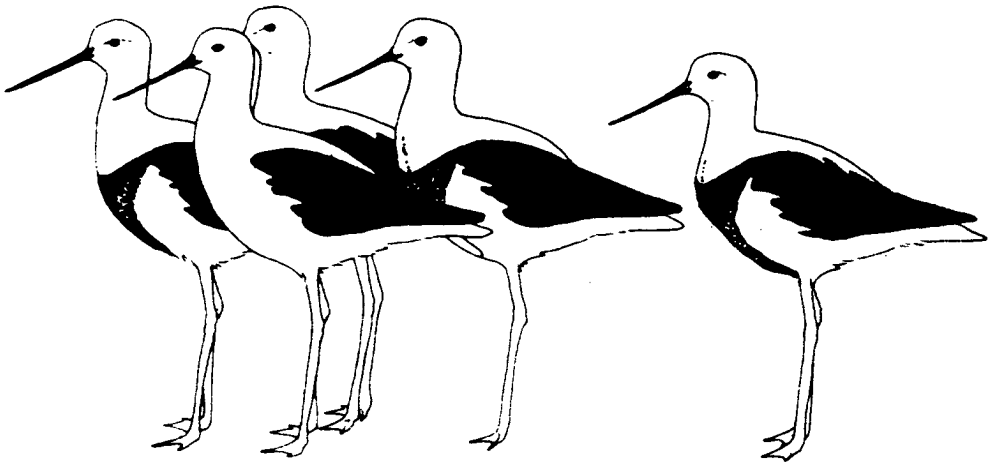
The Stilt



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BULLETIN OF THE AUSTRALASIAN WADER STUDIES GROUP
OF THE
ROYAL AUSTRALASIAN ORNITHOLOGISTS UNION

Number 10. April 1987.

OBJECTIVES OF THE

AUSTRALASIAN WADER STUDIES GROUP

OF THE

ROYAL AUSTRALASIAN ORNITHOLOGISTS UNION

1. To develop or assist with plans for wader research in Australasia in conjunction with other interested bodies;

2. To co-ordinate and encourage counting, banding, feeding studies and other scientific programmes involving amateur and professional skills;

3. To encourage and assist with the publication of results;

4. To maintain effective communication between wader enthusiasts within Australasia and with similar groups overseas;

5. To formulate and promote policies for the conservation and management of waders and their habitat.

EDITORIAL

This issue of 'The Stilt' sees a change in the format used. Because of the increased volume of material submitted for publication we are faced with increased costs for typing, printing and mailing. In order to overcome some of these problems, we have selected the format used by the Wader Study Group (UK) of two columns to a page, thereby reducing the number of pages for each issue.

The Banding Round-Up also sees a change in format. The new format is more concise than the previous one and will be used in all future issues of 'Stilt'.

Two contributions originally submitted for Stilt 9 were held over and appear in this issue. This was due entirely to the lack of space available in Stilt 9 and did not reflect the quality of the contribution or any other reason. My apologies to the authors for the delay in seeing their material to print.

Several members have enquired about the production of a review of "Shorebirds. An identification guide to the waders of the world" by Hayman, Marchant and Prater, 1986. A reviewer has been found and the review will appear in Stilt 11, October 1987. This book will be a standard reference for many years to come and it is important that a review appears as soon as possible for the people using the information presented in the guide.

Readers will note the absence of any banding totals in this issue of 'Stilt'. Only the VWSG and A Lashmar on Kangaroo Island (S.A.) provided any totals; no other banders or groups supplied banding data.

A new regular section appears in this issue. "Wandering Waders" will contain records of interesting observations, unusual numbers or wayward waders, sightings of colour-dyed or colour-banded birds, recoveries/retraps of old or long-range birds etc etc. In future please send such observations directly to the Editor or to your regional representative who can pass on the data.

A second new section was also to have appeared in this issue. "Sorting Them Out: Short notes for the field identification of waders." will provide short, one or two paragraph descriptions of species with an aid to field identification approach, particularly where there are two or more species that could be confused. Many species have been nominated for such descriptions and it is hoped one or two such contributions will appear regularly.

This issue of 'The Stilt' is the largest yet. Reports from the AWSG Committee, activities of AWSG members and the contributed papers from Australia and overseas all add up to provide interesting and thought-provoking reading. I look forward to your contributions for the next issue.

Eric Woehler.

EDITORS ADVICE TO CONTRIBUTORS.

The following is a guide to help contributors and editors in the production of future issues of 'The Stilt', based on the experiences of producing 2 issues.

1. It is preferable to receive material typed, (double spaced) in its FINAL FORMAT. Species' scientific names should be either underlined or in italics. However, if you do not have access to a typewriter please print neatly.

2. All Tables and Figures to be on separate sheets. Please supply originals so that I can reduce, cut and paste etc. Figures and maps should be drawn with black ink (not pencil or ball point pens! and not in blue, green, red etc.) Originals will be returned to authors if requested.

3. For common (vernacular) names, use the RAOU's Recommended English Names for Australian Birds (or its equivalent for birds outside Australia).

4. **Absolute** deadlines for receipt of material are:

   April Stilt end of January

   October " end of July

If you have any queries please write to me, or ring me on (002) 290349 (w), (002) 234666 (h) and I will attempt to solve the problem.

Eric Woehler

CHAIRMAN'S REPORT FOR 1986.

1986 was the first full year of activity for the Group following the cessation of the RAOU Wader Studies Programme in December 1985. It was a year of consolidation, consisting mainly of getting the Scientific Programmes under way, organising the administrative structure of the Group properly and ensuring that the main avenue of communication, The Stilt, was published on time.

Both the Population Monitoring and Regular Count Projects were successfully started and reports on both are being published in The Stilt. The projects will generate essential conservation-related data on changes in wader populations at selected sites around Australia and on the movement of endemic and migratory waders within the country.

The AWSG was involved in the three Northern Australian Wader Expeditions run in August-October period by the RAOU and assisted in arrangements for four Asians to attend one of the expeditions and to travel afterwards to Victoria for training in wader study techniques. The Group organised the third Hooded Plover Survey in Victoria and is involved in planning a major survey of waders in The Coorong to be held in February 1987.

Group members gave papers on wader research activities at the RAOU Congress in Adelaide (abstracts published in this issue) and the Research Co-ordinator was involved in preparing a joint paper, with Interwader and the Ornithological Society of New Zealand, on the East Asian-Australian Flyway which was presented at the Wader Study Group Flyway Symposium in Scotland last September.

It is gratifying to see that copy for The Stilt is plentiful and our problem now is how to improve the format so that all material submitted is published promptly, yet without postage costs. Both copies of The Stilt produced in 1986 were larger than average and we have started regular Interwader and New Zealand sections.

Our contacts with Interwader, the Ornithological Society of New Zealand, the Papua - New Guinea Bird Society and the Wader Study Group (U.K) are developing well and an article on the Group's Scientific Programme was published in the Bulletin of the latter Group during the year.

An elected Committee took office for two years from June 1st and now has the task of building on the solid groundwork laid by the Interim Committee. The Committee consists of five Victorians and two

Tasmanians. This arrangement certainly assists in the administration of the Group with the majority of the Committee Members being able to attend meetings. It is hoped that the geographical imbalance is counterweighed by the existence of a wide Representative network which can ensure that the views of all are presented.

The financial membership at the end of 1986 was 299. All existing members that had not paid their 1986 subscriptions by August 1986 were declared unfinancial, resulting in the loss of 29 members. However, we have managed to attract over 100 new members since our rejuvenation in October 1985. Pleasingly, we have a steady flow of new members from Europe and North America. Presumably, access to The Stilt and, thereby, news of what is happening with waders in our part of the world is the major reason for this.

The increased membership has helped us to maintain the subscription at $10 for 1987 in the face of rising costs. However, we need to keep a steady flow of tax-deductible donations to the research programmed in order to fund these without drawing too heavily on subscription income.

The AWSG is now formally a Group of the RAOU and all members will have received a copy of the Rules. This close association with the RAOU has a number of advantages. Two significant ones are the automatic incorporation of the Group and the extension of the Union's Personal Injury and Legal Liability cover to persons involved in AWSG activities, such as the Scientific Programme, or in projects approved by the AWSG.

As I wrote in the 1985 Report, the strength and cohesion of a widespread Group like ours is dependent on members being involved in AWSG activities and the work of the various groups studying waders around Australasia. Please feel free to contact the Regional Representative or the Administrative Secretary for further information concerning these activities. News, articles and papers are always needed for The Stilt. Members who are interested in assisting with the analysis of count and morphometric data should contact the Research Co-ordinator. Ideas for new work and criticisms of existing programmes are always welcome.

Conservation of waders and their habitats is the core objective of the AWSG and anybody who feels that the resources of the Group, and of the RAOU, would be helpful in developing conservation arguments and management plans for threatened areas should contact us.

I would like to thank the Committee for their hard work throughout the year and particularly those in the front line - the Research and Programme Co-ordinators - for getting the Scientific Programme up and running so successfully.

My thanks also to the members for their moral and financial support, without which little would have happened.

Mark Barter.

AUSTRALASIAN WADER STUDIES GROUP

STATEMENT OF RECEIPTS AND PAYMENTS FOR THE PERIOD 1ST JANUARY, 1986 - 31ST DECEMBER, 1986

RECEIPTS		PAYMENTS	
Balance b/f	148.35	Postage 'Stilt' 7	252.85
Transfer from chq A/c	802.85	Postage 'Stilt' 8	291.95
Subscriptions	3296.21	Printing 'Stilt' 8	511.80
Sale of 'Stilt" back numbers	348.85	Typing 'Stilt' 9	120.00
Payment for insert in "Australian Geographic"	450.00	Printing 'Stilt' 9	486.66
		Postage 'Stilt' 9	328.60
Donation	33.27	Printing Count Sheet & Instructions	73.00
Bank Interest	50.50	Artwork for Letterheads	26.00
Bank Error	1.00	Printing AWSG rules	52.00
		Envelopes	239.93
		Printing 'Stilt' covers and subscription reminders	63.50
		Secretary's expenses	261.31
		Chairman's expenses	40.58
		Treasurer's expenses	20.18
		Bank charges	5.00
		Federal Tax on Debits	3.25
		Govt. Duty	1.95
		Stamp Duty	0.15
		Balance c/f	2352.32
	$5131.03		$5131.03

TREASURER'S REPORT

During the year our cheque account was closed and all funds transferred to our Investment Account in order to attract a more favourable interest rate. Despite a doubling of the subscription rates membership of the AWSG has remained steady in 1986 and revenue from the sale of 'Stilt' back numbers has more than doubled. Whilst it must be noted that 118 members (41% of the 1986 total) had paid their 1987 subscription before the end of 1986, it can be seen that the AWSG is in a sound financial position and although production costs of future 'Stilt' will undoubtedly continue to increase it may well be that AWSG funds will be available for uses other than for production of our bi-annual bulletin.

David Henderson
AWSG TREASURER

INSURANCE COVER FOR AWSG ACTIVITIES.

The Personal Accident and Public Liability sections of the RAOU's insurance policy have been extended to indemnify individuals and groups within Australia acting on behalf, and with the approval, of the AWSG.

Thus, all individuals and groups taking part in the AWSG's Population Monitoring and Regular Count Projects are automatically covered. As are those who take part in activities which the Group organises from time to time, e.g. Hooded Plover Surveys, The Coorong Wader Count, North Western Australia Expeditions.

Undoubtedly, the great majority of wader study activities in Australia would comply with the broad objectives of the AWSG and, thus, be covered by insurance. It is suggested that those individuals and groups involved in studies which are not included in the formal activities of the Group should write to the Administrative Secretary, Mrs Brenda Murlis, and enquire whether their activity is covered.

Voluntary Workers cover is $10,000 for death and a variety of injuries. Public Liability is a maximum of $2 million for a single event and is usually based on a court decision.

ABSTRACTS OF AWSG PAPERS PRESENTED AT THE 87TH RAOU CONGRESS, ADELAIDE DECEMBER 1986.

1: THE USE OF MORPHOMETRIC AND MOULT DATA IN WADER STUDIES.

MARK BARTER 21 Chivalry Ave., Glen Waverley, Vic 3150.

Morphometric and moult data obtained from captured waders are used to gain a better understanding of their ecologies and thus play a critical part in the development of soundly based conservation plans. Typical data collected include bill length, total head length, wing length, weight, progression of primary feather moult and amount of breeding plumage. This information can be used, amongst other things, to determine sexing and aging criteria and establish sex - and - age-related differences within a species, distinguish between races, estimate migration flight range, and study moult strategies. Examples will be given of recent analyses of data obtained from waders caught in Australia, and the ways in which the resulting information can improve our understanding of waders will be discussed.

2: IMPACT OF VEHICLE TRAFFIC ON THE BREEDING BIOLOGY OF THE HOODED PLOVER

ANDREW M BUICK Dept. of Zoology, Univ. of Adelaide, G.P.O. Box 498, Adelaide, S.A. 5001.

Hooded Plovers *Charadrius rubricollis* breed on ocean beaches in southern Australia. Off road vehicles have access to many South Australian beaches and may affect Hooded Plovers in two ways: 1) by interfering with breeding behaviour and/or 2) by running over nests. In the Coorong region Hooded Plovers usually nested on the ocean beach, above high tide mark and close to the base of the frontal dunes. Most nests were within 6m of the base of the foredune. Measurements of the density of vehicle tracks across the beach indicated that over 20% of the beach was run over in a period of a few weeks, with the maximum density of tracks occurring 6m from the base of the foredune. Time budgets indicated that Hooded Plovers incubated eggs for 85% of the day. Passing vehicles did not cause a reduction in nest attentiveness. The potential rates at which nests were run over was measured by deploying painted pigeon eggs in artificial nests. On average 6% of these nests were run over per day. This rate is equivalent to 70% of the nests being run over during the incubation period. Thus the use of off road vehicles on ocean beaches potentially reduces the reproductive outputs of Hooded Plovers.

3: FOOD AND FEEDING OF KNOTS IN NORTH NORWAY IN SPRING

NICOLA J CROCKFORD Dept. of Zoology, University of Durham, Durham DH1 3LE, United Kingdom.

About 15,000 Knots *Calidris canutus* used the recently discovered staging-post at Balsfjord, north Norway, for 2-3 weeks in May 1985, as a final stop-over at which to store fat and protein before flying to North American breeding grounds. This paper reports on the food supply and feeding behaviour of the Knots, and discusses why their distribution within the fjord shifted from that in previous years.

Knots fed chiefly on *Macoma balthica* and preferred large ones. The very late spring in 1985 resulted in more prolonged ice-over on the mudflats particularly at their usual feeding site, Sorkjosen. This caused increased mortality of the larger *Macoma* through oxygen starvation at this site. High predation pressure at Sorkjosen, in conjunction with reduced densities of large *Macoma*, resulted in relatively better feeding conditions elsewhere in the fjord. Such periodic deterioration in feeding conditions may have important consequences for the success with which waders can use such far northern stop-overs in spring.

4: RADAR STUDIES OF WADER MIGRATION AT BROOME, WESTERN AUSTRALIA

BRETT LANE Royal Australasian Ornithol-ogist's Union, 21 Gladstone Street, Moonee Ponds, VIC 3039.

In March and April 1985, and in April, August, and September 1986, the RAOU organised wader study expeditions to north-western Australia. During these expeditions, the Bureau of Meteorology's WF 44 weather radar at Broome was used to observe migrating flocks of waders. Roebuck Bay, near Broome, is one of the major arrival and departure points for palearctic-breeding waders that migrate to and from Asia each year. The aim of the work was to determine the direction of departure and arrival of migrating flocks, and to discover if there was any correlation between migratory movements and weather conditions. The results of this work, together with those from banding and counting studies, presented in this paper, has provided much insight into the migratory behaviour of waders in northern Australia and nearby south-east Asia.

PRELIMINARY REPORT ON THE COORONG WADER COUNT, FEBRUARY 1987.

On February 7th and 8th, thirty South Australian and Victorian wader enthusiasts co-operated to obtain a count of waders in the Coorong.

Prior to the ground count, an aerial survey was carried out on the 6th in order to determine the locations of the major wader concentrations. The counters were split up into eight teams which covered allocated sections of the lagoon shores on foot, in cars and in boats.

Virtually ideal weather conditions enabled the exercise to proceed with few problems. Preliminary results gave a total count of around 130,000 waders of 22 species, the most common being Sharp-tailed

Sandpipers, Red-necked Stints, Curlew Sandpipers and Banded Stilts. Of the rarities, three Red-necked Phalaropes (seen together) and one Cox's Sandpiper deserve mention.

The count total is about 100,000 less than the most recent previous attempt and this is probably due to the birds dispersing over the large amount of alternative habitat created by the wet spring and early summer in south-eastern south Australia. A future count during a drought period would provide an interesting comparison.

A report is in preparation and it is hoped that all or part of this will be included in a future edition of The Stilt.

Mark Barter.

REGULAR COUNTS PROJECT REPORT, DECEMBER 1986.

RICHARD ALCORN, 17 Lawrence Street, Horsham 3400, Victoria.

Introduction

This is the first report on the Regular Counts Project of the AWSG. This five-year project, which began in January 1986, aims to

1. determine the timing of arrival, departure and migration of migratory species and flocking in resident species.

2. monitor the effects of rainfall patterns on the movements of inland resident species.

This report covers the first 6 months of the project, from January to June 1986. This report is not a detailed analysis of the data, but a summary of the state of the project together with a few comments on selected species and sites.

Some of the data and analysis techniques from the RAOU Wader Studies Project have been used in this report.

Participants

37 wader counters surveyed 41 sites, mostly on a monthly or more frequent basis.

Species

Data were collected on almost all Australian waders (Table 1).

Table 1

Species recorded January - June 1986 for the Regular Counts Project.	
Bush Thick-knee	Whimbrel
Beach Thick-knee	Little Curlew
Painted Snipe	Wood Sandpiper
Pied Oystercatcher	Grey-tailed Tattler
Sooty Oystercatcher	Wandering Tattler
Masked Lapwing	Common Sandpiper
Banded Lapwing	Greenshank
Grey Plover	Marsh Sandpiper
Lesser Golden Plover	Terek Sandpiper
Red-kneed Dotterel	Latham's Snipe
Hooded Plover	Black-tailed Godwit
Double-banded Plover	Red Knot
Large Sand Plover	Great Knot
Red-capped Plover	Sharp-tailed Sandpiper
Black-fronted Plover	Pectoral Sandpiper
Black-winged Stilt	Red-necked Stint
Banded Stilt	Long-toed Stint
Red-necked Avocet	Curlew Sandpiper
Ruddy Turnstone	Sanderling
Eastern Curlew	Broad-billed Sandpiper
	Australian Pratincole

SPECIES NOTES

Common Sandpiper, *Tringa hypoleucos*

This species is an example of an uncommon species recorded throughout the continent, and at all times of the year. The Common Sandpiper was recorded at 5 sites over the January-June 1986 period. (Table 2).

Table 2
Common Sandpiper records, January - June, 1986.

Site	Peak Number	Month
Prospect Estate, N.S.W.	4	Jan
Wilsons Inlet, W.A.	1	Jan
Lake Yangebup W.A.	1	Jan
Kanidal Beach, W.A.	52	April
	2	May
Bakers Creek, Far Beach, QLD.	1	June

The April record at Kanidal Beach is notable, as the Common Sandpiper is usually recorded in "loose groups of less than five" in Australia", Blakers et al (1984).

For species like the Common Sandpiper, monthly surveys at any one site must be continued for a long time, perhaps a decade or two, before any trend in movements can be identified with certainty. Prospect Estate and Kanidal Beach are two sites that have been surveyed regularly for several years, and where several sightings have been made of Common Sandpipers.

Red-necked Avocet, *Recurvirostra noveahollandiae*

The Red-necked Avocet is normally restricted to Australia, and is rarely seen in Tasmania. It is rarely reported east of the Great Dividing Range, Blakers et al (1984)

Table 3

Monthly Peak Counts for each locality where Red-necked Avocets were recorded, and for which more than 4 counts were made, for the period January to June 1986.

	Site	Jan	Feb	Mar	Apr	May	Jun
Southern W.A.							
	Wilsons Inlet	0	30	2880	454	341	205
	Lake Forrestdale	41	0	0	0	0	0
Inland SE Australia.							
	Dangar's Lagoon	-	-	10	1	1	0
	Fivebough Swamp	21	18	41	78	99	76
	Nericon Swamp	0	-	0	72	52	-
	Parkes Sewage Farm	-	-	2	3	2	10
	Lake Merreti	9	22	48	28	-	-
	Bitter Swamp	0	13	0	-	0	0
	Hattah Lakes	10	36	68	95	25	142
Eastern Queensland.							
	Kinka Bch.	0	0	0	48	3	15
	Deception Bay	-	-	11	2	248	100
	Bowen Salt Works	-	-	0	0	0	7
	Toomba Lake	1	0	1	7	6	0

Table 3 does not show a pattern of general movement in and out of the Southern WA or South-East Australian region for the period in question. Rather, the data indicates frequent movement of flocks between wetlands, but whether the birds generally move short or long distances is not known.

