on Roebuck Plains Station, Anna Plains Station and the Dampier Peninsula in north west Australia.. Most observations of feeding behaviour were made at the Broome Golf course. Birds first arrived from their night time roosts around

05:30 hours, just after sunrise. During October and early November most individuals fed for the first five hours after arrival. As the daytime temperature increased, with the approach of the wet season, feeding periods were interspersed with visits to the nearby water treatment plant for drinking and bathing.

One night time roost was located. Birds first arrived at the roost at about 16:00 hours with the final arrivals about 30 minutes later. On arrival at the roost most birds would preen, and then feed. As the sun set, 18.30 hours, Little Curlew would walk into the long grass fringing the area and sit down. No birds left the roost for over an hour after sunset (viewed with an image intensifier).

THE INFLUENCE OF PAST CLIMATIC CHANGES ON THE EVOLUTION OF ARCTIC BREEDING WADERS (POSTER)

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This study links the present-day distribution of subspecies of four different wader species breeding in the arctic zone to the availability of suitable breeding habitat during the past 250,000 years. The genetic population structure of two of these species, Dunlin *Calidris alpina* and Red Knot *Calidris canutus*, as revealed by mitochondrial DNA sequence analysis, provides a powerful tool in unraveling the former distribution of these and similar species. Bar-tailed Godwit *Limosa lapponica* and Grey Plover *Pluvialis squatarola*, occupy similar habitats as Dunlin and Red Knot, respectively, and patterns of subspecies distribution resemble each other. Generally, the breeding ranges of arctic waders were most restricted during warm phases in the earth's climate (interglacials), resulting in population bottlenecks in waders breeding in the high arctic zone. The last one of these occurred during the early Holocene, some 7,000 years ago and severely reduced the size of the world population of Red Knot. When the climate cools all species could spread over larger areas. However, the presence of ice-sheets, covering large areas of land during glacial times, fragmented tundra habitat into disjunct patches (refugia), which resulted in subspecies differentiation in at least those species breeding in the low arctic. Important refugia where distinct genetic groups formed were the North Sea basin, eastern Siberia and Beringia and southeastern USA. In Dunlin, the North Sea group split up into three groups after the last glacial. These are morphologically distinct, yet so young that they can't be identified using mtDNA.

SEXING THE HOODED PLOVER

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Many of Australia's waders are not sexually dimorphic, making the sexes difficult to identify from each other. Sexing these birds has traditionally involved destructive or intrusive techniques, or relied on field observations of copulating birds. The former techniques are not suitable for threatened species such as the Hooded Plover, and the latter technique has proven very inefficient.

This talk describes the application of a new genetic-based sexing technique to the Hooded Plover. Blood samples were collected in the field and DNA was extracted from the blood and amplified. Over three months of laboratory trials have resulted in the development of a successful method of sexing Hooded Plovers. This technique and its results are presented. Some possible applications of sex-based analyses are discussed for the Hooded Plover, and it is suggested that genetic-based approaches to sexing waders will be the preferred approach in situations where direct field observations of copulations are difficult, and/or where there is a need to sex sexually immature or sexually inactive individuals.

PAINTED SNIPE - A CAUSE FOR CONCERN ?

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The Painted Snipe *Rostratula bengalensis* is a medium-sized shorebird that inhabits non-tidal freshwater and saline wetlands. In this paper, we aim to review what is known about aspects of the species biology immediately relevant to its taxonomic and conservation status.

Information is presented on the plumage, measurements, anatomical characteristics and behaviour of the Australian and old-world sub-species. The differences described demonstrate that the Australia birds are distinct from their old world counterparts, are almost certainly reproductively isolated and should be treated as a separate species, whether one follows the biological or phylogenetic species concepts.

Information is also presented on the distribution and abundance of the species. This shows that it tends to occur in the wetlands of south-eastern Australia's major inland river systems and in sub-coastal plains wetlands of south-eastern South Australia and southern and northern Western Australia. Most records in Australia are from the spring, summer and early autumn months. There are few documented winter records and it is not known where they move to at this time of year. Historical data from the Atlas of Australian Birds (since 1800) combined with records since then, suggest that the species has experienced a significant decline in the 1970's and 1980's. Some of the reasons for this are explored. It is recommended that the species status be upgraded from "Insufficiently Known" to "Endangered", to reflect the urgency of its plight.