The Queensland records indicate a general movement of a moderate number of Avocets into the coastal strip as far north as Bowen. Atlas records for the period 1977 - 1981 were for no further north than Rockhampton. These birds may have been part of a dispersal of Avocets from the large breeding colonies on Lake Eyre as it dried late in 1984, Lane (1984).

Red-necked Stint, *Calidris ruficollis*

Red-necked Stints are the most abundant migratory wader in Australia, Lane et al (1985) and were recorded from many sites in the period January to June 1986. Of particular note was the large passage of approximately 15,000 Red-necked Stinte through Wilsons Inlet, W.A. in April, presumably on northward migration. Where did they come from? Southern Western Australia does not hold large numbers of stints during summer (numbers of Red-necked Stinte recorded for the whole of Western Australia during the Wader Studies Program summer counts from 1982-1985 were 2754, 7451, 19,639 and 11,878) Lane et al, (1985). Wherever these birds have come from, further records may confirm that Wilsons Inlet is an important staging post for a portion of the Red-necked Stint population on northward migration.

Future directions of the project

The next task is to improve geographical coverage of the continent as a whole, particularly in the Northern Territory and Western Australia, and also in South Australia, Victoria and Tasmania. Also, coverage of at least one site in each of the principal wader areas as identified during the RAOU Wader Studies Project will be sought.

If you are interested in joining this project, please contact Richard Alcorn at the above address.

Acknowledgements.

Thanks goes to Lisa Barter, who spent many days entering data, to Brett Lane for much help and many ideas, and to all the participants for providing their valuable data so promptly.

References.

BLAKERS,M., DAVIES,S.J.J.F., & REILLY.P.N.,1984. The Atlas of Australian Birds, Melbourne: Melbourne Univ. Press.

LANE,B., 1984. Report on a trip to Lake Eyre North. RAOU.

LANE B. et al. 1985. National Wader Count reports, 1982-1985. RAOU.

LETTER TO THE EDITOR OF 'THE STILT'.

Studies of wader species which breed in Australia.

To date, wader studies in Australia have placed emphasis on the study of migrant species which breed outside Australia. This emphasis was timely, as these species tend to congregate in large numbers in a limited number of preferred locations. Through systematic count and banding programmes these areas, previously unknown in most cases, have now been identified.

All those that have contributed can take pride in the recent publication of 'Shorebirds in Australia', which provides an inventory of resources vital to migrant waders. This publication will provide a sound basis for arguing the conservation needs of these species.

In contrast, the life histories and conservation requirements of our breeding waders are less well defined. Perhaps the time has come for the AWSG programme to place greater emphasis on our breeding species.

O.M.G. Newman on behalf of the Tasmanian Shorebird Study Group.

TWO NEW WADER BIBLIOGRAPHIES:

Available from Ottenby Bird Observatory, in Sweden. Volume 3 of the special report series contains 1364 listed references to the genera *Calidris* and *Limicola*, (price: U.S. $7.00). Volume 4 contains 394 listed references to the genus *Phalaropus*,(Price: U.S. $4.00). Both prices include surface mail postage. For air mail postage, add (U.S. $1.00) Please, make your specified order payable by international bank check or money order to:

Ottenby Bird Observatory
Pl. 1500
S-380 65 Degerhamn
Sweden.

CATCHES OF SHOREBIRDS DURING THE AUG-SEPT 1986 NORTH-WEST AUSTRALIA SHOREBIRD STUDY EXPEDITION

LOCATION	SPECIES	NEW	R/TRAP	TOTAL
17/8/86				
Roebuck Bay	Red-necked Stint	21	-	21
		21	-	21
20/8/86				
Roebuck Bay	Red-necked Stint	47	-	47
	Curlew Sandpiper	43	1	44
	Mongolian Plover	1	-	1
		91	1	92
27-8/8/86				
Port Hedland				
S/W	Red Knot	1	-	1
	Sharp-tailed Sandpiper	1	-	1
	Red-necked Stint	2	-	2
	Curlew Sandpiper	5	2	7
	Broad-billed Sandpiper	5	-	5
	Mongolian Plover	1	-	1
		15	2	17

2/9/86				
Roebuck Bay	Large Sand Plover	1	-	1
		1	-	1
5/9/86				
Roebuck Bay	Ruddy Turnstone	4	-	4
	Mongolian Plover	1	-	1
	Large Sand Plover	16	5	21
	Grey-tailed Tattler	2	-	2
	Red-necked Stint	13	1	14
		36	6	42
7/9/86				
Eighty Mile Bch	Large Sand Plover	1	-	1
	Red-necked Stint	1	-	1
		2	-	2
8/9/86				
Eighty Mile Bch	Red-necked Stint	58	-	58
	Curlew Sandpiper	69	2	71
	Great Knot	1	-	1
	Red Knot	1	-	1
	Broad-billed Sandpiper	1	-	1
	Ruddy Turnstone	2	-	2
	Red-capped Plover	3	-	3
	Terek Sandpiper	10	-	10
	Large Sand Plover	13	-	13
	Grey-tailed Tattler	7	-	7
		165	2	167
10-11/9/86				
Port Hedland S/W	Curlew Sandpiper	3	-	3
	Large Sand Plover	1	-	1
	Great Knot	3	-	3
	Mongolian Plover	1	-	1
	Bar-tailed Godwit	6	-	6
	Sharp-tailed Sandpiper	3	-	3
	Broad-billed Sandpiper	11	-	11
	Red-necked Stint	9	-	9
		37	-	37

SUMMARY OF CATCHES

Red-necked Stint	151	1	152
Curlew Sandpiper	120	5	125
Large Sand Plover	32	5	37
Broad-billed Sandpiper	17	-	17
Terek Sandpiper	10	-	10
Grey-tailed Tattler	9	-	9
Ruddy Turnstone	6	-	6
Bar-tailed Godwit	6	-	6
Great Knot	4	-	4
Sharp-tailed Sandpiper	4	-	4
Mongolian Plover	4	-	4
Red-capped Plover	3	-	3
Red Knot	2	-	2
TOTAL	368	11	379

NOTES FROM THE R.A.O.U. LIBRARY.

Members of A.W.S.G. are welcome to use the R.A.O.U. collections of books and periodicals in the Library, but to borrow materials you need to be a member. You will then be entitled to photocopy at the member rate of 10 cents per sheet, as opposed to non-member rate of 20 cents per sheet. Our photocopier has a reducing facility which is very useful when photocopying some articles, since 2 pages will fit onto 1 sheet with slight reduction.

Materials may be borrowed for one month, and we would prefer that you photocopy specific articles from journals rather than they are out of the collection on loan. For those who are not able to make a personal visit to the library, we accept written requests for particular articles to be photocopied at the appropriate rate plus postage. Books may also be borrowed by members - we pay the outward mail (certified) and you pay the return mail (also certified).

So, there are definite advantages in being a member of the R.A.O.U. as well as the A.W.S.G. You may even be lucky enough to strike the one day of the week the honorary librarian spends among all that ornithological literature.

One of our latest very useful items is the AVES section of The Zoological Record, e.g. Vol. 120, 1983. was published in 1985. This is a serial which we exchange with the Zoological Society of London and is an annual volume which gives an index to the ornithological publications appearing worldwide in a particular year. In fact, there are 4 indexes - (1) author (2) subject (3) geographical (4) systematic. e.g. there are 2+ pages of entries in the systematic index on Charadriiformes.

Looking forward to meeting or corresponding with other A.W.S.G. people.

Patricia White,
Hon. Librarian.

TITLES ADDED TO THE R.A.O.U. LIBRARY IN 1986.

Australian Littoral Society. An Investigation of Management Options for Towra Point, Botany Bay.

Barnard, C.J. & Thompson, D.B.A. Gulls and Plovers - The Ecology and Behaviour of Mixed-Species Feeding Groups. Groom Helm, London, 1985. (Studies in behavioural adaptation).

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AGING OF WADERS

Recently there has been some discussion concerning which anniversary date should be used for the aging of palearctic-breeding waders. Obviously, it is important that all banding groups use the same date for the sake of consistency.

When the new aging system was introduced some four years ago it was agreed at the time that the anniversary date should be August 1st. For reasons of uniformity and ease of data interpretation all banding groups should adhere to this date.

Mark Barter.

COLOUR-BANDED HOODED PLOVERS.

Hooded Plovers are being colour banded on Kangaroo Island, S.A., in an effort to establish dispersal patterns, movement and other studies, particularly of the locally bred immatures. Commenced on 28th May 1986, Hooded Plovers have been banded with two colour bands on the left tarsus and one colour over metal band on the right tarsus. Sightings of colour banded birds should be reported to, and would be appreciated by A.F.C. Lashmar, P.O. Box 503, Penneshaw, Kangaroo Island, S.A., 'phone (0848) 31021, or T.E. Dennis, P.O. 39, Kingscote, K.Is., S.A., (0848) 22667, A/H (0848) 22381, stating the colour-band combination, locality, date and observer. The colours used are Red, Dark Blue, Light Green, Yellow, Orange and Black. Colour banding is continuing.

Note that Ospreys and White-bellied Sea Eagles are also being colour banded on the island.

Allen Lashmar

DOUBLEBANDED PLOVER FINALE

The co-operative study of Doublebanded Plovers undertaken by Ray Pierce (assisted by many members of the Ornithological Society of New Zealand and the Victorian Wader Study Group (assisted by other AWSG members) has entered the final phase of the intensive fieldwork programme.

The assistance of all AWSG members who live in (or visit) areas frequented by Doublebanded Plovers is sought to help look for colour banded birds during the period March to August 1987.

More than 1,200 Doublebanded Plovers have been colour banded (many with individual combinations) during the last two summers in New Zealand. In addition, 730 were colour banded (different code for each of the six sites) in Victoria in the 1986 winter. 52 birds with New Zealand colour bands were seen in Australia last winter but the New Zealanders have capped this by finding 86 of our colour banded birds between August 1986 and early January 1987. 64 of these were at breeding sites and 24 in post breeding moulting flocks.

We need another 50-100 N.Z. birds in Australia this winter to produce enough data to make our results conclusive. So please get looking! Information required is -

Colour combinations (including metal) on each leg;
Site and date;
Number of birds present and number checked for bands.

Please note that individual birds may have up to three different colours (plus a metal band) and up to six colour bands in total (i.e. there is sometimes more than one band of the same colour). It is important to note the order of the bands on each leg (i.e. which is topmost, etc.)

Participants will be interested to know that the fairly clear pattern which was beginning to emerge from last year's results has been strongly reinforced by the sightings from New Zealand this spring/summer. It appears that it is predominantly the Doublebanded Plovers breeding in the centre of the South Island of New Zealand (mainly on high ground) which migrate to Australia for the winter. Those breeding on lower ground around the perimeter of the South Island, and those breeding in the North Island, appear to remain largely within New Zealand throughout the winter. An illustration of the above comes from results on the Cass River Delta, Lake Tekapo (centre of South Island and Ray Pierce's principal study area) where nearly 10% of the birds have Australian bands whereas examination of 1,300 birds breeding in North Island failed to produce a single Australian-banded bird.

So every effort please from everyone, in south eastern Australia particularly!

Please send all sightings to -

Clive Minton
165 Dalgetty Road,
Beaumaris. Vic. 3193.

Tel: (03) 589 4901 (home)
(03) 616 7301 (work)

PUBLICATION OF 'AN OCCASIONAL STINT' NO.4

The Tasmanian Shorebird Study Group has published the fourth issue of 'An Occasional Stint' and is now available. The cost is Aus. $7, including postage. Please make cheque or money order payable to 'The Shorebird Study Group' and send your order to Mrs. P. Park, Campania, Tasmania 7026.

Back issues of 'An Occasional Stint' Nos. 1 to 3 are also available.

SORTING THEM OUT: SHORT NOTES FOR THE FIELD IDENTIFICATION OF WADERS

Unfortunately it was not possible to provide species descriptions for this issue of 'The Stilt'. However, it is hoped that several descriptions can be prepared for the October 'Stilt'. Many of the wader species in Australia, New Zealand and South-East Asia have been nominated for short descriptive notes useful for field identification and several people have been approached to prepare this material. If you have suggestions for species that need such descriptions please write to me and I will endeavour to see that the descriptions are prepared. If you are willing to produce such descriptions please forward these to me as soon as possible.

Eric Woehler, Editor.

WANDERING WADERS: October 1986 to February 1987.

The following reports have been received by either myself or the regional representatives. In future, please pass on any records of unusual numbers and/or species or sightings of colour-dyed birds etc. to either the regional representative or directly to The Editor for inclusion in this section.

WESTERN AUSTRALIA

1 Red-necked Phalarope, Rottnest Island, October 1986.
70 Oriental Plovers, Eyre Bird Observatory 15 January, 1987.

SOUTH AUSTRALIA

2 Cox's Sandpipers, ICI Saltworks, Nov-Dec. 1986.
1 Hudsonian Godwit, ICI Saltworks c.Sept-Oct.1986.
1 Little Stint, ICI Saltworks, 13 December, 1986.
1 Long-toed Stint, ICI Saltworks, 13 December,1986.

VICTORIA

1 Cox's Sandpiper, Werribee Sewage farm, November 1986.
1 female Red-necked Phalarope in full breeding plumage,Werribee Sewage farm and Altona Saltworks, Oct-Dec.1986.
2 Ruffs, Lake Bolac, ? 1986.
1 Ruff (imm.),Werribee Sewage farm mid-Oct.1986.

TASMANIA

1 Common Sandpiper, West Bay, South Arm Neck 25 November, 1986.

Subscription rates for 1987 are AUS$10 and AUS$15 for overseas members.

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Please notify Administrative Secretary of any change of address.

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BIOMETRICS, MOULT AND MIGRATION OF DOUBLE-BANDED PLOVERS *CHARADRIUS BICINCTUS BICINCTUS* SPENDING THE NON-BREEDING SEASON IN VICTORIA

Mark Barter, 21 Chivalry Ave., Glen Waverley, Vic. 3150.
Clive Minton, 165 Dalgetty Rd., Beaumaris, Vic. 3193.

SUMMARY

An analysis has been carried out of data obtained from approximately 2000 Double-banded Plovers *Charadrius bicinctus bicinctus* caught by the Victorian Wader Study Group. Results are given by sex and age group for wing, total-head and bill-lengths, and for weight and moult into breeding plumage. Information on sex ratio, breeding success, wintering-site fidelity and migration is also included. On average, adult males are larger and heavier than females of the same age group, whilst adults, as a group, are larger than first-year birds. There are differences between the adult sexes, and between adult and juveniles with respect to moult into breeding plumage, timing of pre-migratory fattening and departure dates. Females appear to be more common than males. Both adults and first-year birds exhibit high wintering-site fidelity.

INTRODUCTION

Double-banded Plovers breed in New Zealand. Part of the population remains there during the non-breeding season but a significant proportion migrates across the Tasman Sea to spend the winter in south-eastern Australia. Birds arrive during February to April and depart in July and August.

The only formal estimate of the population of the nominate sub-species *C.b.bicinctus* has resulted in an estimated minimum number of 12,500 birds, based on winter counts of 7500 in New Zealand and 5000 in Australia (Sagar 1986). However, more recent data suggests that the actual population may be significantly greater. The sedentary sub-species *C.b.exilis* is restricted to Auckland Island to the south of New Zealand and is believed to number approximately 160 birds (Pierce 1980).

The Victorian Wader Study Group has been banding the species since 1976 and during the period to September 1986, has handled 1993 plovers comprising 1732 new birds and 261 retraps.

Regular catches have been made at three sites in Port Philip Bay (Werribee Sewage Farm/Point Wilson, Point Cook and Queenscliff), at Yallock Creek, in Westernport Bay, and at Point Smithe, Inverloch. Two catches each have been made at Stockyard Point, in Westernport Bay, and at Barry Beach, Corner Inlet. Recently, the catching programme has been increased in order to complement an intensive New Zealand study of the species. Thus, in 1986 the VWSG caught 733 plovers which is almost three times more than the previous highest annual total.

Very limited biometric information is available for Double-banded Plovers (see Hayman et al 1986) and the information given here is the first to be based on large sample numbers. Other subjects covered include moult into breeding plumage, migration, breeding success, non-breeding site fidelity and longevity.

METHODS

Double-banded Plovers generally assemble at high-tide in loose flocks and are difficult to catch in large numbers. During the ten year period of the study, 51 cannon-net catches were made where the prime objective was to obtain Double-banded Plovers. Catches were mainly in the range 20 to 55 birds, with an average size of 38. The largest catches were 105 and 167 birds, both of these being achieved in 1986. Birds were mainly caught during the period April to mid-August, with extreme dates of 1st March and 17th August, apart from one bird on September 13th.

Biometric data was obtained using standard methods and birds were aged and sexed by plumage. First-year birds can be identified by the off-white fringing of inner wing covert feathers compared to broad buff fringes in adults. Sexing is only possible when moult into breeding plumage is advanced, i.e. July onwards. Males have a broader and blacker upper breast band than female birds and also have a chestnut-brown lower breast band compared with an orange-brown band in females. Males also possess a black band extending from the base of the bill through the eye, whilst in females the band is mid-to-dark-brown.

RESULTS AND DISCUSSION

Wing Length, Total Head Length and Bill Length

Wing length data is given in Table 1. Wings were measured to the nearest whole millimetre.

AGE	SEX	SAMPLE SIZE	MEAN (mm)	STANDARD DEVIATION
ADULT	-	1299	130.7	3.1
"	M	357	131.3	3.2
"	F	382	130.1	3.2
FIRST-YEAR	-	279	127.7	3.2
"	M	84	127.9	3.4
"	F	73	126.7	3.2

Table 1. Average wing-length data for adult and first-year birds, unsexed and sexed.

On average, male birds have longer wings than females, i.e. 131.3 vs 130.1mm for adults and 127.9 vs 126.7mm for first year birds, and adults have longer wings than first-year birds, i.e. 130.7 vs 127.7mm. The wing length differences are significant between male and female adults ($p<0,995$), male and female first-year birds ($p<0.025$) and the same sex at different ages (both $p<0.005$). However, the degree of overlap in all instances is too great to allow satisfactory sexing to be achieved on the basis of wing-length. The relatively short wing-length of sexed first-years compared to un-sexed birds is caused by the fact that sexing is only possible during July and August, when average wing lengths will be more shortened by wear than earlier in the winter.

Total head-length data is given in Table 2. Measurements were taken to the nearest 0.1mm.

AGE	SEX	SAMPLE SIZE	MEAN (mm)	STANDARD DEVIATION
Adult	-	455	46.5	1.1
"	M	134	46.9	1.0
"	F	127	46.4	1.0
First-Year	-	92	46.5	1.1
"	M	27	46.6	1.2
	F	18	46.7	1.6

Table 2. Average total head-length data for adult and first-year birds, unsexed and sexed.

The total head-length of adult males (46.9mm) is significantly greater than that of female birds (46.4mm) ($p<0,005$).

The differences between male and female first-years (46.6 vs 46.7mm) and between the same sex at different ages are not significant (p>0.05). However, larger samples may allow significant age and sex differences to be established.

Bill length data is given in Table 3, measurements being taken to the nearest 0.1mm.

AGE	SEX	SAMPLE SIZE	MEAN (mm)	STANDARD DEVIATION
Adult	-	324	17.3	0.9
"	M	68	17.1	0.7
"	F	61	17.1	0.8
First-Year	-	73	17.4	0.9

Table 3. Average bill length data for unsexed and sexed adults and unsexed first year birds.

The difference in bill-length between adult and first year birds (17.3 vs 17.4mm) and between the adult sexes (both 17.1mm) are not significant (p>0,05),

The apparently shorter bill length of sexed birds is probably due to replacement of worn feathers at the base of the bill as birds moult into breeding plumage, which is the only time that they can be satisfactorily sexed.

Weight

Weight data by age and sex, from March to August, is plotted in Fig 1., and data from re-trapped individuals is shown in Fig 2.

The mean and standard deviation of weight of adults immediately following arrival is 55.0± 4.0g (March and first-half April), with the lightest adult being 42g. Adults then gain weight to reach an early winter (second-half May to first-half July) average of 59.4± 3.9g. Fattening commences in the second-half of July and adults attain an average weight of 73.7±8.8g in the second week of August with the heaviest bird being 91g.

The average difference in weight between male and female adult birds during the period that they can be sexed, i.e., July and August, is 1.0g, with males being the heavier. The weight difference is consistent throughout this period and is in conformity with the generally larger dimensions of males.

First-year birds are generally lighter than adults throughout their stay in Australia and average 57.1±3.6g in mid-winter (vs 59.4g for adults).

They do not appear to commence fattening until early August and the average weight for the second week of August is 63.0±7.6g (vs 73.7g for adults). During this period males average 64.2g (n=48) and females 61.7g (n=44).