A QUARTER CENTURY OF WADER COUNTS IN WESTERN PORT (THE BOCA SURVEY)

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The Bird Observers Club of Australia began counting waders and other water birds at high-tide roosts in Western Port as part of an environmental study in 1973. The survey continues and is the longest running of its kind in Australia. All water birds are counted simultaneously by volunteer observers at up to 20 roosts in three to five "seasons" each year. This paper discusses wader numbers from 1973-98. The bay supports over 10,000 waders, and 38 species have been recorded. The bay is a Ramsar site, and survey data were used in its nomination.

The three most numerous waders showed a cyclic pattern of abundance, with no long-term trends. High summer numbers of Red-necked Stints usually followed high winter numbers (reflecting breeding success in the previous Arctic summer). Increased numbers of Curlew Sandpipers wintered in the bay in recent years. Eastern Curlew recovered quickly from a decline in the early 1980s when there was extensive seagrass dieback. At a local level, two of the 20 roosts have been largely abandoned by wadersprobably because of a loss of seagrass.

Bar-tailed Godwits have increased and Grey-tailed Tattlers decreased over the years. Flocks of Red Knot use the bay irregularly. Pied Oystercatcher numbers increased steadily and have doubled over the last 25 years, breeding mainly on French Island where there are no Red Foxes. Hundreds of Red-necked Avocets now visit the east coast in winter and spring, in contrast to previous years when the species was only a rare vagrant.

AN ARTIFICIAL WETLAND – CHEETHAM WETLANDS,VICTORIA, AUSTRALIA.

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In 1924 the Cheetham Salt Company purchased 1200 acres of land along the western shoreline of Port Phillip Bay. Saltpans, pumping plants and circulation channels were constructed. The first harvesting took place in 1926 and salt production continued up until 1992. The land was eventually sold with the central proportion being transferred to the Victorian government. Today Cheetham wetlands is owned and managed by Parks Victoria. A fragile ecosystem and a noted Ramsar site, Cheetham is home to approximately 200 species of bird.

With the construction of a lagoon system and a maintained water flow, a suitable environment for birds has been constructed. Shallow ponds attract numerous birds to feed on accessible vegetation, insects and larvae. Salinity acts as a coagulant, allowing colloidal particles to settle to the bottom, leaving the water clear and any food in the water column easy to visualise. Due to saline and tidal influences a saltmarsh environment has been created. Wind and water flow have dispersed seed to various sites for germination, this has allowed a variety of plants to be scattered through out the wetlands, compensating for the needs for roosting, wind protection and nest building.

A region suitable for birdlife, Cheetham contains a wide variety of habitats, including: both saline and fresh water; intertidal mud flats; a creek system and beaches and coastal dunes. Vegetation is of great importance to the Cheetham ecosystem and approximately 197 species of p[lant have been recorded. The area supports some coastal vegetation communities, which have been completely destroyed in many nearby coastal regions. Due to saltmarshes being defiant against weed invasion and the area being preserved by environmental management, the vegetation of the Cheetham wetland is still relatively intact. This allows the waders to maximise their feeding, breeding, and roosting capabilities.

Cheetham's is a unique and fragile ecosystem. The environmental management of the area, incorporating; water flow; salinity; and prohibition of possible destructive influences, is crucial to the maintenance and sustainability of this wetland system.

ROOST CHOICE IN THE WADERS OF ROEBUCK BAY: IS AVOIDING HEAT STRESS THEIR MAIN CONSIDERATION?

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Heat stress can be damaging or lethal to birds. In this presentation, several lines of evidence will be summarised which suggest that migratory shorebirds are particularly susceptible to heat stress. One of the main reasons for this is that their body composition changes markedly during the period of pre-migratory mass-gain. Their metabolic rate increases as a result of an increase in the lean mass of heat-producing organs. In the same period, their ability to lose heat may be impeded by their development of substantial fat deposits.