Individual retrap data (see Fig 2) confirms the gain in weight of adults between arrival and mid-winter and the sharp increase in weight from mid-July onwards. The first-year retrap data also confirms that this age-group commences fattening later than adults.

The weight percentage frequency histograms for adult birds in the majority of the major catches (i.e. >20 birds, except for the last catch) in 1986 are shown in Fig 3. The lighter weights in late Match and the first-half of April are evident, with birds attaining a higher and relatively constant weight from late April to early July. Substantial weight gains do not appear to commence until the second half of July. The greater range of weights shortly after arrival (late March) and during pre-migratory fattening, compared to those in mid-winter, is due to birds being at different stages of recovery from, or preparation for, migration.

Moult into Breeding Plumage

The degree of breeding plumage was assessed subjectively in percentage terms for each captured bird and the catch averages are shown in Fig 4. It can be seen that adults as a group moult into breeding plumage before first-year birds and that males of both age groups are in advance of females. Adult males commence moulting in May and appear to attain breeding plumage at a constant rate, whereas females of the same age group commence moult in June and develop breeding plumage at an accelerating rate, reaching the same level as males by early-to mid-August. Both sexes seem to reach full, or near full, breeding plumage prior to departure for New Zealand.

First-year birds do not start moult until July but have substantially caught up with the adults by the first-half of August.

All first-year birds moult into breeding plumage and return to New Zealand during the breeding season, unlike many of the arctic-breeding waders in which the first-years remain in non-breeding plumage and stay in Australia during their first breeding season.

Sex Ratio

Determination of the overall sex ratio is difficult to achieve because it is possible that some birds could be leaving for New Zealand by the time that all adults can be confidently sexed, i.e. late July onwards. Thus, if one sex leaves earlier than the other the ratio would not correctly reflect the mid-winter situation. However, data for 1981-1985 combined, and 1986 alone, which is presented in Tables 4 (a) and (b), provides some evidence that adult females outnumber males, although the data for the first week of August for the 1981-85 period is contrary to the trend. The higher percentage of females is more evident in 1986 than during the 1981-85 period. The data for first-year birds is insufficient to allow any conclusions to be drawn.

The data does not indicate the earlier departure of one of the sexes. The ratios for the second week of August in both Tables are not significantly different form those in first Or second-half of July (p>0.05).

PERIOD	ADULT		FIRST-YEAR	
	MALE %(n)	FEMALE %(n)	MALE %(n)	FEMALE %(n)
First-half July	48 (16)	52 (17)	-	-
Second-half July	41 (19)	59 (27)	-	-
First-week August	59 (97)	41 (67)	-	-
Second-week August	46 (37)	54 (43)	52 (48)	48 (45)

Table 4 (a) Percentages of each sex, by age, during the period 1981-85.

PERIOD	ADULT		FIRST-YEAR	
	MALE %(n)	FEMALE %(n)	MALE %(n)	FEMALE %(n)
First-half July	37 (35)	63 (59)	-	-
Second-half July	38 (53)	62 (86)	-	-
First-week August	-	-	-	-
Second-week August	45 (36)	55 (44)	44 (30)	56 (38)

Table 4 (b) Percentages of each sex, by age, in 1986.

Breeding Success

The percentages of first-year birds caught in May and June, during the period 1981-1986, are given in Table 5. The months of May and June were chosen because the population could be expected to be reasonably stable at that time and not affected by varying arrival and departure times of the two age groups.

YEAR	No.of first-years in May & June	Total No of Birds	%first-year
1981	20	114	17.5
1982	5	29	17.2
1983	5	29	17.2
1984	12	114	10.5
1985	6	49	12.2
1986	9	146	6.2
		AVERAGE =	11.9

Table 5. Percentages of first-year birds caught in May and June in the years 1981-86.

The average percentage of first-year birds during the 1981-86 period is 11.9% and varies on an annual basis from a low of 6.2% in 1986 to a high of 17.5% in 1981.

The 1986 figure was obtained from three catches at two sites. The inclusion of three further catches made in late April and early July at an additional three sites, making five in all, gives an overall percentage of 5.7% (n=249), which confirms the percentage based on May and June data alone.

The obvious conclusion that the 1985-86 breeding season was very poor is at variance with reports from New Zealand that it was, in fact, a good season (Ray Pierce, pers. comm.). Additionally, the percentages of first-year birds caught at the beginning and end of the wintering period were much greater in 1986 than the averages for the 1981-85 period, as is shown in Table 6.

1981/85					
MARCH	APRIL	MAY	JUNE	JULY	AUGUST
4 (26)	11 (38)	14 (234)	16 (101)	13 (194)	15 (372)
1986					
20 (64)	19 (72)	6 (33)	6 (113)	21 (301)	42 (161)

Table 6. Percentages of first-year birds by month. ( )= sample size).

It is possible that first-year birds in 1986 may have collected at sites not included in the late April-early July catches, and in fact a total catch of 203 birds handled at Queenscliff on 19-20th July contained 30% first-years. Unfortunately, no catches were made at Queenscliff during the May-June period. However, data obtained during the 1981-85 period at four of the major study sites does not indicate that any of these areas, including Queenscliff, are favoured by first-year birds.

There is obviously a need for further work to be carried out on the movements of first-year birds.

Site Fidelity

Only six birds (four adults and two first-years) out of 241 retraps investigated were found to have moved from the original catching site.

All movements were between seasons, none being during a single season. Of these movements, five were intra-bay (three within Port Philip Bay, two within Westernport Bay) with distances ranging from 12 to 49km and one was from Barry Beach, Corner Inlet, to Altona, Port Philip Bay, a distance of 155 km.

A small number of movements (less than 3%) indicate that Double-banded Plovers show high wintering-site fidelity.

This conclusion is supported by re-sightings of colour banded and/or dyed birds which, during the period 1980-86 resulted in five movements, the longest being 55km. Approximately 1900 birds were colour marked. Interestingly, three of these movements were within the same season.

Longevity

Use of a capture - recapture model, such as that described by Harris (1983), requires that there be a sufficient number of successful recapture attempts at the same site in subsequent seasons, following an initial large capture and banding exercise. Unfortunately, this requirement has not been met to date, but a large catch at Queenscliff in 1986 may allow a longevity value to be calculated if satisfactory catches can be made there in future years.

To date, the oldest recaptured bird originally caught as an adult is over seven years old (17/6/79 - 5/7/86) and the oldest original first-year is over six years old (14/6/80 - 20/7/86).

In 1986, 26% of those recaptured adults which were banded in a previous season were five years of age or older. For first-year birds the equivalent value is 29%.

Migration

The distance from the major catching sites to the breeding areas in South Island (e.g. Lake Tekapo) is approximately 2300 km. Use of the Summers and Waltner (1979) flight distance equation, with the assumptions of lean weights of 55.8 and 53.7g (6% fat index) for adult and first-year birds, respectively, and an average flight speed of 75 km/h, shows that adults require a minimum departure weight of 71.9g and first-years, 69.4g, in order to just fly the distance.

The percentages of birds, in a sample of catches, which are capable of flying 2300 km are shown in Table 7. The catches were selected on the criteria of large size (n>30), except for the late catch on 16/8/86 which comprised 11 birds, and spread of dates.

DATE	ADULT	FIRST-YEAR
28/6/86	0	0
5/7/86	0	0
10/7/82	0	0
19-20/7/86	6	2
6/8/83	31	0
9-10/8/86	57	2
11/8/84	67	56
16/8/86	36	15

Table 7. Percentages of birds which can fly 2300 km, based on adults = 72g or greater and first-years =69g or greater.

The results show that few adult birds are capable of flying 2300km until late in July. However, the percentage of adults able to fly the distance successfully increases very quickly during the first half of August. The percentages are subject to the continuous departure of birds with sufficient weight for successful migration and the sharp drop on the 16/8/86 could be due to this factor.

The percentage of first-year birds capable of flying 2300km is always less than that of adults, indicating that first-years commence putting on weight after adults and migrate at a later date.

CONCLUSIONS

(a) The average wing-lengths of adult male and female Double-banded Plovers are 131.3 and 130.1mm, respectively, and of first-year males and females are 127.9 and 126.7mm. The differences between the sexes at the same age and the same sex at different ages are significant, but the overlap is too great to allow satisfactory sexing on the basis of wing-length.

(b) The average total head-lengths of adult males is significantly greater than females, i.e. 46.9 vs 46.4mm. Differences between the sexes for first-year birds and between the two age groups are not significant for the available sample sizes.

(c) Both male and female adult bill-lengths are the same at 17.1mm. Differences between the age groups are not significant.

(d) The average mid-winter weight of adult and first-year birds is 59.4 and 57.1 respectively. Adults commence pre-migratory fattening in the second half of July and reach an average weight of 73.7g in the second week of August, whilst first-year birds do not start gaining weight until early August and have reached 63.0g by the second week of August. Adult males are on average 1.0g heavier than females of the same age.

(e) Adult males commence moult into breeding plumage in May and females start in June. Both sexes reach full, or near full, breeding plumage prior to departure. First-year birds start gaining breeding plumage in July, but moult quickly and have substantially caught up with the adults by mid-August.

(f) Adult females appear to outnumber males. There is insufficient data to allow any conclusions to be drawn for first-year birds.

(g) The average percentage of first-year birds in all catches in May and June over the 1981-86 period is 11.9%. The 1986 data indicates that the 1985-86 breeding season was a poor one, but this conclusion is at variance to reports on breeding success, received from New Zealand and to results of catches containing higher than normal numbers of first-year birds at the beginning and end of the wintering season.

(h) Double-banded Plovers exhibit high wintering-site fidelity with only six out of 241 retraps involving movement, all except one being within the same bay. Limited movements of colour marked birds support this conclusion.

(i) Substantial numbers of adults are capable of flying the 2300km to New Zealand's South Island by early August. However, first-years do not reach this situation until mid-August.

ACKNOWLEDGEMENTS

Our thanks are due to the many VWSG colleagues who over the years have braved Victoria's winter in order to collect the data on which this paper is based. We would also like to thank Karen Barter for typing the various drafts.

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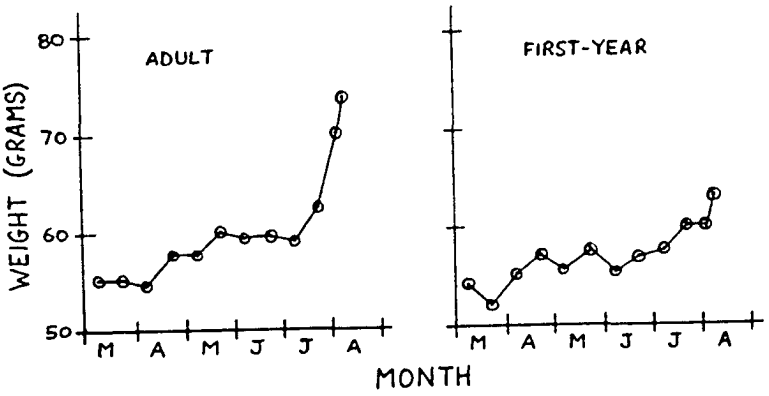

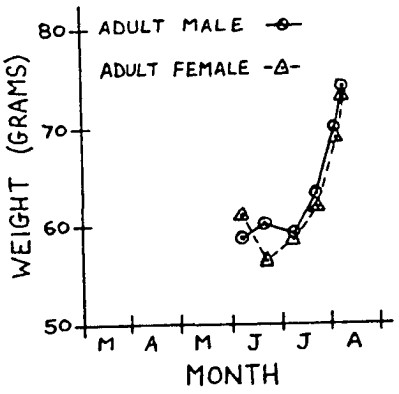

Fig 1. Average weights by age and sex from March to August. (Data is fortnightly except for August, when it is weekly).

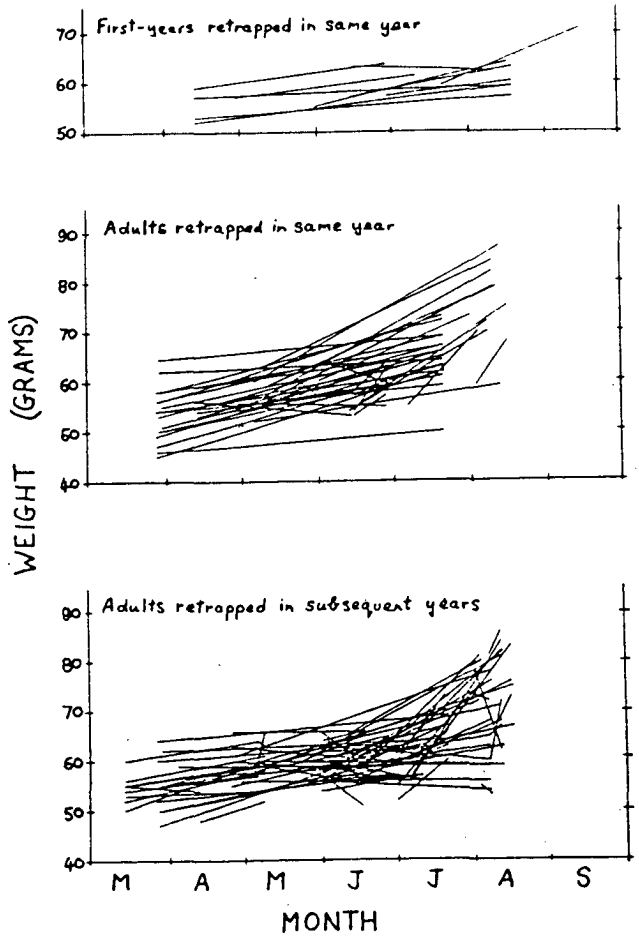

Fig 2. Weight changes in re-trapped birds

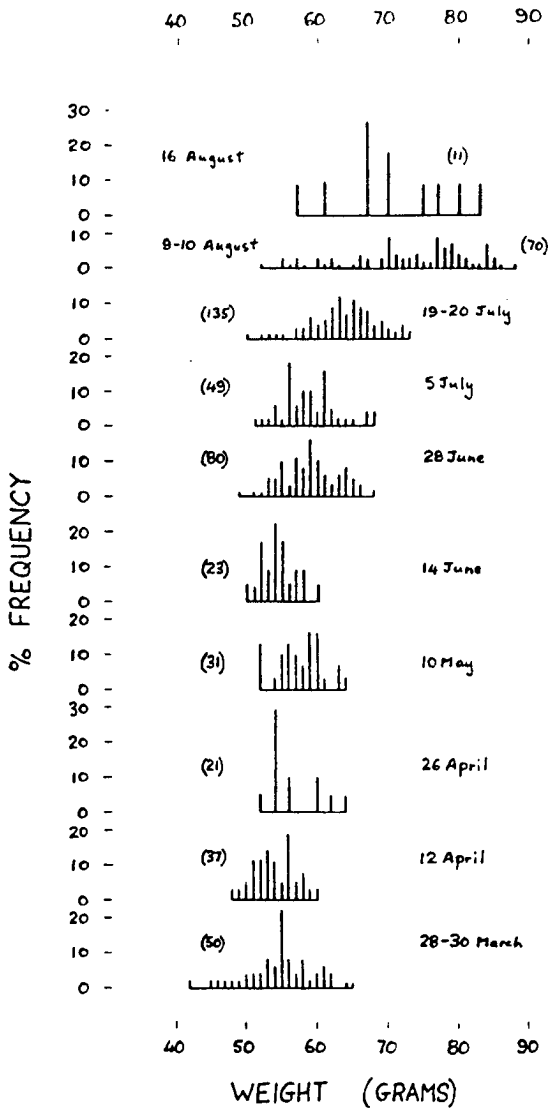

Fig 3. Weight percentage frequency histograms for adult birds in 1986. ( ) = sample size).

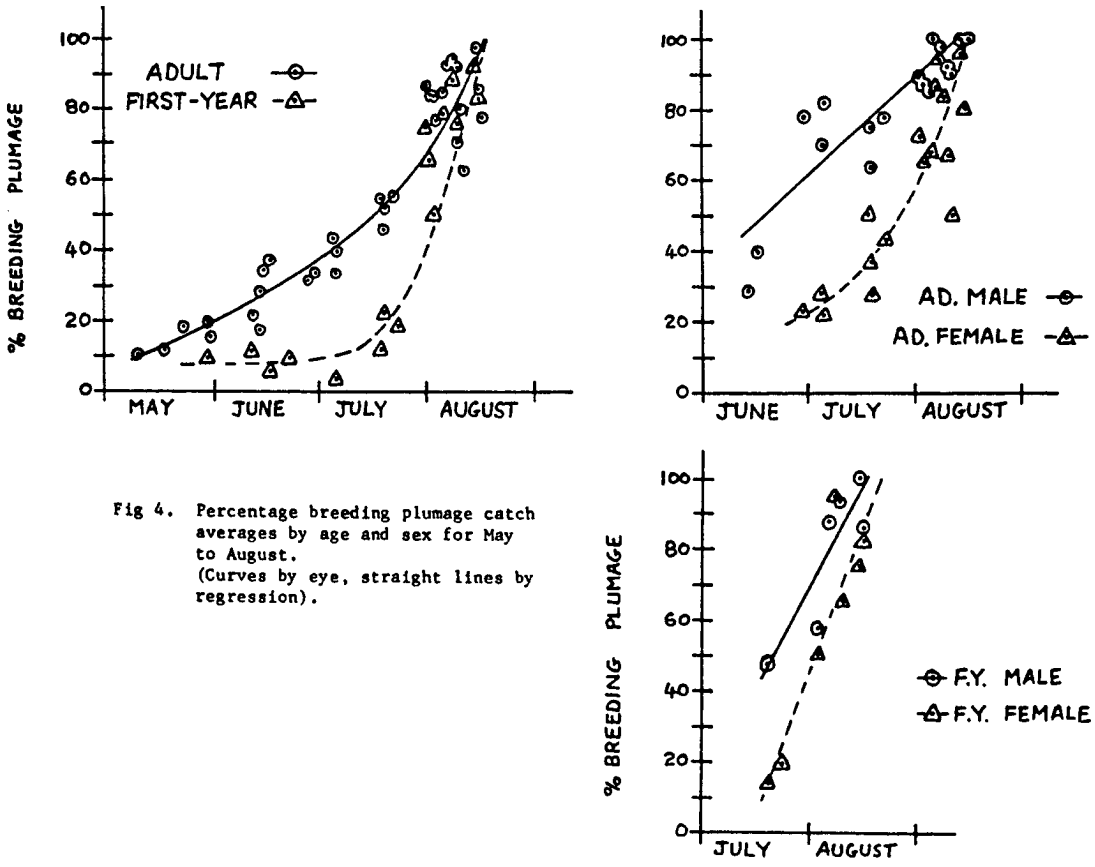

Fig 4. Percentage breeding plumage catch averages by age and sex for May to August.
(Curves by eye, straight lines by regression).

FORAGING STRATEGIES OF THE FAMILY RECURVIOSTRIDAE

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INTRODUCTION

Three different representatives of the family Recurviostridae are found at the Cheetham Saltworks, Laverton. The saltworks is situated approximately 20km south west of Melbourne and covers approximately 576ha which consists of a series of man-made pans which decrease in size as salinity increases. The area is generally flat and is at the edge of the Keilor-Werribee basalt plain. The three representatives found at the saltworks are the Banded Stilt, *Cladorhynchus leucopcephalus*, the Pied Stilt, *Himantopus himantopus* and the Red-necked Avocet, *Recurvirostra novaehollandiae*.

The presence of all three species in the one area enable the theories of niche partitioning, optimal foraging and flocking between species to be examined.

The foraging strategies of each species was examined using three main parameters: morphological data, diet and behavioural components such as peck rate.

Niche Partitioning and Optimal Foraging

Hutchinson (1957) defined a niche as being the multidimensional space of hypervolume within which the environment permits an individual or species to survive indefinitely. It has been suggested that no two species can occupy for long the same ecological niche (Grinnell 1917). Related species often have similar morphological and and behavioural traits. This often leads them to having similar environmental requirements. Partitioning of the resources between related species allows them to survive in the same area (i.e. niche partitioning).

The theory that Pied Stilts, Banded Stilts and Red-necked Avocets partition the environment will be tested using several hypotheses further in this paper.

Feeding in animals is an important activity for energy gain for basal metabolic requirements. The optimal foraging theory advances the idea that an animal will forage in an energy efficient way which maximizes its fitness. There are several means by which animals can accomplish this when feeding. Pyke et al (1977) suggests that optimal foraging could be categorized into four main areas:

1.) choice of prey types taken by the predator (i.e. optimal diet).

2.) selection of feeding patch (i.e. optimal patch choice).

3.) allocation of time to different patches (i.e. optimal giving up time).

4.) optimal patterns and speed of movement.

The optimal foraging theory complements the niche partitioning theory in that it explains how an animal can exploit a niche in relation to its own fitness. Optimal foraging can also be used to compare similar species. If similar morphological species use the same foraging methods and occur in the same area then the way in which each species optimizes its energy intake may be important to distinguish how niche partitioning is occurring.

METHODS

All three species selected for study occurred at the Laverton Saltpans throughout the year. Pied Stilts were considered juvenile if they did not exhibit full adult plumage. No juvenile Banded Stilts were present during the study.

Data needed to test the four hypotheses advanced were collected between April and June 1982. Goss-Custard's (1970) method for measuring feeding behaviour was followed. A stopwatch was used to time ten pecks. The number of successful pecks during this time was also recorded. A successful peck occurred when a peck was followed by visible swallowing. One sweep by a feeding Red-necked Avocet was considered to be equivalent to one peck. Only data collected from adult birds was used to investigate differences in peck rates between different species. All observations were made via a telescope at a distance of 20 to 30 metres from the bird being observed, under good light conditions. After each measurement a different bird was recorded. Selection of Statistical tests were based on those recommended by Bailey (1981) and Siegel (1956),

RESULTS

Do Banded Stilts compete with Pied Stilts?

Morphological Data: There is a significant difference between Banded Stilts and Pied Stilts in bill size ($F_{1,15} \approx 62.85$, $p \ll 0.01$). and body weights ($F_{1,15} = 61.17$, $p \ll 0.01$).

The Banded Stilt is approximately 28% heavier than the Pied Stilt. The Banded Stilt has a slightly longer bill than the Pied Stilt although bill shape is the same in both birds. The webbing between the toes is only partial in the Pied Stilt while in the Banded Stilt full webbing is present.

Feeding Behaviour Characteristics: When the feeding behaviour characteristics of the Pied Stilt and Banded Stilt were compared (Table 1) similarities and differences were found. The Pied Stilt and Banded Stilt were not commonly observed foraging together. Pied Stilts tend to forage in loose groups while Banded Stilts were only found in loose groups if a few birds were feeding. Often if large numbers of Banded Stilts, approximately 100 birds or more, were feeding in the same area, a tight feeding flock several rows deep was formed.

The feeding repertoire of the Banded Stilt appeared to be larger than that of the Pied Stilt. As some feeding methods tend to be rare, the entire feeding repertoire of both birds may not have been observed. The usual method of feeding in saltpans in both Stilts was the same. Both peck and probe the water for prey while walking along and the head is held upright between feeding movements. The Banded Stilt was also observed swimming while foraging. Banded Stilts were never recorded from the brackish water creek (salinity <10 parts per thousand (ppt)) (Table 2).

Feeding Rates:

Hypothesis: Pied Stilts perform the same number of pecks per minute as Banded Stilts.

Alternative Hypothesis: Pied Stilts perform more pecks per minute compared with Banded Stilts.

The hypothesis was rejected (Mann-Whitney U tests, $z = -6.36$, $p \ll 0.0001$) and the alternative hypothesis that Pied Stilts peck at a faster rate per minute accepted. A large standard deviation occurred in both groups (Table 1). Approximately 90% of the pecks in the Banded Stilt and Pied Stilt were successful.

Do Avocets compete with Stilts?

Morphological Data: One of the main differences between Avocets and Stilts was the difference in bill shape. The Avocet has a long slender, upcurved

bill while the Stilts have slender straight bills. The Avocet is the heaviest of the three birds (Table 3). Full webbing between the toes occurs in the Avocet and in the Banded Stilt.

Feeding Behaviour Characteristics: Most of the behavioural characteristics found in the Avocet are found in the Banded Stilt and to a lesser extent in the Pied Stilt. The Avocet like the Stilts forages by walking in the water and feeding in loose groups. The main difference between the two is the feeding method.

In the Avocet the feeding movement consisted of moving the slightly open bill from side to side in a sweeping action. Foraging took place with the head either above or below the water. One sweep was usually followed by a swallow but occasionally several sweeps were made.

In addition to showing several similar feeding characteristics the Avocet and Banded Stilt were commonly found together. Tight foraging groups of Banded Stilts did not contain other species of birds. Avocets may forage in the vicinity of Banded Stilts but do not join tight foraging flocks. It was observed that Banded Stilts occasionally followed foraging Avocets.

Feeding Rates: The feeding rates of both Avocet and Stilts were investigated to determine if differences occurred between them. Two hypotheses were tested.

Hypothesis One: Red-necked Avocets make the same number of pecks as Banded Stilts.

Alternative Hypothesis: Red-necked Avocets make a different number of pecks per minute than Banded Stilts

Hypothesis One was rejected (Mann-Whitney U tests, $z = -2.9$, $p(<0.0001)$ and the alternative hypothesis accepted.

Hypothesis Two: Red-necked Avocets complete the same number of pecks per minute as Pied Stilts.

Alternative Hypothesis: Red-necked Avocets complete a different number of pecks per minute than Pied Stilts.

Hypothesis two was rejected (Mann-Whitney U test. $z = 4.5$, $p<<0.0001$) and the alternative hypothesis accepted.

The Avocet also had less unsuccessful pecks per minute compared to Stilts when the data collected on each species was compared.

The Avocet foraged in a wider salinity range than the Pied and Banded Stilt (Table 2). None of the three species were observed foraging in areas where the salinity exceeded 145 ppt. The Avocet uses a wider range of salinity than the Banded Stilt and Pied Stilt. When the Avocet's salinity range (10-146 ppt) was compared to the salinity range of both Stilts combined it was found that they were the same (Table 2).

Effect of Age on Foraging Strategies

The effect of age on foraging was studied by comparing foraging rates and behaviour of juvenile and adult Pied Stilts. Morphological data does not separate juvenile and adult Pied Stilts (Table 4). This is probably due to the small sample size. Two hypotheses were tested to see if the rate of feeding and feeding success were different for juveniles and adults, taking pecks per minute as a measure of feeding rates (Table 5).

Hypotheses One: No difference occurs between the number of pecks per minute in juveniles and adults.

Alternative Hypothesis: Juvenile Pied Stilts perform fewer pecks per minute compared to adult Pied Stilts.

Hypothesis one is rejected (Mann-Whitney U test, $z = 2.68$, $p < 0.05$) and the alternative hypothesis is accepted. This result must be considered with caution as base data in Table 5 shows that juvenile Pied Stilts make only slightly fewer pecks than adults (i.e. 43.3 pecks/minute compared to 46.8 pecks/minute.

Hypothesis Two: Juvenile Pied Stilts have the same number of successful pecks as adults.

Alternative Hypothesis: Juvenile Pied Stilts perform fewer successful pecks per minute than adults.

Hypothesis two is rejected (Mann-Whitney U test, $z=3.02$, $p<0.05$) and the alternative hypothesis accepted.

When feeding the juvenile birds were often observed to feed close by adult birds.

Members of the family Recurviostridae, although having some similar morphological and behavioural traits, must also have traits which allow them to partition the environment at the saltpans, thus allowing all three species to survive there indefinitely.

Do Banded and Pied Stilts compete? When Banded and Pied Stilts were compared it was found that there were similarities and differences in morphology and behaviour of the birds.

Banded Stilts were found to have longer bills and were heavier than Pied Stilts. Bill shape was similar. This similarity suggests that the birds could be feeding on similar types of prey.

It has been suggested that the smaller bird species have a more restricted diet than large birds because they have a shorter search time for the smaller more abundant prey they consume (Kushlan 1981, Odum 1971). Comparatively large birds should be able to have a longer search time and eat a wider range of prey. Thus Banded Stilts would theoretically eat a wider range of prey at a slower rate than Pied Stilts. Taking into account the morphology of both birds it could be predicted that Pied Stilts foraging in the same area as Banded Stilts may consume the same type of prey but of a smaller size category, than Banded Stilts.

The rate of successful pecks per minute was taken as an indication of intake of feed at the optimal level possible for the prey being taken. Therefore, if Pied Stilts and Banded Stilts were directly competing for the same type of food it would be expected that the Banded Stilt would peck at a slower rate than Pied Stilts. Measuring successful pecks per minute it was shown (Table 1) that Banded Stilts do feed at a slower rate. This supports the idea that Pied Stilts consume smaller more abundant prey. Whether Banded Stilts take a greater number of prey types remains to be tested. The Banded Stilt was never recorded from the brackish water site. This suggests that Banded Stilts may have a preference for more saline areas and this differs from Kushlan's (1981) suggestion that larger birds have a more varied diet and presumably are able to forage in a wide range of habitats.

Do Avocets compete with Stilts?

The one main characteristic which distinguishes the Avocet from the Stilts is its bill and the way in which it is used. The Avocet when feeding either has its head above or below the water. This suggests that visual cues are less important in the Avocet than the Stilts. In the Stilts the head is usually held in an upright posture between foraging movements.

The side to side movement of the bill in the Avocet suggests that all items encountered in a certain size range will be eaten. The Avocet being larger in both weight and bill length than the Stilts, but only able to sweep feed for a limited size range of prey, would be expected to have a balance between body size and method of feed. A study conducted in America on the Avocet *Recurvirostra americana* and the Stilt *Himantopus mexicanus* equivalent of the Red-necked Avocet and Pied Stilt found that Stilts took an overall higher number of prey types than the Avocet (Wetmore 1925). Wetmore (1925) also found that the high number of prey types taken by the Stilt *Himantopus mexicanus* were not all eaten in great abundance.

When other behavioural characteristics of the Red-necked Avocet and both Stilts were examined (Table 1) it was found that there were similarities and differences. These differences could be related to the different feeding method used by the Avocet and it's ability to capture more than one prey item per sweep. The Avocet also has less unsuccessful pecks per minute than Stilts. The feeding method of the Avocet. may again account for this occurrence. The Avocet when moving it's bill from side to side has a larger surface area (i.e. the side of the bill) with which to capture prey. The selection of all items within a size range which come into contact with the bill may also lead to less unsuccessful pecks.

The Red-necked Avocet was able to utilise a larger number of salinity levels than both species of Stilt thus reducing competition. The selection of foraging sites by the three species may have been due to different prey items being available at different salinity levels. Differences in water depth, vegetation and turbidity may have also affected selection.

The Avocet is commonly observed with Banded Stilts at the saltpans. Behavioural similarities may therefore help maintain flock cohesion. The advantages gained by foraging and resting in a flock can be divided into two main categories:

1) better protection from predators,
2) better utilization of the food resource present (Morse 1970),

Early warning of an approaching predator such as the fox *Vulpes Vulpes* may be particularly important when Avocets and Stilts are resting on the shore or bank of the pan, the low shrubs providing enough cover for potential surprise attack by a fox. If mixed flocks stay together then food patches (e.g.pans) could, through optimal allocation time, be fully utilized (i.e. criteria three suggested by Pyke et al 1977).

The overlap in the use of different sites by Avocets and Pied and Banded Stilts suggests that partitioning of sites occurs when both types of birds are present.

Effect of Age on Foraging Strategies.

Foraging in an efficient manner often requires birds to learn feeding skills. The learning period usually occurs while the bird is immature. Juvenile birds are therefore expected to be less efficient at obtaining and handling prey than adults. As morphological data does not separate juvenile and adult birds, because of a small sample size (Table 4), it will be assumed that juvenile birds need almost as much energy as adults.

The results showed that juvenile Pied Stilts make significantly less successful pecks than adults (Table 5). The question then to be asked is how does the juvenile bird make up the short fall in energy?

Two ways in which juvenile birds could make up the shortfall are:

1) by having a larger prey repertoire than adults.

2) by foraging for a longer time than adults (Curio 1976).

Both these explanations are plausible for the Pied Stilt.

As well as learning through success and failure, juvenile birds could learn feeding skills by watching adult birds. This probably occurs with Pied Stilts, as juveniles were often observed to be apparently watching and foraging close to adults.

Foraging Strategies of the Family Recurviostridae in Relation to Flocking.

The three members of the family Recurviostridae studied i.e. the Banded Stilt, the Pied Stilt and the Red-necked Avocet exhibit morphological and behavioural characteristics which reduces competition for food between them.

Pied Stilts and Banded Stilts were not usually observed foraging together.

As both birds can forage in the same area, it is suggested that this is the result of the similarity in their foraging techniques i.e. high cost of interference (Morse 1980). Morse (1980) has suggested that loose flocking is a characteristic of birds hunting by sight. This study showed that Banded Stilts and Pied Stilts forage in loose flocks. Banded Stilts however, also foraged in tight flocks. Banded Stilts however, also foraged in tight flocks. This suggests that either:

1) Banded Stilts change foraging tactics to less visual cues and more tactile cues when foraging in a tight flock,

2) Banded Stilts do not conform to Morse's (1980) suggestion and feed by sight in loose and tight flocks.

3) Neither Banded or Pied Stilts conform to Morse's (1980) suggestion and feed using tactile cues in loose flocks.

The second alternative seems the more plausible.

Avocets and Banded Stilts were often observed foraging in loose groups, suggesting that their different foraging techniques prevents interference (Morse 1980). Diamond (1981) found that flocking in mixed groups of species, with similar diets, but different foraging techniques was common. Mixed flocking promotes feeding efficiency by:

1) decreasing search time for food. The more individuals searching the more likely a good feeding area is to be found.

2) enabling birds to learn new foraging techniques from allospecifics. Banded Stilts were observed moving their bills in a scything motion.

Other theories to explain mixed flocking (besides the feeding efficiency theory expounded above) include:

1) Dilution Theory - anti-predator. More birds more protection.

2) Beater Theory - one species flushes out prey for the other.

3) Pirate Theory - seizing food of other members of the flock. Easier than searching for your own.

4) Gang Theory - better chance of defending a territory.

The Beater Theory may also apply to Avocets and Banded Stilts.

When Banded Stilts formed tight flocks Avocets were absent. These tight flocks often moved forward on a broad front. This achieves greater lateral spacing than single file (Morse 1980).

In the mixed flocks of Banded Stilts and Avocets the greater distances between birds would 'permit' the presence of the more subordinate species. Closer inter-bird distances in a tight flock may lead to the subordinates exclusion (Morse 1980). As Red-necked Avocets were the largest birds present one would not have expected them to be a subordinate species. Larger animals tend to be dominate over smaller ones (Odum 1971), so other factors must also be involved.

The loose flocks of Pied Stilts were composed of adults and juveniles. Juveniles may learn foraging techniques (feeding methods and site selection) from adults (MacArthur 1972; Kushlan 1981). Similar behaviour has been observed amongst juvenile Oystercatchers *Haematopus ostralegus*, (Norton-Griffiths 1969).

This study shows that the Red-necked Avocet has similar behaviour to the English Avocet *Recurviostra avocetta*, (Goss-Custard 1970).

When the feeding rate of the Avocets was compared they were found to be similar (English Avocet 28.5 + 1.5 - 34.4 + 12 pecks per minute: Red necked Avocet 36.8 + 16.8 pecks per minute). The greater standard deviation in the feeding rate of the Red-necked Avocet was probably due to the wider range of weather conditions under which feeding was observed. Evans (1976) found that windy conditions could considerably reduce the feeding rate of the Grey Plover *Squatorola squatorola*.

The English Avocet (Goss-Custard 1970) has been observed foraging in tight flocks. Red-necked Avocets in this study were not observed in tight flocks. This may have been due to difference in:

1) temperature: Morse (1980) suggests that flock size decreases as daily temperature rises. This enables dominants to satisfy energy demands quicker and spend more time evicting subordinates. Scotland would have a lower daily temperature during winter than Laverton.

2) food availability: Laverton saltpans may have a greater food supply than the Scottish estuary (this does not seem likely). Increased food supply reduces the tendency to flock (Morse 1980).

CONCLUSION

The study of the family Recuriostridae at the Laverton Saltpans has demonstrated that all three representatives of the family can survive in the same area indefinitely. This achieved by all three species displaying at least some different morphological and behavioural characteristics, and by the partitioning of the environment when characteristics between the different species are similar. The ability of all three species to utilise the saltpans successfully suggests that extensive competition between species does not occur. The Banded Stilt and Red-necked Avocet had several behavioural characteristics in common. This enables these species to form loose mixed species flocks. Studies on the juvenile and adult Pied Stilt showed that mastery of efficient foraging techniques requires a component of learning.

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Table 1

FEEDING CHARACTERISTICS OF THE PIED STILT, BANDED STILT AND RED-NECKED AVOCET ADULTS

Bird Species	Red-necked Avocet	Banded Stilt	Pied Stilt
Behavioural Characteristics			
Pecks/minute	36.8+16.5*	30.7+10.8*	46.8+18.9*
Successful pecks/minute	36.6+16.6	27.2+11.9*	43.6+20.1*
Sample Size	135	60	66
Feeding repertoire at the salt pans	scythe, peck	peck,probe scythe	peck,probe
Usual feeding method	scythe	peck,probe	peck,probe
Walk through water searching for prey	yes	yes	yes
Swim through water searching for prey	yes	yes	no
Foraging in tight groups	no	yes	no
Foraging in loose groups	yes	yes	yes

* Significant difference (p<<0.001) across rows

Table 2

DISTRIBUTION OF FORAGING PIED STILTS, BANDED STILTS AND RED-NECKED AVOCETS IN RELATION TO SALINITY RANGE (FEBRUARY - OCTOBER 1982)

Salinity ‰	10	40	69	86	124	145	>269
Species							
Pied Stilt	x	-	x	-	x	x	-
Banded Stilt	-	x	x	-	x	x	-
Red-necked Avocet	x	x	x	x	x	x	-

x present

\- absent

Table 3

MORPHOLOGICAL CHARACTERISTICS OF THE PIED STILT, BANDED STILT AND RED-NECKED AVOCET ADULTS

*Significant Difference (p<<0.01) across rows

Bird Species	Red-necked Avocet	Banded Stilt	Pied Stilt
Character-istics			
Sample Size	135	6	10
Body Weight (g)	309.6±29.1	255.8±16.6*	183.0±18.8*
Bill Length(mm)	90.4±4.8	71.2±1.2*	61.9±2.7*
Shape of Bill	recurvature	straight	straight
Webbing between toes	full	full	partial

Table 4

MORPHOLOGICAL DATA ON THE JUVENILE AND ADULT PIED STILT

AGE	JUVENILE	ADULT
Characteristics		
Body Weight (g)	194.6 ± 14.4*	183.0 ± 18.8*
Bill Length (mm)	62.8 ± 3.1*	61.9 ± 2.7*
Sample Size	5	10

* No significant Difference (p >0.05) across rows

Table 5

FEEDING DIFFERENCES BETWEEN JUVENILE AND ADULT PIED STILTS

AGE	JUVENILE	ADULT
Behavioural Characteristics		
Pecks/Minute	43.3 ± 21.5*	46.8 ± 18.9*
Successful. Pecks	31.4 ± 12.5*	43.6 ± 20.1*
Sample Size	48	66

* Significant Difference (p<0.05) across rows

THE NORTHWARD MIGRATION OF WADERS FROM AUSTRALIA, FEBRUARY TO APRIL, 1985.

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INTRODUCTION

Until recently, little was known of the timing and routes of northward migration of waders from Australia. Previous work in Australia (Lane 1987) has determined for some species the relative importance of many sites during northward and southward migration. Monthly wader counts had shown that the southward migration was more protracted than the northward and that more frequent counts were probably required during northward migration (February to April) in order to detect influxes of migrating waders at sites along their migration routes. Data from banding studies, especially departure weights, (for example, Barter 1984) and movements of colour-dyed birds, (for example Newman, Patterson and Barter 1985) have yielded new information on the northward migration of some species from Australia. To supplement this data and to improve the understanding of northward migration of waders from Australia, the "Northward Migration Project" was organised as part of the RAOU Wader Studies Programme.

This involved regular counts at both inland and coastal sites throughout Australia from mid-February to late April, 1985. The project was run in conjunction with colour-dyeing of waders in Victoria and Tasmania and with the 1985 North-west Australia wader studies expedition. (The results of the latter were published as a separate paper (Lane & Jessop, 1985a).

This paper presents the results of the "Northward Migration Project". The method of data collection and analysis is outlined and three hypotheses, outlined below, concerning the migration of waders out of southern Australia are tested for the 12 species for which sufficient data were collected. The hypotheses are:

1) some species depart from southern Australia with enough fat reserve to reach northern Australia where they again fatten before onward migration out of the country;

2) some species depart from southern Australia with fat reserves sufficient to fly beyond the northern coast but stop in the north to "top up" their reserves before finally leaving; and

3) some species depart from southern Australia with fat reserves sufficient to fly beyond the north coast and do not stop in northern Australia once they have commenced migration.

Hypothesis 1 has been proposed for Curlew Sandpipers by Barter (1984) and Newman et. al (1985). Hypothesis 2 was proposed for Red Knot by Lane and Jessop (1985).

METHODS

Data Collection

Sixty wetland sites were counted weekly by volunteers (area search); 48 sites east of 134°E and 22 sites north of 28°S. Table 1 lists the sites together with the number of counts conducted at each.