The roosting behaviour of shorebirds is currently being studied in Roebuck Bay, tropical north-western Australia. Early indications from this tropical site are that one of the main mechanisms used by shorebirds to avoid heat stress during high tides is roost choice. Shorebirds of Roebuck Bay show a strong preference for roosts where a damp substrate lowers the local temperature. This may have important conservation implications, because in some tide conditions the only roosts where shorebirds can experience a relatively benign microclimate are heavily disturbed beaches where the risk of predation is high.

INTERNATIONAL FRAMEWORKS FOR CONSERVATION OF MIGRATORY WATERBIRDS

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Conservation of migratory shorebirds requires the cooperation of the countries which these species visit. In the Asia Pacific region there is no effective formal multilateral conservation agreement in relation to migratory waterbirds. Nine bilateral agreements, including JAMBA and CAMBA, have provided the only formal basis for international cooperation. While these have been positive influences, they are relatively limited in their scope and in their capacity to foster truly multilateral approaches to migratory waterbird conservation.

The Asia Pacific Migratory Waterbird Conservation Strategy 1996-2000 has provided a valuable but non-binding regional framework. The Strategy has given rise to three Action Plans, including the Shorebird Action Plan to which Australia has committed substantial funding. The Strategy expires at the end of 2000.

Future shorebird conservation requires greater government ownership of shorebird conservation, better monitoring of shorebird populations, heightened public awareness throughout the region of shorebirds and their habitats, strategic, management-focussed research into the ecology of shorebirds, and better resourcing for shorebird conservation activities. Work is underway to develop a post-2000 framework that will incorporate these needs.

THE FORAGING ECOLOGY OF THE HOODED PLOVER IN EASTERN AND WESTERN AUSTRALIA

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The diet and foraging behaviour of the Hooded Plover *Thinornis rubricollis* is poorly known. This is particularly true of the West Australian populations, at least some of which inhabit salt-lakes. These habitats are very different from the high energy beach environments which are used by Hooded Plovers in the eastern part of their range.

This talk presents preliminary comparisons between the foraging ecologies of eastern and western populations of Hooded Plovers. Data were collected from Lake Gore, south-western Australia, in 1995 and from various Victorian sites between 1994 and 1998. Comparisons of the foraging behaviour and of the diet of the birds are made. Foraging behaviour was assessed using standardised observation techniques from concealed positions. Diet was determined by faecal analysis, and comparison with suitable reference collections.

HABITAT REMEDIATION - A LAST RESORT?

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With 86% of the Australian human population living in coastal regions, loss of wader habitat has been inevitable. An example is Botany Bay where about 900 ha of wetland habitat had been lost by 1950. Since then habitat loss has continued with the expansion of Sydney Airport, the construction of Port Botany. Other sites in NSW include the Hunter River estuary with the loss of a major part of Kooragang Island and estuary foreshores to industrial development. Similar situations exist near other major population centres around Australia.

There is an assumption by many people (especially developers and politicians) that waders will simply move "somewhere else" when wader feeding habitat is lost to development. If, despite all protests, wader habitat is to be lost, serious consideration should be given to replacing lost habitat with remediated or constructed habitat. However this alternative needs to be considered as early as possible so that sufficient lead-time exists for habitat construction and for the establishment of invertebrate populations on which the waders feed. This means that potential threats to wader habitat need to be identified as early as possible.

Wader feeding habitat has been created in the past in Australia, though largely accidental or incidental to other activities. I am referring to areas such as Port Headland Saltworks, the Tullakool salt evaporation ponds and Werribee sewage treatment works. However until now, purpose built wader habitats have been almost non-existent.

Fortunately, the attitude of some government agencies in NSW is moving towards a "no net loss" attitude towards habitat remediation during development. This means the creation of at least the same amount of habitat, of similar quality, to that which will be lost during development. Several major projects are currently under way in NSW to reverse losses of wetland habitat.

The design and construction of compensatory wader habitat must, wherever possible, result in a maintenance free system so that ongoing resources, which can rarely be guaranteed, do not have to be sought. For example, several successfully constructed sites have failed in the long term due to weed invasion and erosion.

Replacement might be second best to protecting original habitat, but if protection fails and habitat compensation has not been considered, we are faced with a "net loss". In some situations "moving" habitat to a less disturbed area can be of additional benefit to waders.

HOW WILL WADERS BENEFIT FROM THE NEW ATLAS OF AUSTRALIAN BIRDS?