Data analysis

The results of the counts for each species and each site were tabulated and the maximum number per week of each species at each site was graphed. Changes in numbers were given an index according to the magnitude of change and the number of birds involved. Each species was analysed separately. How the score was derived is outlined below.

Peaks and plateaux in numbers of each species at a site were identified from the graphs and classified in the following way: a big peak was a greater than 100% increase in numbers of birds at a site over the previous week; a small peak was an increase of between 50% and 100% at a site over the previous week; and a plateau was a change in numbers of less than 50% for a period of ten days or more (it may represent peak numbers over that period, or it may precede or follow a peak).

Changes in numbers are assumed to indicate movement into or out of a site, the magnitude of change being proportional to the amount of movement.

Peaks and plateaux involving numbers of birds greater than the median of all peaks and plateaux for that species were considered to involve large numbers of birds, those involving numbers less than the median, small numbers. Based on these divisions of magnitude of change in numbers and actual numbers involved, peaks and plateaux were assigned a score between one and ten as outlined in Table 2. If the numbers of birds at a site in a particular week did not exceed 10% of the maximum count for that site over the period of the project, then the result was disregarded. Furthermore, if numbers increased by less than 50% over the previous week then this was not classified as a peak or plateau and consequently did not get scored.

This approach allowed changes in numbers to be consistently described between species and sites because peaks and plateaux were scored relative to the abundance of each species. Species abundance can reflect its overall status in Australia and the size at the site being counted. For example, a big peak for a very common species, such as the Red-necked Stint, may in many cases involve thousands of birds but for a less abundant species, such as the Terek Sandpiper, it may never involve more than a hundred.

Scores for sites north and south of latitude 28°s were summed separately each week. This gave the movement index for northern and southern Australia each week. As each site was counted at least once each week, the indices consistently represent the amount of movement occurring during the period of the project.

In a further analysis, site latitude was graphed against time and peaks and plateaux plotted on these axes (Figure 1). This was done to show any north-south trends in the periods of movement.

Data on pre-migratory fattening in south-eastern Australia were examined and potential flight ranges calculated using the formulae of Summers and Waltner (1979) and Davidson (1984).

RESULTS

The results of the analysis set earlier are presented below for each species. The northern and southern totals refer to the number of birds counted at the monitored sites where the species occurred. The totals are given for the first count in the project (the 1985 Summer National Wader Count) and the last week in March. The first date represented the north-south distribution of a species before migration started and the last week

in March, the period when the maximum movement indices were recorded for all species examined.

Lesser Golden Plover *Pluvialis fulva*

	No. of sites	Feb(10-17)	Mar(22-31)
Northern Australia	13	79	96
Southern Australia	8	323	268

Most Lesser Golden Plovers were counted at southern sites during the project. There, departure started in late February and continued until the second week in April. The maximum movement index occurred in the south in the second week in March. At many northern sites, temporary influxes were recorded in the first two weeks in March. Very few were recorded in the north-west (Lane and Jessop, 1985a).

Birds occurred in numbers only in the eastern half of Australia during northward migration, suggesting that they are from a different migratory population from that which migrates to south-east Asia in large numbers (Parish and Wells, 1984) immediately north-west of Australia. Observations during the project suggest that Lesser Golden Plovers move up the east coast but not synchronously. The role of the islands of the Great Barrier Reef, where they are common (Lane, 1987), in the northward migration is not known but usage of these may account for the lack of synchrony on mainland coastal sites counted during the project.

Mongolian Plover *Charadrius mongolus*

	No. of sites	Feb (10-16)	Mar (1-7)
Northern Australia	19	1,415	2,581
Southern Australia	7	93	45

In mid-February, 94% of the Mongolian Plovers counted were at northern sites, reflecting their normal non-breeding distribution in Australia. Most departure from northern Australia occurred in the first two weeks of March. There was a second period of departure, involving fewer birds, in the first week of April. At northern sites, an 82% increase in numbers was observed between mid-February and mid-March, indicating a considerable influx to the Queensland coast of Mongolian Plovers, possibly from coastal New South Wales, as comparatively few occur further south of there. These findings suggest that Mongolian Plovers move northwards up the east coast of Australia in early March, many departing Australia at this time. In Queensland, most have left by mid-April. Observations at Darwin (this study) and in the north-west (Lane and Jessop, 1985a) suggest that they probably linger even later, until the end of April, further west.

Large Sand Plover *Charadrius leschenaultii*

	No.of sites	Feb(10-17)	Mar(22-31)
Northern Australia	20	130	474
Southern Australia	0	-	-

No Large Sand Plovers were recorded in southern Australia during the project. In northern Australia, few sites held them in mid February but by the third week in March, most Queensland sites had experienced an influx. Queensland birds had departed by the end of March. Very few Large Sand Plovers occurred south of Moreton Bay in mid February and consequently the origin of birds landing on the Queensland coast is a mystery. Two temporary influxes were recorded at Darwin: one in late February/early March and another in late April, suggesting two waves of migration. This species was very abundant in the north-west where a large departure was recorded in the second week of April. At all sites, Large Sand Plovers had departed by the end of April.

Ruddy Turnstone *Arenaria interpres*

	No.of sites	Feb(10-17)	Mar(22-31)
Northern Australia	14	175	244
Southern Australia	6	207	202

Ruddy Turnstones were fairly evenly distributed between northern and southern sites in mid February. There was a tendency for more to occur at northern sites later on. Most departure from southern sites occurred in the second week in March and at a small number of sites in the third week in April. At northern sites, influxes occurred between early March and the third week in April, with the movement index reaching its maximum in the last week in March. In north-western Australia, continuous passage of birds was occurring from late March until at least the third week in April (Lane and Jessop, 1985a). Most birds had departed from the majority of sites by the third week in April. These findings suggest that some Ruddy Turnstones from southern Australia may touch down in the north, especially in the north-west. The lack of synchrony on the mainland Queensland coast may be due to many birds using the islands of the Great Barrier Reef where they are abundant (Lane, 1987).

Eastern Curlew *Numenius madagascariensis*

	No. of sites	Feb(10-17)	Mar(22-31)
Northern Australia	16	202	212
Southern Australia	13	1.058	340

In mid-February, the majority of Eastern Curlews were at the southern sites. Numbers began declining in both southern and northern Australia in the third week of February. In southern Australia, the greatest decline in numbers occurred in the third week of February then numbers dropped steadily until the last week in April. Two distinct peaks in the movement index occurred in late-February/early March and in late March/mid-April in northern Australia. The earlier peak at northern sites could have been of birds moving from southern Australia. The later peak was particularly obvious on the Queensland coast and could have been a second wave of birds that had departed from southern Australia. These observations indicate that Eastern Curlews start to move north in the last week of February and that

they probably use habitats in northern Australia on the way.

Greenshank *Tringa nebularia*

	No. of sites	Feb (10-17)	Mar (22-31)
Northern Australia	16	180	149
Southern Australia	12	738	515

The majority of Greenshanks were counted at southern sites during the project. Numbers at these sites fluctuated between mid February and mid April, with some sites (including the only inland site that held numbers) showing temporary influxes of comparatively large numbers in late March and early April. At northern sites, numbers fluctuated more than in the south, and birds tended to stay for shorter periods. The movement index in the north reached a maximum in the last week in February and the first two weeks in March, earlier than in the south. In the north-west, departure occurred in the last week in March, followed by an influx then further departure in Mid April. Birds had departed from most sites by late April. These observations suggest that there were two waves of migration. The first, in late February and early March involved departures of birds from southern and northern Australia, some of the former touching down in northern Australia on the way. The second, in late March and early April, involved birds from southern Australia that generally did not stop in northern Australia, except for small numbers which did in the north-west.

Bar-tailed Godwit *Limosa laponica*

	No.of sites	Feb (10-17)	Mar (22-31)
Northern Australia	17	2.975	4,915
Southern Australia	9	1,673	867

The majority of Bar-tailed Godwits were counted at northern sites. Numbers started to decline in the south in early March, although at some sites, numbers remained high well into March. Most northern sites showed increases in numbers during late February and most of March. In the last week in March, there were major influxes at most northern sites, indeed the maximum movement indices in both southern and northern Australia occurred in this week. By the first week in April, most Bar-tailed Godwits had left northern and southern sites. In the north-west, most departure occurred suddenly in the second week in April (Lane and Jessop,1985a). These observations indicated that Bar-tailed Godwits probably touch down in northern Australia on their way northwards, many migrating along the east coast of Australia.

Red Knot *Calidris canutus*

	No.of sites	Feb (10-17)	Mar(22-31)
Northern Australia	13	246	261
Southern Australia	5	935	68

Red Knots were recorded in large numbers in southern Australia at only two sites. Departure of Red Knots from southern sites started from the third week in February, when maximum numbers were attained, and finished in the first week of April. Small, temporary influxes were recorded in a handful of other southern sites in the first and third week in March. At almost all northern Australian sites, Red Knots were in transient groups, occurring in the second and last weeks of March. Numbers of Red Knots in the north-west increased in mid-April, possibly due to the arrival of birds from south-eastern Australia (Lane and Jessop, 1985a). There was a substantial influx of Red Knots at sites in Victoria, Queensland and at Darwin in the last week of April. The general absence of birds from southern sites immediately beforehand suggests that these may have been from New Zealand rather than from within Australia. New Zealand birds may even have been responsible for the temporary influxes observed at many sites in March, especially in Queensland, where the coast lies between New Zealand and an area they use in large numbers during southward migration, the Gulf of Carpentaria (Garnett, 1986). These observations, suggest that Red Knots probably land in northern Australia on their way northwards from southern Australia and that New Zealand birds probably land in northern and southern Australia on their way to the breeding grounds.

Great Knot *Calidris tenuirostris*

	No.of sites	Feb(10-17)	Mar(22-31)
Northern Australia	16	3,012	5,693
Southern Australia	2	152	6

Most Great Knot were counted at northern Australian sites. They had departed from the one southern site where they were counted in any numbers by the end of February. All northern observations were on the eastern Queensland coast, the Darwin area and in the north-west. Generally, numbers in Queensland and at Darwin showed an increase between early and mid March, a decline, then an increase in late March before a dramatic, simultaneous departure from most sites at the end of the month. These observations suggest some movement on the Queensland and Northern Territory coasts in March before final departure at the end of the month. Many Great Knot had already left the north-west coast by mid March when counts there began and most had gone, presumably directly to Asia, by the first week in April (Lane and Jessop, 1985a).

Sharp-tailed Sandpiper *Calidris acuminata*

	No. of sites	Feb 10-16	Mar 22-31
Northern Australia	22	273	556
Southern Australia	23	3,973	239

The vast majority of Sharp-tailed Sandpipers occurred in the south in mid-February. Most southern sites showed a general decline in numbers from late February to mid April whereas many northern sites showed rapid increases in numbers in late March and April. Maximum movement indices were recorded at southern sites in the second week of March and at northern sites at the end of March. At southern sites, birds remained until the second week of April whereas in the north, they stayed until the end of April. This, together with the higher numbers in the north compared with the south at the end of March (see above), suggests that Sharp-tailed Sandpipers departed from southern Australia and stopped in the north, at least in the north-east and on the Northern Territory coast. Very few were observed on the north-west coast in

late March and April (Lane and Jessop, 1985a), suggesting that the species has a more easterly migration route out of Australia compared with the previous species, something supported by the observation of large numbers (more than 10,000) in the Gulf of Carpentaria in April (Garnett, 1986).

Red-necked Stint *Calidris ruficollis*

	No.of sites	Feb(10-17)	Mar(22-31)
Northern Australia	15	985	651
Southern Australia	16	10,865	5.607

Southern sites held 97% of the Red-necked Stints counted in mid-February. In the south, departure started in early March, after a slight increase at many sites in late February, and continued until late March. After this, flocks appeared at many inland and coastal sites in western Victoria, South Australia and eastern Western Australia, suggesting continuing migration, possibly westwards, until late April. In south-western Australia, maximum departure from near-coastal lakes occurred (probably because these dried up) in early March when there was a corresponding increase at coastal sites, followed by departure in early and mid April, later than in the south-east. Small influxes of Red-necked Stints occurred in mid to late March on the northern New South Wales and Queensland coasts but most had departed by mid April. Few were counted at Darwin. In the north-west, there appeared to be a continual turnover of migrating birds and numbers had not declined by mid April suggesting that this area was being used as a passage area during northward migration at least until late April.

The preceding observations, although complex, suggest that Red-necked Stints undertake a north-westward migration from south-eastern Australia in mid-March. A few go up the east coast. Most take a more westerly route along the south coast and through nearby inland habitats, across the continent to the north-west coast before finally leaving Australia by the end of April. Departure from the south is later further west. Counts in past years suggest that the South Australian Gulfs (especially Gulf St Vincent) are an important staging area in southern Australia for stints migrating northwards to north-western Australia (Close and McCrie, 1986).

Curlew Sandpiper *Calidris ferruginea*

	No.of Sites	Feb 10-16	Mar 22-31
Northern Australia	9	514	502
Southern Australia	10	7,551	1,349

In mid-February, 93% of all Curlew Sandpipers counted occurred at southern sites. Numbers declined in the south from the second week in February until the fourth week of March, by which time all migrating birds must have left. Movement indices were highest in the south in the fourth week of February and the fourth week of March. Movement in northern Australia was recorded only during March when three small temporary influxes occurred. The small number moving through northern sites suggested that Curlew Sandpipers from southern areas either overflew the north-east and Northern Territory coast, or stopped on the coast of north-western Australia. The latter seems most likely as during the north-west expedition in late March and April many thousands of them were present until the second week in April (Lane and Jessop, 1985a).

The information presented in the preceding accounts is summarised in Figure 2. Figure 3 shows the generalised departure schedule of species other than the twelve most abundant discussed earlier. This table is based on counts during the Northward Migration Project and the results of the 1985 north-west Australia wader studies expedition (Lane and Jessop, 1985a).

Work by the Victorian Wader Study Group (Minton and Lane, 1984; Barter, 1986; Lane and Minton, in prep.) has enabled the potential flight range of a number of species that spend the non-breeding months in south-eastern Australia to be calculated based on pre-migratory fat reserves in March and April. The results, using the formulae of both Summers and Waltner (1979) and Davidson (1984) and assuming a ground speed of 75 km/h (Lane and Jessop, 1985b), are presented in Table 3.

Species fell into broad groups based on flight range, in a similar manner to that found in waders departing from north-western Australia (Lane and Jessop, 1985a):

a) species capable of flying non-stop for between about 6,600 and 6,800 kilometers (5,800 to 6,000) Grey Plover and Great Knot;

b) species that can fly non-stop for between about 5,000 and 5,900 kilometers (4,500 to 5,300); Bar-tailed Godwit (male and female) and Ruddy Turnstone;

c) those capable of flying non-stop for between about 3,700 and 4,200 kilometres (3,100 and 3,600); Lesser Golden Plover, Mongolian Plover, Red Knot and Curlew Sandpiper;

d) species that can fly non-stop for between about 2,700 and 3,000 kilometres (2,200 and 2,500); Sharp-tailed Sandpiper and Red-necked Stint.

These are shown on a map in Figure 4.

DISCUSSION

The count data strongly suggest that the following species use parts of the north coast of Australia as a migratory fattening area on their way to the breeding grounds from southern Australia: Lesser Golden Plover, Mongolian Plover, Eastern Curlew, Greenshank, Bar-tailed Godwit, Red Knot, Sharp-tailed Sandpiper, Red-necked Stint and Curlew Sandpiper. Some species appear to depart directly from the northern coast and do not occur in southern Australia in appreciable numbers: Large Sand Plover and Great Knot.

The count and flight range data both indicate that Great Knots depart from Australia directly, although some short-distance movement on the north coast probably occurs before final departure.

The count and flight range data contradict each other for Bar-tailed Godwit, suggesting that this species stop in the north with considerable fat reserves remaining. This indicates that predicted stop-over areas in Asia (i.e. Borneo, Java and Sulawesi), based on fat reserves in south-eastern Australia, are not necessarily used by the species. Information is available on the status of Bar-tailed Godwits in Borneo, (Smythies, 1981) and it suggests that Bar-tailed Godwits do not use this area. This supports a hypothesis that they fatten in northern Australia for a flight to an intermediate staging area farther north than Borneo, probably on the coast of China.

The flight range data suggest that Ruddy Turnstones migrate to areas well beyond northern Australia from south-eastern Australia. Although the count data are inclusive, the species is known to pass through Roebuck Bay in north-western Australia where fattening occurs (Lane and Jessop, 1985a). It is not known if it arrives in Roebuck Bay with some fat in reserve. East coast Ruddy Turnstones might be from a different population from those that pass through the north-west (Lane, 1987) and consequently might have a different migration strategy. The presence of more than one population in Australia would certainly make interpretation of the count data difficult in the absence of a detailed banding study.

Lesser Golden Plovers cannot fly as far as Ruddy Turnstones but could overfly the north coast of Australia to New Guinea and the Solomon Islands. The count data showed that they moved up the east coast of Australia before finally departing, possibly fattening further in the process. If this were the case, then New Guinea and the Solomons probably would not be used as a stopover. Rather, an area farther north, such as Micronesia and/or the Philippines might act as an intermediate stopover.

Micronesia seems more likely as they are one of the more abundant waders in these island (Owen,1977). Curlew Sandpipers are capable of flying non-stop to beyond north-eastern Australia but not to beyond the north-west coast. Because few occur in the north-east (Lane, 1987; this study) or in the Gulf of Carpentaria (Garnett, 1986), and as they are known to land on the north-west coast during northward migration (Lane and Jessop, 1985a), it is likely that few overfly the north coast. Furthermore, they would arrive in the north-west with very little fat reserve. It is of interest that Curlew Sandpipers leaving the north-west are capable of non-stop flight for about 3,700 kilometres, the same distance that they are capable of flying from south-eastern Australia. The Curlew Sandpiper does not, therefore, migrate via the shortest route to the breeding grounds, the great circle route via the Gulf of Carpentaria which would be the most energy efficient (Barter, 1984). This suggests that energy efficiency is not an over-riding factor in the evolution of migration routes. From the Gulf of Carpentaria, they would have to fly another 5,500 kilometres along the great circle route to their breeding grounds before coming to the next potential intermediate stop-over, eastern China. Observations (see earlier) indicate that 3,700 kilometres is about the limit for non-stop flight in the species. From north-western Australia, by contrast, a number of potential stop-overs lie within this range. Thus, one leg of the migration cannot be considered in isolation from the others.

Red-necked Stints are not capable of reaching the north-west coast of Australia from Victoria. This would probably account for the considerable westward movement of this species along the south coast recorded during the project. The distance to the north-west coast (they were not abundant on the north-east coast) from South Australia is within the capabilities of the Red-necked Stint. Further more, as in Curlew Sandpipers, Red-necked Stinte probably migrate via the north-west coast because stop-overs in Asia are more accessible from there compared with north-eastern Australia.

The Sharp-tailed Sandpiper is another species that does not fatten sufficiently before departure to reach much of the north coast of Australia. They can, however, reach the southern part of the Gulf of Carpentaria, where they were observed in thousands in mid-April (Garnett, 1986). This raises the interesting question of stopovers in Asia. Perhaps Sharp-tailed Sandpipers turn westwards (into south-east Asia) after crossing Australia, compared with Red-necked Stints which turn westwards before crossing Australia. Dann (1987) found that Red-necked Stinte and Sharp-tailed Sandpipers competed more for resources than did Red-necked Stints and Curlew Sandpipers. This similarity in feeding requirements might have led to the evolution of different migration routes in these two species (c.f. Red-necked Stint and Curlew Sandpiper) in order to reduce competition at the energetically critical time of migration.

Red Knots are not capable of flying far beyond the north coast of Australia, except to New Guinea and the Solomon Islands. The counts indicated that they indeed land in northern Australia. It is of interest that those in north-western Australia arrived from further south carrying considerable reserves of fat corresponding to the amount that would be left over after a flight from south-eastern Australia (Lane and Jessop. 1985a) based on the formula of Summers and Waltner (1979). This suggests that this flight range formula is more realistic than that of Davidson (1984). However, it seems unlikely that waders migrate in still air but rather choose tail winds (Richardson, 1978; Lane, in prep.). Thus, Davidson's (1984) formula might still be appropriate.

In conclusion, the following species were found to conform to the first hypothesis; that is, Red-necked Stint, Curlew Sandpiper, Sharp-tailed Sandpiper. Lesser Golden Plover, Mongolian Plover, Bar-tailed Godwit, and Red Knot behaved in a manner consistent with the second hypothesis; that is, they stopped in northern Australia despite not having used all their fat reserves to get there. The Great Knot was found to conform to the third hypothesis. In the other species considered in this paper, data were insufficient to test the hypotheses.

There is clearly much scope for further research on the northward migration of waders from Australia. Banding studies in the north would be particularly desirable for two reasons: firstly, they would increase the chances of recaptures in the north of birds banded in southern Australia, and vice-versa, as well as improving the prospects for more frequent reports of banded birds from Asia; secondly, they would provide information on the condition, especially fat reserves, of migrating waders in the north. There is also scope for more banding work in southern Australia to determine movements in this part of the continent before departure for destinations north and to compare the amount of pre-migratory fattening in different areas. Clearly work in South Australia, where many of the species examined here occur in their largest numbers in the south, would be most desirable.

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Table 1: List of sites counted during the Northward Migration Project.

New South Wales	
Iluka/Woody Head	10
Nambucca River Estuary	8
Pelican Island, Hastings River	11
Wallis Lake, Forster	17
Kooragang Island, Newcastle	9
Swansea	10
The Entrance	7
Long Reef	10
Dangars Lagoon, Uralla	11
Racecourse Lagoon, Uralla	10
Dubbo Sewerage Lagoons	7
Fivebough Swamp, Leeton	9
Lake Wyangan	7
Victoria	
Lake Murtnagurt	9
Barwon Heads	9
Thompson Creek Mouth	9
Swan Island, Queenscliff	11
Werribee Sewerage Farm	10
Yallock Creek, Westenport	8
Observation Point, Westernport	10
Lake Hindmarsh	7
Hattah Lakes	9
Bendigo Sewerage Farm	12
Tatura Sewerage Farm	6
Lake Lonsdale	10
Queensland	
Cairns Foreshore	14
Bushland Beach, nr Townsville	10
Ross River Mouth, Townsville	11
Alva Beach, nr Ayr	8
Port Denison, Bowen	10
Mackay Area:	
Finlaysons Point, Seaforth	12
Bucasia Beach	9
Town Beach	10
Far Beach/Bakers Creek	12
Armstrongs Beach	10
Gatakers Bay, nr Point Vernon	10
Moreton Bay:	
Hays Inlet to Nudgee Beach	12
Toorbul	8
Deception Bay	16
Thornside area	7
Manly	9
Wellington Point	11
Nanango Sewerage Works	9
South Australia	
North Canunda Beach	12
Pelican Lagoon, Kangaroo Island	11
Western Cove, Kangaroo Island	9
Whyalla Saltfields	6
Western Australia	
Kanidal Beach, Eyre	9
Wilsons Inlet, nr Albany	8
Peel Inlet	11
Lake Yangebup	10
Greenough River Mouth	12
Boulder Sewerage Farm	10
Kalgoorlie Sewerage Farm	9
Tasmania	
Georgetown, nr Launceston	10
Northern Territory	
East Point, Darwin	12
Casuarina Sandbar, Darwin	7
Lee Point, nr Darwin	13
Alice Springs Sewerage Farm	12

Table 2: Scores allocated to peaks and plateaux in numbers of waders at a site and used as the basis for the movement index (see text).

CHANGE IN NUMBERS	SMALL NO. BIRDS	LARGE NO. BIRDS
Big Peak	5	10
Small Peak	2.5	7.5
Plateau	2.5	7.5

Table 3: Lean weights and departure weights of selected species in Victoria, together with flight ranges calculated using the formulae of Summers and Waltner (1) and Davidson (2).

SPECIES	LEAN WEIGHT (g)	FAT WEIGHT (g)	FLIGHT RANGE(km) (1)	(2)
Grey Plover	230	380	6760	6060
Lesser Golden Plover	127	177	3750	3260
Mongolian Plover	70	106	4070	3260
Ruddy Turnstone	100	172	5930	5120
Bar-tailed Godwit				
male	290	416	5060	4570
female	350	520	5850	5330
Red Knot	120	175	4230	3670
Great Knot	155	267	6650	5860
Sharp-tailed Sandpiper				
male	74	100	2950	2500

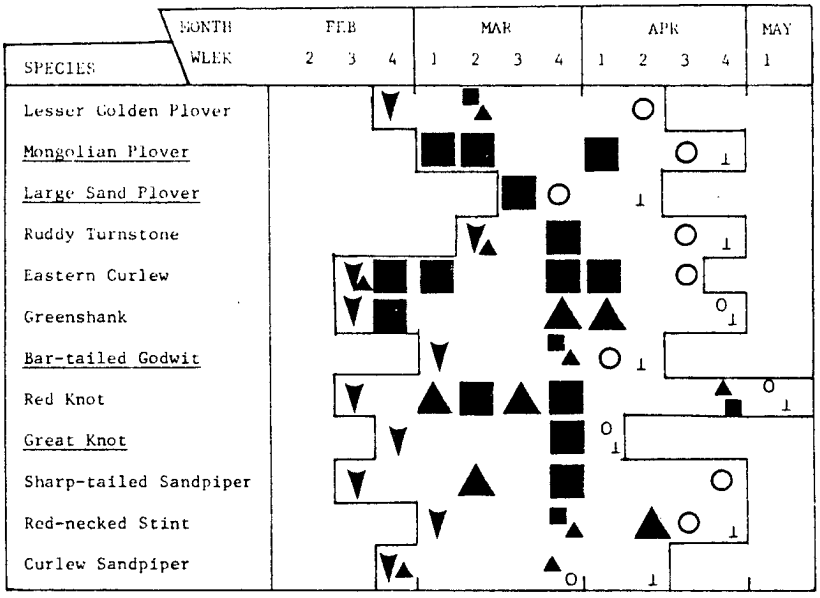
female	56	75	2660	2230
Red-necked Stint	29.5	42	2760	2240
Curlew Sandpiper				
male	56	85	3870	3240
female	60	89	3710	3120

KEY TO SYMBOLS

- First departure (southern Australia)
- Period of maximum departure from southern Australia
- Period of maximum departure from northern Australia
- O o Most birds gone by this time (excl. north-west coast)
- ⊥ Most birds gone from north-west coast by this time

Figure 2: Summary of northward migration of the twelve most abundant species counted during the northward migration project.

Underlined species occured predominantly in northern Australia.



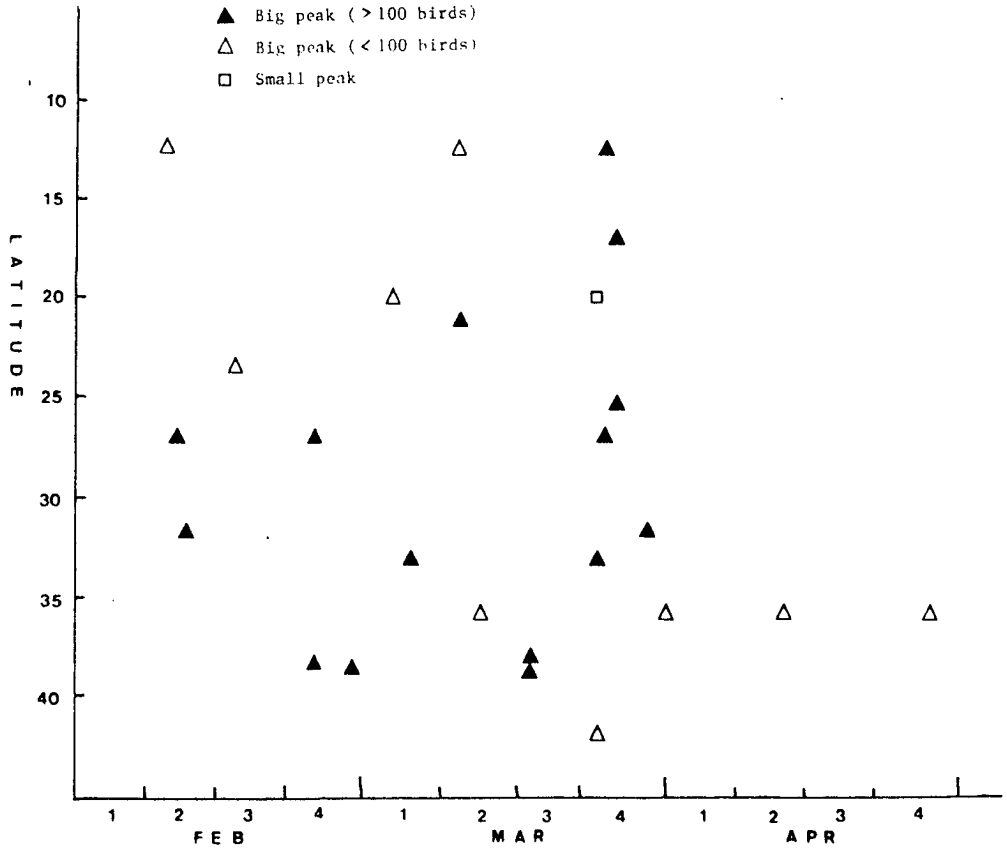
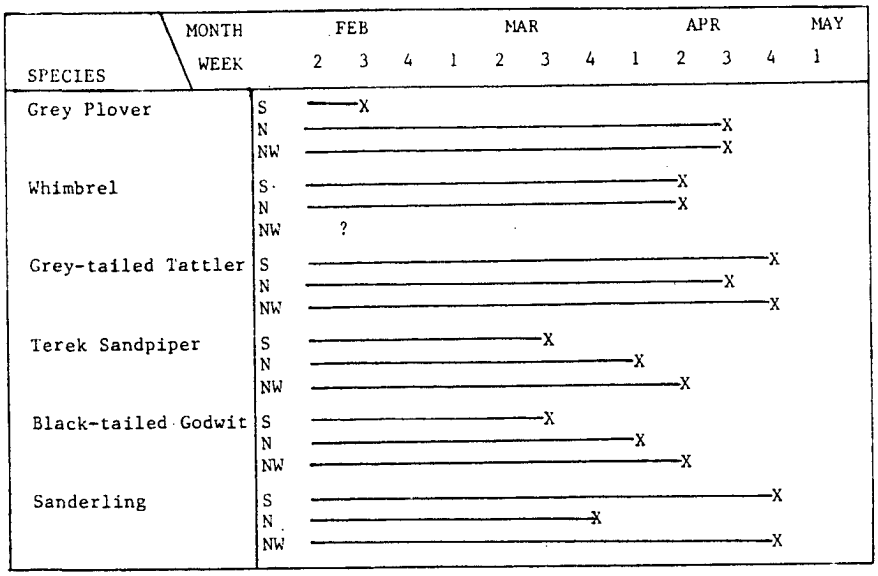
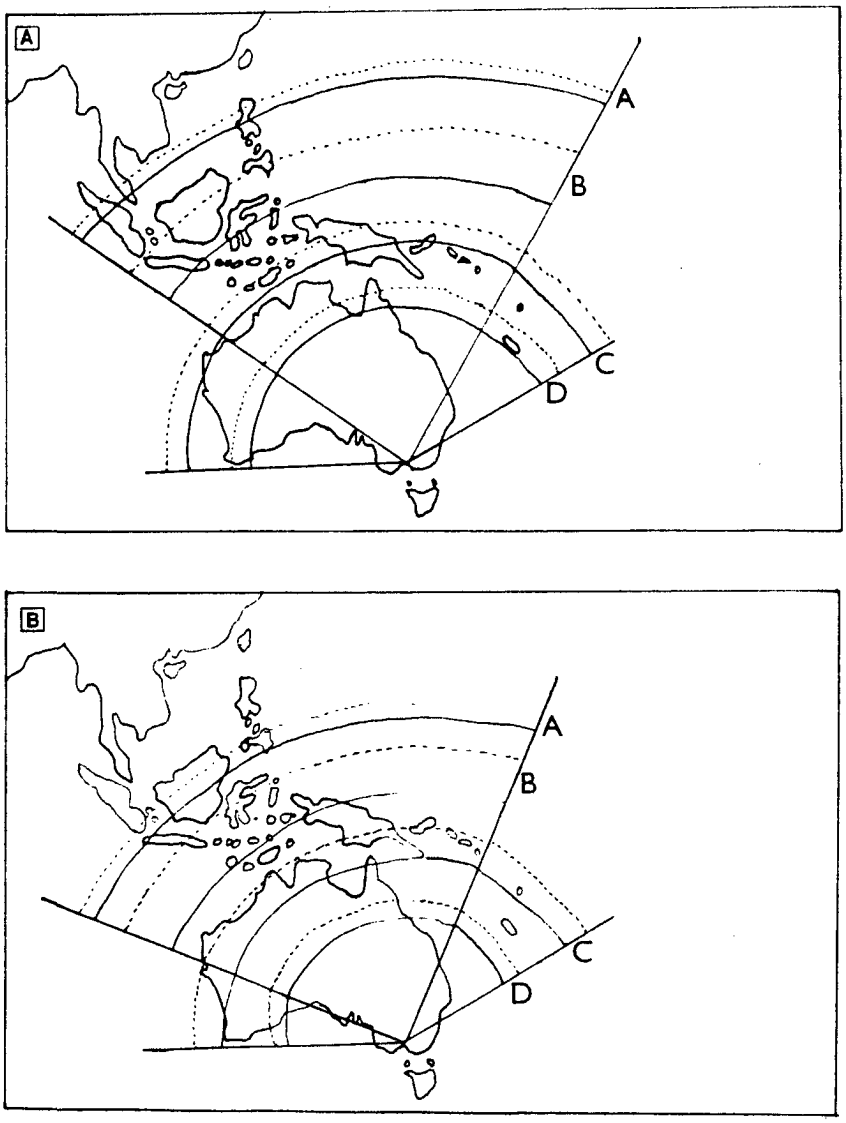


Figure 1: Scattergram of peaks and plateaux in numbers of Bartailed Godwits; latitude versus date.



S= Southern Australia
N= Northern Australia
NW= North-west coast

Figure 3: Generalised departure schedule of remaining species counted during the Northward Migration Project.



A = Grey Plover, Great Knot
B = Bar-tailed Godwit, Ruddy Turnstone
C = Lesser Golden Plover, Red Knot, Curlew Sandpiper
D = Sharp-tailed Sandpiper, Red-necked Stint

Figure 4: Maps showing the potential flight ranges from Victoria of selected waders based on the formulae of Summers and Waltner (A) and Davidson (B).

HOW FAR CAN WADERS FLY?

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Introduction

Recent papers by Barter (1984a,b) have suggested that small *Calidris* species may be able to fly from Tasmania to north-western Australia in a single flight, a distance of 3670 km. This assumes that birds fly directly across Australia, a suggestion I first put forward in 1970 (Thomas 1970). I believe that Barter's flight ranges of Tasmanian Curlew Sandpipers *C.ferruginea* and Red-necked Stints *C. ruficollis*, which he admits are conservative, underestimate the potential distances which these birds can fly nonstop, that a re-examination is warranted. The main difficulties associated with Barter's calculations stem from his use of the McNeil and Cadieux (1972) equation, as modified by Summers and Waltner (1979), which involves assigning values to both ground speed and take-off weight.

Estimated flight ranges well in excess of 3670 km have been published (for summary see Hale (1980)). For example, Johnston and McFarlane (1967) estimated that Lesser Golden Plover *Pluvialis dominica* can fly 10,000 km and Barter (1986) gives a value of 7300 km for the Great Knot *C.tenuirostris*. If these estimates are correct it raises two important questions:

1. How far can Tasmanian birds fly and do they need to pause on reaching the north Australian coast, and

2. Do Tasmanian birds fly mainly to N.W. Australia or do they follow the more direct great circle route to their breeding grounds which could take them east to the Gulf of Carpentaria or even northern Queensland?

Some Theoretical Considerations

Barter (1984,b) used the McNeil and Cadieux (1972) equation as modified by Summers and Waltner(1979)

Flight range (km) R =

$$956.8 \times S \times (M_2^{0.256} - M_1^{0.256})$$

where S = flight speed in km/h and M_1 and M_2 the lean peak weights in kg.
Barter took the flight speed to be 75 km/h. It is presumed that this is the ground rather than the air speed. Only flight through the air involves the consumption of a bird's energy reserves. Recent studies by the A.W.S.G. as reported in the media have shown that birds may leave N.W. Australia with a strong, 40 km/h following wind and ground speeds of 100 km/h. This alone increases Barter's estimated flight ranges by a factor of 1.33 (see below). However, if birds wait for a suitable following wind they must be able to determine their desired heading by some means, probably from astral clues. As wind direction changes with altitude, how do birds select the altitude at which they fly? Lack (1960) has recorded waders at an altitude of 7000m after a sea crossing. I have long believed that, to some extent, birds navigate by maintaining a constant angle to the wind, a view shared by Bellrose (1967). If wind direction changes during the duration of a flight, wind drifted migrants will result. Possibly birds can compensate for this, using visual clues (if available), Coriolis forces or magnetic fields or by changing altitude to maintain a constant angle to the wind. Bellrose has reported that the volume of migration may be independent of the presence of astral clues. He has also reported that air speed is reduced as wind speed increases so that ground speed is constant. As this is a means of energy conservation it throws some doubt on the accuracy of the modified McNeil-Cadieux equation. I suggest that a more accurate representation would be

$$R = 956.8 \times S_G \times (S_A + S_W)/S_A \times (M_2^{0.256} - M_1^{0.256})$$

where S_G is the ground speed, S_A the air speed and S_W (which can be either positive for a following or negative for a head wind), the resolved ($S_W \cos \theta$) where θ is the angle between the birds track and the wind direction component of the wind speed.

Barter used the mean March or April weight for M_2. For the Curlew Sandpiper *Calidris ferruginea* the mean March weight of 68.7g in south-eastern Tasmania is considerably less than the mean April weight of 79g found by Elliott et al (1978) in South Africa. On the 24th March, 1968 I collected a female weighing 81g, considerably heavier than the 77g calculated by Barter required to reach Port Hedland. It represents a 44% increase over the mean northern winter weight. Minton (1969) recorded an even greater increase of over 100% for a bird in the U.K. and this increase was achieved in only 10 days. I collected a female Red-necked Stint on 6 April 1968 that weighed 49% more than the mean winter weight. Middlemiss (1961) recorded a Little Stint *C.minuta* that showed a corresponding increase of 90%.

Assuming an increase of weight of up to 100% is possible, the theoretical flight ranges of Curlew Sandpipers and Red-necked Stinte are as shown in Fig.1 for ground speeds of 75 and 100 km/h. These curves have been calculated from the modified equation used by Barter. If the ground speed is 100 km/h and the wind speed 40 km/h curve C results. From the maximum weights of Tasmanian birds, an air speed of 60 km/h and a following wind of 40 km/h the potential flight ranges are 9400 km for the Curlew Sandpiper and 8950 km for the Red-necked Stint. These values are approaching the 10000 km suggested by Johnston and McFarlane (1967) provided that the following wind remains constant over these distances in both velocity and direction. This seems unlikely so that the values quoted above represent an upper-bound to the potential flight range although wind drift may be an alternative result.

There can be no doubt that small waders are capable of flying far further than either the Gulf of Carpentaria or N.W.Australia, at least in theory. In practice we do not know what the take-off weight is or whether there is a critical weight below which an individual will not take-off. The take-off weight almost certainly is greater than the mean catch weight used by other workers. The important question then becomes: will an individual take-off with the advent of favourable conditions regardless of its weight or will it wait for these conditions to occur once it has attained a certain critical weight? Is this critical weight the same for all individuals? This seems to pose an impossible dilemma, especially as a bird may double its weight in as little as 10 days. It must also be assumed that the environment can provide sufficient food and, equally important, enough foraging time is available to obtain the required amount of food. Further, we do not yet know what the weather conditions are when they leave Tasmania or what winds they are likely to encounter on their flights. Nor do we know what effect changes in wind direction have on the track of migrants. If birds have such a large potential flight range, why should Tasmanian birds fly via N.W. Australia, if indeed they do, rather than by the more direct great circle route via the Gulf of Carpentaria or northern Queensland? One possibility is that the New Guinean cordillera of up to 5500m results in a migratory divide. If Tasmanian birds fly west of New Guinea to avoid the cordillera then it would be reasonable to expect them to travel by N.W.

Australia. However, Garnett (1986) reports large numbers of migratory waders in the Gulf of Carpentaria. He assumes that Red Knots *Calidris canutus* move on to New Zealand but the reasons for this are obscure. In any case, to reach the Gulf birds must fly east from N.W. Australia or west from N.E. Australia or they must have crossed the cordillera. As stated earlier Lack (1960) has shown that waders can fly at heights that would allow them to cross the cordillera. Bull (1948), Thompson and Hackman (1968) and Stickney (1943) report waders on islands east of New Guinea that are as representative of Australia as they are of New Zealand. I provided some circumstantial evidence for waders crossing the cordillera (Thomas 1970) and the late H.L.Bell (in litt.) provided me with additional evidence. Contrary to my earlier statement concerning southern New Guinea, the south coast contains prime wader habitat west from the east of the Gulf of Papua. In March 1967 Bell witnessed 500 Eastern Curlews *Numenius madagascariensis* leaving Port Moresby where it is normally "very very rare" taking off at dusk heading over the Owen Stanley Range. The inference is that waders may pause on the southern coast of New Guinea before crossing the cordillera. If they do they could fly to and from south-eastern Australia and Tasmania without landing on Australia's northern coasts.