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The work done by the various wader study groups in Australia has done much to identify migration routes, staging areas and over-wintering grounds of a large proportion of the waders using the East Asian-Australasian Flyway. We now have fairly good data on where the majority of migratory waders go during their stay in Australia. We are also finding out some interesting things about non-migratory waders, such as the phenomenal breeding events of the Banded Stilt due to the efforts of a few energetic individuals.

What we still need to know is which wetlands of the interior of Australia are important for migratory and non-migratory waders. We also need to identify many of the smaller coastal sites used by migratory waders which, collectively, account for thousands of birds. Information on the presence of waders, with the exception of some of the larger concentrations of birds, has been rather scant over the years due to the lack of observers able to identify and count these species. The data being collected by "Atlassers" will be available for analysis by members of the AWSG or Birds Australia and will provide us with much needed data on which important wader sites need protecting.

An example of a very successful, although much smaller, project is the Murray-Darling Waterbird Project where count data was obtained using volunteer observers over a three-year period providing some interesting results. In all, 26 sites of national importance and 19 sites of international importance for waders in the flyway were included in the survey.

Of these 20 sites of national importance and 14 sites of international importance had not been previously known. What can we find out with many more observers?

THE RESPONSE OF FORAGING WADERS TO HUMAN RECREATION DISTURBANCE AT RHYLL, PHILLIP ISLAND, VICTORIA

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Australian wetlands support estimated minima of 1.1 million resident and 2 million migratory waders, the great majority of which occur in coastal areas which are increasingly threatened by habitat loss from development, reclamation, pollution and by disturbance from human recreation activities. There have been no quantitative studies of the impact of recreation activities on waders in Australia but research in Europe and North America has demonstrated serious negative impacts of some activities on some species, suggesting the need to develop management guidelines for particularly important habitats and species.

From November 1997 to March 1998 we examined the responses of a range of foraging wader species to the three main recreation activities at Rhyll: walking, dog-walking and bait digging. We quantified the distances at which birds stopped feeding, whether they ran or flew from the source of disturbance, the distances at which they took flight and the distances they flew, in response to simulated disturbance under controlled conditions.

The initial response of most individuals was to stop feeding and look at the source of disturbance. Thereafter, some species tended to walk or run away while others tended to take flight. Whimbrel and Eastern Curlew were the most likely to fly off and Masked Lapwing were the least likely to take flight. The mean distances at which birds stopped feeding and the mean distances at which they took flight were significantly positively correlated with body size among different species. Larger species such as Eastern Curlew responded at greater distances than small species such as Red-necked Stint. It is argued that this variation may be related to size differences in energy budgets and the amount of time devoted to foraging and/or to size differences in exposure to human hunting. Smaller species must devote most of their time to foraging and hence may minimise the time spent responding to potential danger, whereas larger species that have to spend less time collecting food may be able to devote more time to the avoidance of danger. Human hunting also tends to be concentrated on larger species.

The distances to which disturbed birds flew also varied among species with Eastern Curlew and Whimbrel tending to fly farthest and smaller species such as Red-necked Stint flying shorter distances.

Most of the species studied at Rhyll tolerated much closer approaches of humans than did the same or equivalent species in European studies. For example, Eastern Curlews at Ryhll took flight at distances ranging from 30 to 100 m whereas Eurasian Curlews in the Netherlands flew off at distances between 120 and 550 m. Bar-tailed Godwits at Rhyll took off between 10 and 70 m, and in the Netherlands, between 90 and 225 m. The reasons for such differences are discussed.

The conservation implications of disturbance are likely to be of minor significance for the smaller species. However, for species such as Eastern Curlew and Whimbrel it is possible that disturbance may reduce the extent of suitable foraging areas, at least during daytime. The implications of this may depend on the extent to which the birds can compensate by nocturnal feeding.

THE EFFECT OF A CLAM *KATELYSIA* HARVESTING INDUSTRY IN TASMANIA ON A POPULATION OF PIED OYSTERCATCHERS *HAEMATOPUS LONGIROSTRIS*

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Commercial harvesting of clams *Katelysia* spp for human consumption began on several Tasmanian estuaries around 1987 and the main harvesting area has been Anson's Bay in north east Tasmania. *Katelysia* occur only in sheltered estuaries and bays, in areas that are also important feeding habitats for Pied Oystercatchers such as Anson's Bay. *Katelysia* populations in Anson's Bay showed no sign of recruitment in 1994/95 and little in 1995/96. The size distribution within the population in 1994 indicated a lack of recruitment for a number of years previously. The estimated standing crop of *Katelysia* declined by about 69% between 1994/95 and 1996/97.

The main prey of the Pied Oystercatchers in Anson's in 1993/94 and 1994/95 was *Katelysia* and the birds fed within the main harvesting areas. There were no other bivalve molluscs of equivalent size to serve as alternative prey. Between 1994/95 and 1996/97, the Oystercatcher population declined by 78%. By 1997 the Oystercatchers' diet had switched from 87% to only 9.5% *Katelysia* with the main prey having become the Southern Mud Creeper *Bittium lawleyanum*, a small gastropod mollusc.

It is estimated that the human harvesters, assuming they adhered to their quotas, would have removed approximately 16% of the standing crop of *Katelysia* annually and that the Pied Oystercatcher population would have removed about 22%. Together, these come close to the estimated reduction in standing crop observed over the study period.

It is suggested that the decline in the Pied Oystercatcher population was a result of harvesting in the absence of recruitment to the *Katelysia* population. The results are discussed in relation to the future of *Katelysia* harvesting in Tasmania and elsewhere and to the increasing incidence of human shellfish collecting within Oystercatcher habitats more generally in southern Australia.

SEX-RELATED DIFFERENCES IN THE FORAGING BEHAVIOUR OF BAR-TAILED GODWITS *LIMOSA LAPPONICA* IN NEW SOUTH WALES AUSTRALIA (POSTER)

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Bar-tailed Godwits show considerable sexual size dimorphism: male/female ratios are 0.94 for wing length, 0.76 for bill length, 0.93 for tarsus length and 0.81 for body weight. To test if such morphological differences are related to foraging, the habitat selection and foraging behaviour of male and female Bar-tailed Godwits were compared on the Parramatta estuary, New South Wales from November 1993 to April 1994. The birds could have fed in three types of habitat: shallow water close to the tide edge, exposed intertidal dry sandy ridges and intertidal wet muddy troughs. Females spent almost all of their time foraging in the water, whereas males spent about 50% of their time foraging in water, 30% on dry ridges and 20% in wet hollows. Females tended to feed in slightly deeper water than males but in neither sex was foraging depth limited by leg lengths. Both sexes fed entirely on polychaete worms and there were no differences in the lengths taken in relation to habitat or sex of the birds. Prey capture rates of females when feeding in water were 41% higher than those of males. Capture rates were significantly lower in the dry ridges and lower still in the wet hollows with no significant differences between the sexes. Associated with their lower overall prey capture rates males spent a higher percentage of the low tide period feeding than did females. Aggressive encounters during foraging were frequent. Those involving females were most often over prey and individuals would run up to 5-7 m to steal them. Encounters involving males were equally over space and food items. Encounters were initiated by females more frequently than expected by chance and encounters also took place along the water's-edge feeding habitat more frequently than expected. Females were dominant over males. It is suggested that males may have been forced to feed in less profitable habitats through the aggressive behaviour of females feeding in the best quality habitat.

THE CARRYING CAPACITY OF WETLANDS FOR SHOREBIRDS: A CASE STUDY OF BLACK-WINGED STILTS *HIMANTOPUS HIMANTOPUS* IN SALINE LAGOONS (POSTER)

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The reclamation of coastal areas for industrial and agricultural purposes continues to accelerate. How will populations of shorebirds respond to this loss of feeding areas? Can higher densities be supported in remaining areas without reducing survival or migratory ability? Could wetlands be managed to support higher densities of shorebirds? At present there are few answers to such questions in the Asia-Pacific region and studies elsewhere are still inconclusive. Extrapolation of studies from the Northern Hemisphere to Australia may be difficult as the birds spend their non-breeding season in the north under local winter conditions in which the prey neither breed nor grow and where severe weather is an important factor. In Australia migrant waders spend their non-breeding season in the local summer where prey biomass increases rather than depletes as the season progresses.