Discussion

The aerodynamic aspects of waders are such that they would be expected to fly the great circle route between their breeding and wintering grounds, i.e. they would migrate on a broad front not relying on topographical features. On the other hand, it is equally possible that migration occurs in several stages with halts at traditional "staging points" which could ignore great circle routes. Latham's Snipes appear to enter and leave Australia through northern Queensland and to enter Tasmania through King Island and the Circular Head area (Naarding 1981). N.W. Australia may well be such a staging area for birds from southern Australia, including Tasmania. However, on present evidence, including that given in Thomas (1970) and Blakers et al (1984), it would be most unwise to assume that this is so, particularly when biases are introduced by banding at a limited number of selected areas on northern Australian coats. Given known maximum weights small waders can fly up to 5500 km at 100 km/h without wind assistance and it would be equally unwise, on present evidence, to assume that migrants would pause on reaching the northern coasts of Australia unless forced to do so by unfavourable weather conditions or to correct their course when subject to wind drift. Then the pause may be only temporary while waiting for favourable conditions. They may also pause if they leave their wintering grounds with insufficient fat reserves and need to replenish subcutaneous fat (King and Farmer 1965), but this has still to be proved.

This leaves several unanswered questions concerning the use of regular staging posts during migration. These areas may hold really large transient numbers of waders (e.g. Recher 1966). If these areas are capable of supporting these large transient numbers, why do birds find it necessary to move on only to be replaced by others? Presumably the number of migrants present during the southern summer is determined by the carrying capacity of the northern Australian habitats, so how did this behaviour evolve? Is it influenced by the composition of the resident species? Similarly, why have some species, e.g. Short-billed Dowitcher *Limnodromus griseus* (Jehl 1963), acquired the adaptation whereby adult females, adult males, and birds of the year migrate at different times and in that order? How many species does this apply to?

Since I published my earlier wader papers a considerable amount of additional knowledge has been acquired although I fear that some of it may be open to misinterpretation. In this note I trust I have drawn attention to some of the aspects which I wish I had been able to follow up because I believe it preferable to solve these problems than, in Newman's (1982) words, "the continued monotonous collection of biometric date (i.e. weights, wing lengths, moult score (etc.)". For instance, I find the question of whether the rate of increase of primary moult score is linear or sigmoidal to be mildly interesting but essentially trivial: the important factor being that most members of the Scolopacidae, apart from some populations of the Dunlin *Calidris alpina* (Holmes 1966), probably moult their flight feathers on the wintering grounds although some species of populations, e.g. the Wood Sandpiper *Tringa glareola*, may halt migration to renew remiges (Hoffman 1957, Hale 1980). However, confirmation of this is still required for many species.

I discontinued my own work on waders, which included as yet unpublished studies of foraging ecology and aggression in 1969 because I felt that I had reached the limit that one person working alone in his spare time could hope to achieve. Also, I wished to study bush birds with the advent of the woodchip industry. The advent of new techniques, such as cannon netting, and increased interest in the systematic study of waders that can be organised into co-operative ventures has far extended this limit. As one of the first to undertake systematic wader studies in Australia I hope that I will be excused for this purely personal selection of what I perceive to be the most important topics for study.

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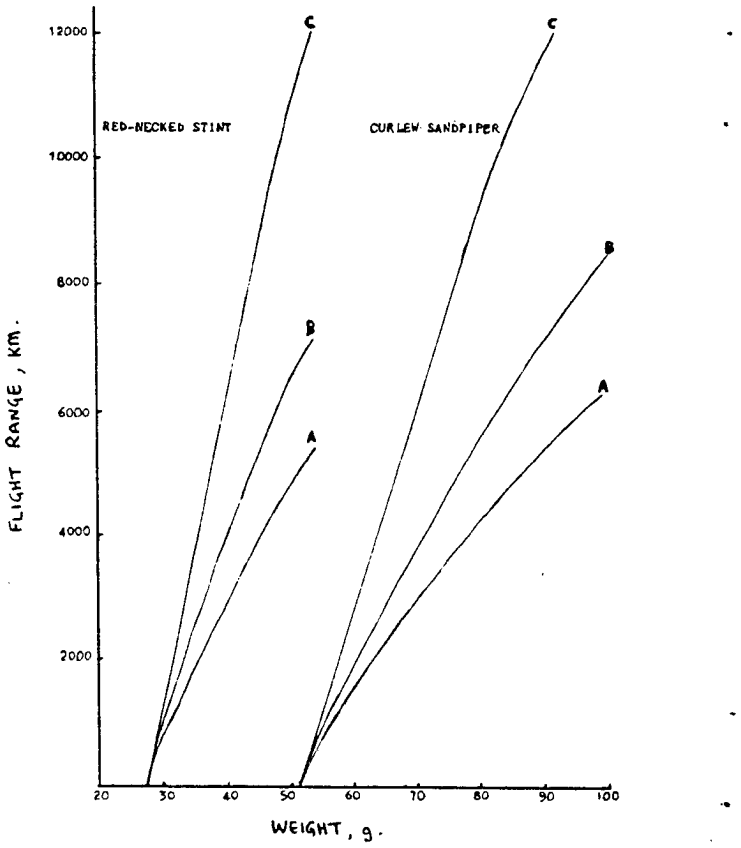

Fig. 1.

Calculated flight ranges of Red-necked Stinte and Curlew Sandpipers according to take-off weight.

A. Calculated from

$R = 956.8 \times S \times (M_2^{0.256} - M_1^{0.256})$

with S = 75 km/h.

B. Calculated as A but with S = 100 km/h.

C. Calculated from

$R = 956.8 \times S_G \times (S_A + S_W) / S_A \times (M_2^{0.256} - M_1^{0.256})$

with S_A = 60 and S_W = 40 giving S_G = 100 km/h.

With different values of S_A and S_W a family of curves is generated. For S_G = 100 and S_W = 0, S_G = S and Curve B results because $(S_A + S_W)/S_A = 1$ assuming S_G is constant regardless of S_W (Bellrose 1967). Where the direction of the wind is different to that of S_A the value of S_W becomes $S_A \cos \theta$ where θ is the angle between the bird's course and the wind direction.

NORTHWARD WADER MIGRATION ALONG THE EAST COAST OF SUMATRA: Joint PHPA/INTERWADER SURVEY.

Marcel J.Silvius

INTRODUCTION

As part of the joint programme between INTERWADER and the Indonesian Directorate General of Forest Protection and Nature Conservation (PHPA), a preliminary survey was conducted between 23 March and 14 April 1986 covering the major parts of Jambi and Sumatra Selatan provinces. The survey concentrated on four areas which had already been identified as being of great importance for waders, storks and Black-headed Ibis (Silvius et al 1985). These areas, located between 103 degrees 5 minutes and 105 degrees East, 1 degree and 2 degrees 5 minutes South, are:

1. Berbak Game Reserve, Jambi Province
2. Hutan Bakau Pantai Timor Nature Reserve, Jambi Province.
3. Tanjung Jabung area, Jambi Province
4. The peninsula between the Banyuasin and Sembilang rivers, Sumatra Selatan Province (further referred to as "Banyuasin Peninsula").

AIMS

The aim of the project was to gather information on the potential of this stretch of coastline as a feeding and resting area for migratory shorebirds, to search for colonies of herons and storke, collect information on habitat, especially vegetation and habitat threats. With this information a preliminary evaluation of the forest areas in the context of the RAMSAR CONVENTION (1971) was to be made.

This article gives a short overview of the wader data from this area, and special attention is paid to the Asian Dowitcher.

METHODS

Surveys were conducted with speedboats and fishing boats, approaching important feeding sites and high tide roosts from the seaward side.

RESULTS

A total of nearly 40,000 waders was recorded, of which 63% were in Jambi Province and 37% on Banguasin Peninsula. Important feeding areas were located at S.Siput (>10,000 birds), S.Jentolo (>1500), S.Barong Kecil (1400), S. Dinding (3300), the mudflats south of Cemara (2850), Tg. Jabung (5300) and the area between S.Simbur Maik and S. Lambur Luar (>10,000). High tide roosts were often found in the vicinity of these feeding areas. A species breakdown of wader numbers per site is given in Tables 1 and 2.

A total of 20 species was recorded including rare species such as the Nordmann's Greenshank (8 individuals) and Asian Dowitcher. The observations of the Nordmann's Greenshanks constitute the first record of the species on Sumatra. Of a few other species only very few sightings were known for Sumatra (K. Voous Pers. comm.):

Oriental Plover: second sight record
Red Knot: only one previous sight record (7/5/79, a small flock at Percut by W.E.M. van der Schot; K.Voous pers.comm.) and one specimen collected in mid May 1905 by Parrot (1907). Large flocks such as at S.Simbur Naik (250) had never been reported before from Indonesia.

Sanderling: only very few records including one record from Way Kambas (S.E.Sumatra) by J.Wind.

The most exciting result was the minimum total count of 3800 - 4000 Asian Dowitchers, of which 1763 to 2263 were at the Banyuasin Peninsula. This is the largest number ever recorded. Large flocks (total of 1460) were also sighted in 1984 in Jambi Province (Silvius et al 1985). These data indicate that the south-east coast of Sumatra is the main staging, and probably wintering, area of the species.

In early November 1985, Milton (1985) recorded 486 Asian Dowitchers in Way Kambas Game Reserve, Lampung Province, which shows an even wider distribution along the south-east coast of Sumatra. In July/August 1985, Danielson and Skov recorded 16 birds which may have stayed over the summer. That small numbers of Asian Dowitchers remain in the Indonesian region during summer (June-July) was already known from 4 specimens collected on Java by Barsel at the beginning of this century in May, June and July (Silvius et at 1985).

A remarkable difference between the Dowitcher populations of the two Provinces was noticed. In Sumatra Selatan 80-90% of the birds were in winter/first winter plumage, while in Jambi Province nearly all birds were in summer plumage (>90%). This difference facilitates cumulation of the counts as significant overlap can be ruled out.

The difference may be caused by clustering of different age groups, but as plumage descriptions of Asian Dowitchers of different ages are too incomplete and often conflicting, it was not possible to conclude anything about this.

A possible distinguishing feature may be the pinkish base of the lower mandible of immature birds (Beadle and Whittaker 1985), but during this survey no particular attention was paid to this.

It is, however, very unlikely that the majority of the birds in Sumatra Selatan were first winter birds, as this would account for nearly 50% of the presently known world population. Another possibility is that birds used separate wintering areas, causing differences in moult timing.

With at least 3800 individuals, the Asian Dowitcher was one of the commonest waders on Sumatra's east coast. Other abundant species were Common Redshank (>7500), Mongolian Plover (>3500) and Black-tailed Godwit (>3000).

The Black-tailed Godwit was much commoner in October - November 1984 when a total of 15,750 was counted (Silvius et at 1985). In 1985, 42800 individuals were counted in July - August (Danielson and Skov, in press). From these figures we can conclude that the species is an early migrant, arriving before most other species and departing earlier to the breeding grounds.

The Curlew Sandpiper was also very common. A total of 2750 were identified, but many more were present. They were often feeding far up the beach, and with the observer standing in the sea, they were often difficult to identify (recorded as unidentified waders). During the 1984 survey only about 860 individuals were counted. This species occasionally roosts in small trees together with Terek Sandpipers and Common Redshanks.

Importance of the east coast of Sumatra as part of the East Asia/Pacific Flyway.

It is clear that the east coast of Sumatra holds internationally important concentrations of waders. Table 3 gives an overview of the highest numbers recorded for wader species in the area.

From other areas (ie Sabah: Parish, Beadle and Whittaker, in prep., Morocco: Kersten and Smit 1984), turnover rates have been estimated up to a

range of 3-6 times and 4-5 times of the peak count respectively. In south-east Sumatra this would mean 300,000 - 600,000 waders use the coastline each year.

The area contains the highest number of Asian Dowitchers ever recorded. and may be a staging and may be wintering area for more than 90% of its world population.

PHPA - INTERWADER are currently preparing recommendations for the conservation of the more important sites along this coast.

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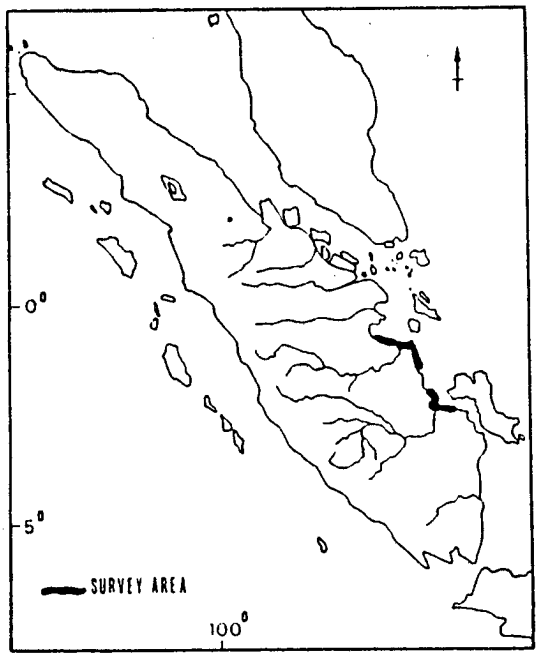
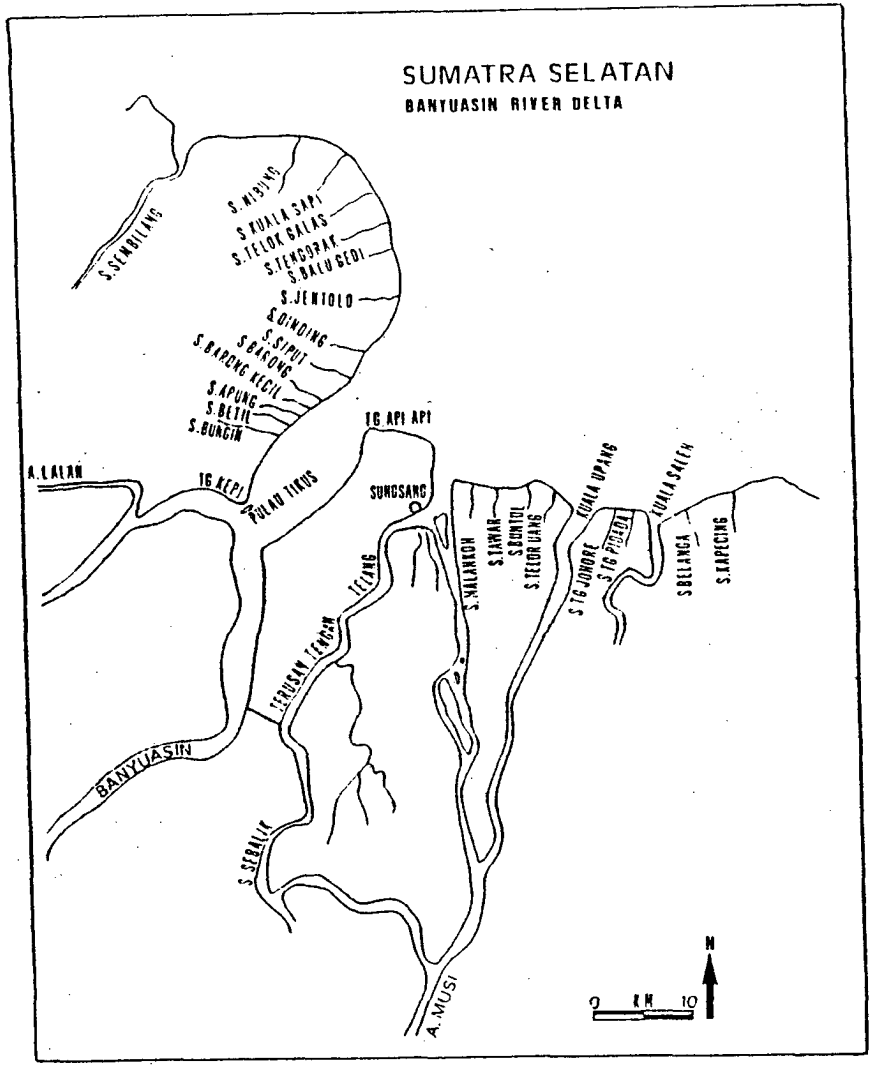
TABLE 3: Highest recorded number of wader species on the South-east coast of Sumatra (1984-1986).

SOUTH EAST COAST OF SUMATRA		%
Oriental Pratincole	87	0.08
Malaysian Plover	30	0.03
Kentish Plover	14	0.01
Mongolian Plover	16426	15.46
Large Sandplover	360	0.34
Oriental Plover	1	0.00
Asian Golden Plover	17	0.02
Grey Plover	203	0.19
Great Knot	775	0.73
Red Knot	304	0.29
Red-Necked Stint	89	0.08
Curlew Sandpiper	2753	2.59
Sanderling	4	0.00
Broad-billed Sandpiper	33	0.03
Asian Dowitcher	3800	3.58
Black-tailed Godwit	42800	40.28
Bar-tailed Godwit	9020	8.49
Whimbrel	1677	1.58
Eurasian Curlew	4720	4.44
Eastern Curlew	406	0.38
Common Redshank	14580	13.72
Marsh Sandpiper	395	0.37
Common Greenshank	375	0.35
Nordmann's Greenshank	8	0.01
Wood Sandpiper	27	0.03
Terek Sandpiper	6610	6.22
Common Sandpiper	218	0.21
Ruddy Turnstone	521	0.49
TOTAL	106253	

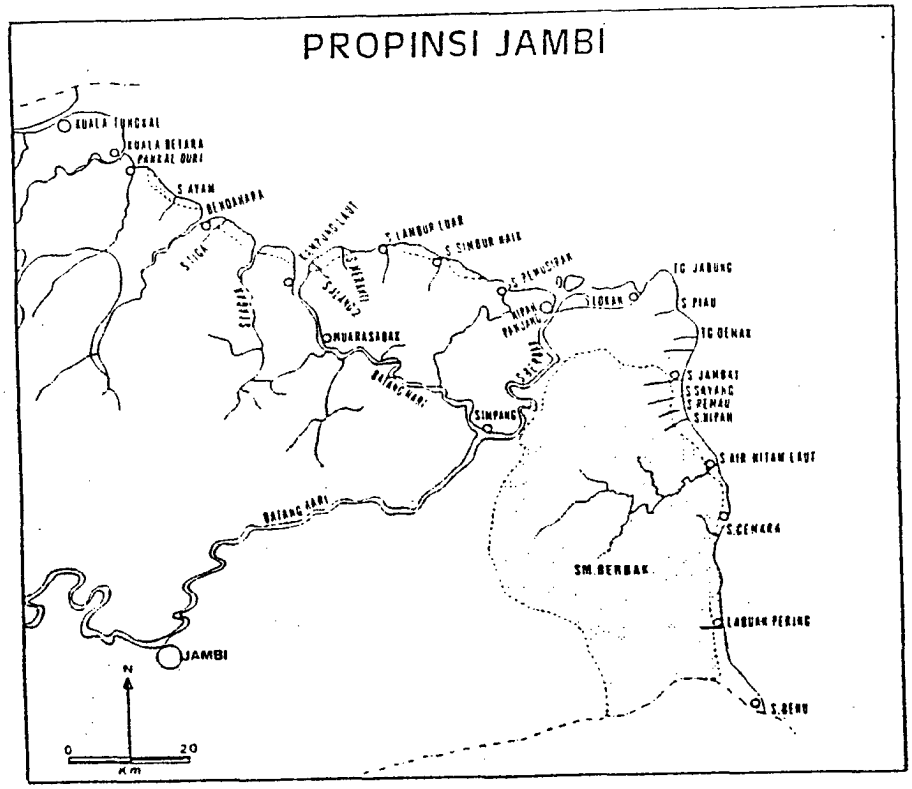
SOURCES:
Silvius et al 1985
Danielson and Skov 1986
Silvius 1986



MAP 1: Location of the survey area on the south-east coast of Sumatra.



MAP 2 : The survey area in Sumatra Selatan Province, March 1986.



MAP 3 : The survey area in Jambi Province, April 1986.

TABLE 1

SUMATRA SELATAN

MIGRATORY WADERS	1	2	3	4	5	6	7	8	9	TOTAL
Glareola maldivarus										0
Pluvialis squatarola							3			3
P. fulva										0
Charadrius alexandrinus										0
C. peronii										0
C. mongolus							600	150		750
C. leschenaultii							65	80		145
C. veredus										0
Numenius arquata				174				50	3	227
N. phaeopus		6		25	2		237	150	10	430
N. madagascariensis							9	30		39
Limosa limosa							100	6	35	141
L. lapponica				1						1
Tringa totanus		130		480		30	1688	650		2978
T. stagnatilis							20			20
T. nebularia							96	10		106
T. guttifer										0
T. glareola										0
Xenus cinereus				20			610			630
Actitis hypoleucos							4			4
Arenaria interpres								5		5
Limnodromus semipalmatus							1763	*500		1763-2263
Calidris tenuirostris							66			66
C. canutus							5			5
C. ruficollis										0
C. feruginea							600	100		700
C. alba										0
Limicola falcinellus										0
Unidentified waders							5800	550		6350
WADERS TOTAL	0	136	0	700	2	30	11666	2281	48	14363/ 14863

TABLE 1: Peak counts of waterbirds per observation site, in Sumatra Selatan province and the total. 23-30 March 1986.