The central question of interest is the way in which the densities of feeding shorebirds are determined. This question was investigated in a study of Black-winged Stilts foraging in shallow coastal lagoons at Homebush Bay, Sydney, New South Wales. Three lagoons suitable for stilt foraging occurred within 4 km of each other. One lagoon, The Waterbird Refuge was consistently the most profitable feeding site for the birds, assessed by prey densities (chironomid larvae) and by the birds' prey capture rates. The density of feeding stilts was positively correlated with prey density: as prey density on the Waterbird Refuge declined so also did stilt density with birds moving out to the other lagoons. They moved out even when average prey capture rates on the Waterbird Refuge were still higher than on the other lagoons suggesting they may have been forced out rather than simply moving according to the balance of profitabilities of different feeding sites. Fluctuating water depths in the Waterbird Refuge caused changes in the extent of the feeding area there suitable for foraging stilts and as the size of the suitable area increased birds moved into the Refuge from the other lagoons. Thus birds moved into the most profitable lagoon when there was an increase in the feeding area available to them there and *vice verca.*

These observations suggest that the density and numbers of stilts feeding in the preferred area reached ceiling levels depending on the density of prey prevailing at the time and the extent of the suitable foraging space. What were the mechanisms underlying this apparent density limitation? The birds were found to be highly aggressive towards each other when feeding. They engaged in threat posturing, threat calls and overt attacks. When feeding they tended to be evenly spaced. There was a close correlation between spacing and threat call and attack rates. The density of birds may have been limited by their aggressive behaviour towards each other. This study suggests that the carrying capacity of the lagoon habitat was not fixed but was in a state of constant flux as prey densities and water depths changed through time.

THE DISTRIBUTION AND NUMBERS OF HOODED PLOVER AT WILSON'S PROMONTORY NATIONAL PARK

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The state's oldest national park, Wilson's Promontory is not generally recognised as an important site for Hooded Plover *Thinornis rubricollis*. Indeed, the recent edition of the *Victorian Naturalist*, which commemorates the centenary of the park, failed to mention this threatened species. This study summarises the distribution and numbers of Hooded Plover in the park.

The park provides habitat both for breeding and overwintering of a large number of birds. Distribution within the park is not uniform, being biased toward the north-western part. Two hypotheses are suggested to explain this: 1) physiogeographic differences that mean the northern part is more suitable habitat and 2) that pressure from recreationists has reduced the suitability of southern parts. These hypotheses require further investigation.

SHOREBIRD CONSERVATION IN THE EAST-ASIAN AUSTRALASIAN FLYWAY

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Migratory shorebirds are under significant threat, especially due to habitat destruction and human disturbance. Following an international meeting held in 1994, hosted by the Australian and Japanese Governments, a broad ranging strategy was developed to conserve migratory waterbirds in the Asia-Pacific region. The strategy called for the formulation of an Action Plan to identify priority actions for migratory shorebird conservation. The recently developed Shorebird Action Plan focuses on the establishment of a network of well-managed sites of international importance for shorebirds in the East Asian-

Australasian Flyway. The presentation will cover the Strategy and Plan development process, provide an outline of the Plan priority Actions and discuss ways in which Australia can assist with its successful implementation.

EFFECTS OF HUMAN DISTURBANCE ON THE BREEDING OF THE HOODED PLOVER

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It has been suggested that the response of breeding Hooded Plovers to human disturbance is a major threat to the species. This study examined the effects of human disturbance on breeding Hooded Plovers by observing disturbance and the bird's response to it. False eggs were used to measure egg temperature, and concurrent observations allowed us to examine the effect of disturbance on nest thermoregulation. Paris were monitored to determine nest outcome. We found a substantial spatial and temporal overlap between humans and breeding Plovers on beaches. High levels of disturbances resulted in a lower attendance of nests, because the Plovers behavioural response to the presence of humans. We found that nest attendance affected nest thermoregulation. Some data, such as the distribution of abandoned eggs, suggests disturbance could be implicated in at least some nest loss and further research into the relationship is required.

WADER COUNTS ON THE NORTH COAST OF THE YELLOW SEA

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The north coasts of the Yellow Sea were first anticipated in 1997 to be of major importance to migrating waders from Australia although observations on waders were almost entirely lacking. For the first time parts of the north Yellow Sea coasts of China were counted in May 1998 and April to May 1999. Two main areas were counted: the Liadong Wan and the Yalu Jiang. In the Liadong Wan 103,000 waders have been counted, including 10 species of international significance. The most numerous was Great Knot with possibly 42,000. At Yalu Jiang 151,000 waders were counted in 8 days in 1999, including 8 species of international significance. The most numerous were Bar-tailed Godwit 52,000 and Great Knot 54,000. There were also 20-30% of the estimated world breeding population of Eastern Curlew present. The first flags from Australia and New Zealand have now been found on the north coasts of the Yellow Sea (18). It is possible that the final staging site for at least half of the New Zealand/East Australia Bar-Tailed Godwits was found on the Yalu Jiang. Also it may prove to be the final staging site for New Zealand Red Knots. The mudflats on the N. Korea side of the Yalu River are much more extensive than in China. It is provisionally estimated that about 1,000,000 waders could be using the Yalu River Estuary and adjacent coastlines. It is possibly one of the world's top 10 wader sites. The talk will be illustrated with slides, showing potential threats to the waders.

WADER POPULATION MONITORING IN AUSTRALIA

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The paper documents the purposes of monitoring wader populations and gives a brief review of the history of population monitoring in Australia. Peter Driscoll's report to Environment Australia on the AWSG population monitoring project (PMP), and its recommendations, are reviewed. The author's own ideas are presented on the form a new revised integrated monitoring project should take. The proposed procedures for putting a revised project into action are outlined.

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.

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.

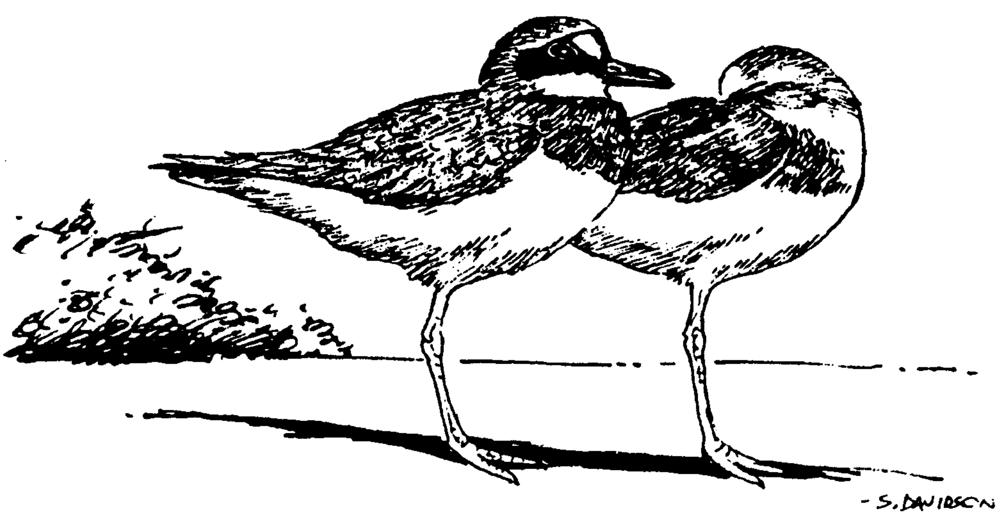
All maps should have a border, distance scale, reference latitude and longitude and/or inset map to enable readers unfamiliar with the area to locate the site in an atlas.

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.
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- 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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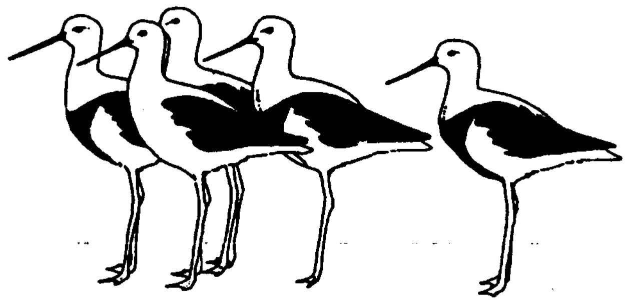
Indexes:

Author and species indexes have been published within *The Stilt* to volume 30.

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.



Stilt 35 - October 1999
Table of Contents