Note to Table 1:
Site numbering and date of visits:

1. S. Kapecing (26th March)
2. S. Buntol (26th March)
3. Sungsang inland (30th March)
4. Tg. Api Api & Sungsang (23rd March, 29th March)
5. Tg. Kepi - S. Bungin (27th March)
6. S. Bungin - S. Betil (24th, 26th March)
7. S. Apung - S. Dinding (24th, 25th, 29th March)
8. S. Jentolo - Telok Galas (23rd, 25th, 28th, 29th March)
9. Telok Galas - S. Nibung (25th, 28th, 29th March)

Symbols in the table:

■: Estimate from the number of nests (2 x number of nests).
*: Double count or maybe double counted.

MIGRATORY WADERS	10	11	12	13	14	15	16	17	JAMBI TOTAL
Glareola maldivarum	6								6
Pluvialis squatarola	41	8	8	140		3			200
P. fulva		3							3
Charadrius alexandrinus	14								14
C. peronii	30								30
C. mongolus	960	370	36	900		520			2786
C. leschenaultii	105	30		80					215
C. veredus		1							1
Numenius arquata	20	27	20	46		1			114
N. phaeopus	141	119	36	82		70		97	545
N. madagascariensis	18	110	2	51					181
Limosa limosa		2760		64		125			2949
L. lapponica	35	3		50					88
Tringa totanus	475	990	42	2500		400	90	60	4557
T. stagnatilis	129	15	51	150		30			375
T. nebularia	15	32	37	150		35			269
T. guttifer	6			2					8
T. glareola	5	2		20					27
Xenus cinereus	375	115	12	40		29			571
Actitis hypoleucos	11								12
Arenaria interpres	2	49		5					56
Limnodromus semipalmatus	19	474	*196	1497		52			2042-2238
Calidris tenuirostris	19	3							22
C. canutus	4	44		250		1			299
C. ruficollis		20		38					58
C. ferruginea	420	130	53	750		700			2053
C. alba	4								4
Limicola falcinellus	2	11		20					33
Unidentified waders			100	9400					9500
WADERS TOTAL	2856	5316	397-593	16236	0	1966	90	157	24976

TABLE 2; Peak counts of waterbirds per observation site in Jambi Province and the total. 3-13 April 1986.

Note to Table 2:
Site numbering and date of visits:

10. Cemara sandy beach (12th April);
11. S. Jambat - Tg. Jabung (11th, 13th April:
12. Nipah Panjang - S. Pemusiran (3rd, 5th, 6th April);
13. S. Simbur Naik (eastside) - Lambur Luar (6th, 10th April);
14. Kampung Laut (eastside) - S. Lagan (10th April);
15. Bendahara (westside rivermouth), (7th April);
16. Pankal Duri eastward halfway to Bendahara (9th April);
17. Sungai Betara, eastward to Pankul Duri (9th April).

Symbols in the table:

*: Double count or maybe double counted.

WADERS ALONG A SECTION OF THE GREAT BARRIER REEF.

John Cornelius, 88 Hayward Street, Cairns, Queensland 4870.

During 1-15 April, 1986, I was involved in routine field operations in the Far Northern Section of the Great Barrier Reef Marine Park from Thursday Island to Cairns. A list of waders counted on the reef sand cays and continental islands is presented.

Species codes used:

1. Beach Thick-knee
2. Pied Oystercatcher
3. Sooty Oystercatcher
4. Lesser Golden Plover
5. Mongolian Plover
6. Large Sand Plover
7. Ruddy Turnstone
8. Eastern Curlew
9. Whimbrel
10. Grey-tailed Tattler
11. Greenshank
12. Terek Sandpiper
13. Bar-tailed Godwit
14. Great Knot
15. Red-necked Stint
16. Curlew Sandpiper

Date	Island Name	Location	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
3.4.86	Milman Islet	(11°10.3'S,143°00.8'E)	2			3	7		3			6	1	1				
4.4.86	W.Hannibal Islet	(11°31.0'S,142°56.0'E)	1	14	3	12	17		12		1		1		12	20	17	
4.4.86	Saunders Islet	(11°42.2'S,142°10.8'E)	2						2									
5.4.86	Buchan Rock	(11°51.4'S,143°18.7'E)				1			8									
5.4.86	Magra Islet	(11°51.0'S,143°17.0'E)					1		17									
6.4.86	Kay Island	(12°13.2'S,143°15.8'E)		2		2			9									
6.4.86	Farmer Island	(12°16.0'S,143°14.0'E)	5	6		4	2		8	2	29	7		7	5			
6.4.86	Beesley Island	(12°14.5'S,143°12.0'E)	1		2	1	1			2	5	16			1			
7.4.86	Chapman Island	(12°53.2'S,143°36.2'E)									2	3						
8.4.86	Night Island	(13°11.0'S.143°34.5'E)				2	2		1			1						
8.4.86	Binstead Island	(13°13.1'S,143°34.2'E)	2		4				25		2							
8.4.86	Ellis Cay	(13°23.9'S,143°42.1'E)		2		7	42		7			196						1
8.4.86	Morris Island	(13°29.6'S,143°43.4'E)		2				1										
8.4.86	Fife Island	(13°39.4'S,143°43.1'E)													1			
9.4.86	Hay Island	(13°40.3'S,143°04.4'E)		2			4					4						
9.4.86	Pelican Island	(13°55.0'S,143°50.0'E)	2	16	1	6	7		5		2	150					6	
9.4.86	Stainer Island	(13°57.4'S,143°50.2'E)																
9.4.86	Grub Reef	(14°04.0'S,143°53.0'E)					3		3		1	7						
11.4.86	Pipon Islet	(14°07.3'S,144°31.6'E)	1	4														
12.4.86	Sinclair Island	(14°33.7'S,144°53.2'E)	6	4	2				7		1	5					5	
14.4.86	E. Hope Island	(15°45.0'S,145°27.0'E)				1			5		3	7						
		Total Birds	22	55	12	34	88	1	114	4	46	409	2	8	19	20	28	1

OCEAN SLICKS AND THE RED-NECKED PHALAROPE *Phalaropus lobatus*

M. Schultz, 167 South Beach Road, Bittern, Victoria, 3918.

Ocean slicks are smooth, narrow, long lines on the sea which mark zones of convergence between surface currents. Slicks are most prominent after heavy rains, when debris and floating objects wash out from large coastal river systems and collect along these lines of convergence (Dietz and LaFond 1950). The slicks provide a mechanism by which organic matter and nutrients are gathered, around which faunal concentrations build up and a food web is established. Here occur dense concentrations of planktonic organisms and predators such as fish, turtles, marine mammals and birds. Slicks are of particular importance in seas of poor productivity such as in the tropics (Kropach 1971).

The presence of slicks has been shown to be an important factor accounting for the distribution of some marine animals. The best documented example is the Yellow-bellied Sea Snake, *Pelamis platurus*, which forms aggregations of up to several thousand individuals along ocean slicks in tropical and subtropical waters (Allee 1931, Kropach 1971, Dunson and Ehlert 1971). The main activity of *P. platurus* in these slicks is foraging for fish and other prey (Kropach 1975).

Between the 8 and 11 November 1986, several thousand Red-necked Phalaropes *Phalaropus lobatus* were observed between Madang and Karkar Island and off the Huon Peninsula, Papua New Guinea. Here *P.lobatus* was primarily observed in flocks of from 6 to 100+ individuals. All birds were concentrated in slicks readily denoted by the presence of white froth and floating vegetation such as branches and coconuts.

P.lobatus primarily forages in densely packed flocks on small invertebrates such as crustaceans and insects (Burton 1974). On its "wintering" (non-breeding) grounds food is obtained by swimming on the sea with swift pecks into the water surface or by spinning in a rotary manner which is thought to help bring subsurface items within reach (Hohn 1971). A large proportion of *P. lobatus* observed were actively engaged in foraging. The only foraging method recorded were repeated series of rapid shallow pecks into the sea surface.

From these observations it would appear at least on *P. lobatus* "wintering" grounds off the coast of northern Papua New Guinea that ocean slicks are an important source of food and hence a major factor in determining the species' distribution at sea.

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FEEDING BEHAVIOUR OF EASTERN CURLEWS, WHIMBRELS AND TWO SPECIES OF OYSTERCATCHER.

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A perusal of a paper on the feeding behaviour of Eastern Curlew, (Piersma 1985), immediately recalled some comparatively superficial observations of my own made from the Esplanade, Cairns, Queensland, in January 1967 at half tide.

My field note, slightly modified, reads: 'I watched Eastern Curlews, *Numenius madagascariensis*, feeding. They were pursuing crabs, most of which dived into holes to escape. The curlew would plunge its bill into the hole to its full extent. Then, usually after many probes, a crab was extracted, its legs were removed and the body washed and swallowed. I gained the impression that the largest crabs were ignored and that the medium-sized crabs I saw swallowed represented a maximum effort.'

Also present were Whimbrels, *N.phaeopus*. The field note reads: 'These, unlike the smaller waders present, were respected by the crabs, which took evasive action. One bird caught a small crab, pulled it to pieces and ate the pieces unwashed.'

I am not competent to identify the crabs but they appeared to be frequent on the mud flats (mangrove swamp when I first knew Cairns). They may well have been Ocypodids.

Similar observations have been made elsewhere in Australia, (Thomas 1985).

Though I made no note of the impression at the time, I recall considering the possibility that the Curlews and Whimbrels were not competing, but preyed upon crabs of different sizes. This could also have applied to the Little Curlews, *N.minutus* which occurred in the same area.

On 20 April 1968, at Point Peron, W.A., I observed two Sooty Oystercatchers, *Haematopus fulginosus* on the rocks near Fisherman Point. My field note reads: 'One bird dislodged two limpets as the sea surged over them. One caused the bird some trouble: the soft parts separated from the shell only after a good deal of shaking and tapping on the rocks and being twice washed. It was then swallowed very quickly. The second mollusc gave less trouble, the soft parts being detached from the shell and swallowed in what was practically one movement. As I did not wish to flush the birds, I did not recover the shells but, viewed through binoculars they appeared almost certainly *Patelloida alticostata*, a very common animal in this area.

On 25 January 1969, at Karitane, Otago, New Zealand I watched at close quarters, with binoculars, two South Island Pied Oystercatchers,m *Haematopus finschi* opening bivalves, in at least one case, *Chione stutchburgi*, the common 'Cockle' of New Zealand - very frequent in that location. The opening took some time, the bird pivoting round the shell in its endeavours to screw out the animal.

REFERENCES:

Piersma,T., 1985, Eastern Curlew *Numenius madagascariensis* Feeding on *Macrophthalmus* and Ocypodid Crabs in Nakdong Estuary, South Korea. Emu 85:155.

Thomas,D.M., 1985, Gut Contents of Four Small Waders, The Stilt No.9: 30-31.

BANDING ROUND-UP.

Symbols used:

Age code:

U = unknown;
P = nestling;
J = juvenile;
1 = within the first year of life;
+1 = within the first year or older;
2 = within the second year;
+2 = within the second year or older; etc.

Sex: U = unknown; M = male; F = female.

Method of encounter:

01 = probably trapped but device unknown to banding office;
02 = trapped but device unknown to banding office;
03 = trapped in a mist net;
04 = trapped with cage trap;
05 = trapped with cannon net;
06 = trapped in clap trap, etc;
08 = caught by hand or with handheld net;
15 = deliberately trapped for food or aviary;
25 = sick or injured;
35 = collided with a lighthouse or stationary night light;
40 = band found on bird, no further data re method of encounter;
43 = band number only reported;
48 = colour marking sighted in field;
54 = beachwashed;
57 = band found on another species;
61 = shot;
67 = shot for food;
68 = shot for food or sport;
81 = taken by domestic or wild cat;
99 = found dead, cause unknown.

Status after encounter:

00 = unknown by banding office for bird and band;
02 = status of bird unknown, band removed;
03 = bird was dead, band status unknown;
05 = bird is dead and band was removed;
13 = bird released alive with band;
14 = bird released alive and the band was removed;
16 = bird rehabilitated, released with band;
19 = bird alive in captivity with band;
26 = bird alive in wild with band;
29 = bird partially decomposed, band removed.

Layout of data:

Line 1 - band number, banding place, co-ordinates, date, age, sex, bander;
Line 2 - recovery method, status, place, coordinates, date, age, sex, finder;
Line 3 - distance, direction, time elapsed.

The following lists are from data supplied to the Australian Bird and Bat Banding Schemes, Australian National Parks and Wildlife Service. Permission must be sought from the banders and clearance given by ABBBS before using these data in publications.

BAND NUMBERS BEGINNING WITH LETTERS ARE BANDS FROM FOREIGN BANDING SCHEMES.

137 LESSER GOLDEN PLOVER — PLUVIALIS DOMINICA

U86399641 ST GEORGE IS PRIBILOF ISLANDS ALASKA USA 56d31mN 169d31mW 24/08/66 +1 U BIRD BANDING LABORATORY (US
85 03 URUNGA NSW 30d30mS 153d 0mE 27/03/70 U U UNKNOWN
Distance: 10271.3 km Direction: 211 degs. Time elapsed: 3 yrs 7 mths 3 days

139 MONGOLIAN PLOVER — CHARADRIUS MONGOLUS

051-01796 STOCKTON BRIDGE STOCKTON NSW 32d54mS 151d47mE 28/12/76 +2 U LANE
67 05 RECLAIMED LAND NR MANILA HBR PHILLIPINES 14d37mN 120d58mE 19/04/86 U U DE PANO JR
Distance: 6196.41 km Direction: 323 degs. Time elapsed: 9 yrs 3 mths 22 days

140 DOUBLE-BANDED PLOVER — CHARADRIUS BICINCTUS

040-96019 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 17/06/79 1 U VICTORIAN WADER STUDY GROUP
04 13 HAKATARAMEA RIVER NEW ZEALAND 44d44mS 170d29mE 09/11/85 +2 F NEW ZEALAND BANDING SCHEME
Distance: 2282.10 km Direction: 117 degs. Time elapsed: 6 yrs 4 mths 22 days

041-01280 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 23/05/81 +2 U VICTORIAN WADER STUDY GROUP
04 13 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 21/11/86 +2 M NEW ZEALAND BANDING SCHEME
Distance: 2269.03 km Direction: 114 degs. Time elapsed: 5 yrs 5 mths 29 days

041-01361 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 31/05/81 +2 U VICTORIAN WADER STUDY GROUP
04 13 ALEXANDRA, NEW ZEALAND 45d15mS 169d23mE 27/10/85 U U NEW ZEALAND BANDING SCHEME
Distance: 2208.12 km Direction: 119 degs. Time elapsed: 4 yrs 4 mths 27 days

041-01444 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 01/08/81 +2 U VICTORIAN WADER STUDY GROUP
04 13 TEKAPO RIVER, NEW ZEALAND 44d 9mS 170d25mE 24/09/85 +1 F PIERCE & MALONEY
Distance: 2266.55 km Direction: 115 degs. Time elapsed: 4 yrs 1 mths 23 days

041-05050 STOCKYARD PT, LANG LANG, WESTERNPORT VIC 38d22mS 145d32mE 24/07/83 +2 U VICTORIAN WADER STUDY GROUP
04 13 TEKAPO RIVER, NEW ZEALAND 41d18mS 170d15mE 09/10/85 +1 F PIERCE & MALONEY
Distance: 2133.27 km Direction: 106 degs. Time elapsed: 2 yrs 2 mths 16 days

041-06811 STOCKYARD PT, LANG LANG, WESTERNPORT VIC 38d22mS 145d32mE 24/04/82 +2 U VICTORIAN WADER STUDY GROUP
04 13 POTTS RIVER, SOUTH ISLAND, NEW ZEALAND 43d35mS 170d55mE 06/10/85 +1 M PIERCE & MALONEY
Distance: 2203.94 km Direction: 113 degs. Time elapsed: 3 yrs 5 mths 12 days

041-09885 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 30/06/84 J U VICTORIAN WADER STUDY GROUP
04 13 ALEXANDRA, NEW ZEALAND 45d15mS 169d23mE 20/10/85 U U NEW ZEALAND BANDING SCHEME
Distance: 2187.15 km Direction: 118 degs. Time elapsed: 1 yrs 3 mths 20 days

041-15432 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 20/07/85 1 U VICTORIAN WADER STUDY GROUP
04 13 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 17/11/86 +2 F NEW ZEALAND BANDING SCHEME
Distance: 2249.16 km Direction: 114 degs. Time elapsed: 1 yrs 3 mths 28 days

041-16439 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 28/03/86 +2 U VICTORIAN WADER STUDY GROUP
04 13 ASHLEY RIVER NEW ZEALAND 43d17mS 172d20mE 15/11/86 +2 F NEW ZEALAND BANDING SCHEME
Distance: 2389.98 km Direction: 112 degs. Time elapsed: 0 yrs 7 mths 18 days

041-17992 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 28/06/86 1 U VICTORIAN WADER STUDY GROUP
04 13 LAKE TEKAPO NEW ZEALAND 43d55mS 170d30mE 31/10/86 +2 F NEW ZEALAND BANDING SCHEME
Distance: 2187.51 km Direction: 114 degs. Time elapsed: 0 yrs 4 mths 3 days

NB52910 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 29/10/84 +2 F NEW ZEALAND BANDING SCHEME
05 13 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 17/08/85 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2186.98 km Direction: 278 degs. Time elapsed: 0 yrs 9 mths 19 days

NB52921 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 03/11/84 J U NEW ZEALAND BANDING SCHEME
48 26 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 15/06/85 +1 M VICTORIAN WADER STUDY GROUP
Distance: 2186.98 km Direction: 278 degs. Time elapsed: 0 yrs 7 mths 12 days

NB52921 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 03/11/84 J U NEW ZEALAND BANDING SCHEME
48 26 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 14/06/86 +1 M VICTORIAN WADER STUDY GROUP
Distance: 2186.98 km Direction: 278 degs. Time elapsed: 1 yrs 7 mths 11 days

NB52921 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 03/11/84 J U NEW ZEALAND BANDING SCHEME
05 13 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 28/06/86 +1 M VICTORIAN WADER STUDY GROUP
Distance: 2186.98 km Direction: 278 degs. Time elapsed: 1 yrs 7 mths 25 days

NB53566 CASS RIVER NEW ZEALAND 43d53mS 170d30mE 24/12/84 J U NEW ZEALAND BANDING SCHEME
05 13 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 18/05/85 +2 U VICTORIAN WADER STUDY GROUP
Distance: 2269.03 km Direction: 277 degs. Time elapsed: 0 yrs 4 mths 25 days

NB53670 ASHBURTON RIVER NEW ZEALAND 43d50mS 171d40mE 23/11/85 J U NEW ZEALAND BANDING SCHEME
05 13 INVERLOCH (ANDERSONS INLET & PT. SMYTHE) VIC 38d37mS 145d45mE 09/08/86 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2238.72 km Direction: 276 degs. Time elapsed: 0 yrs 8 mths 16 days

NB54138 ORETI RIVER NEW ZEALAND 46d10mS 168d17mE 02/10/85 +2 F NEW ZEALAND BANDING SCHEME
48 26 INVERLOCH (ANDERSONS INLET & PT. SMYTHE) VIC 38d37mS 145d45mE 27/07/86 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2026.86 km Direction: 286 degs. Time elapsed: 0 yrs 9 mths 25 days

NB54138 ORETI RIVER NEW ZEALAND 46d10mS 168d17mE 02/10/85 +2 F NEW ZEALAND BANDING SCHEME
05 13 INVERLOCH (ANDERSONS INLET & PT. SMYTHE) VIC 38d37mS 145d45mE 10/08/86 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2026.86 km Direction: 286 degs. Time elapsed: 0 yrs 10 mths 8 days

NB54203 MATUKITUKI RIVER NEW ZEALAND 44d31mS 168d43mE 22/09/85 +2 M NEW ZEALAND BANDING SCHEME
48 26 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 12/07/86 U U VICTORIAN WADER STUDY GROUP
Distance: 2119.36 km Direction: 280 degs. Time elapsed: 0 yrs 9 mths 20 days

NB54203 MATUKITUKI RIVER NEW ZEALAND 44d31mS 168d43mE 22/09/85 +2 M NEW ZEALAND BANDING SCHEME
05 13 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 20/07/86 +2 M VICTORIAN WADER STUDY GROUP
Distance: 2119.36 km Direction: 280 degs. Time elapsed: 0 yrs 9 mths 28 days

NB54259 REES RIVER NEW ZEALAND 44d46mS 168d26mE 01/11/85 +2 F NEW ZEALAND BANDING SCHEME
05 13 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 28/06/86 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2042.62 km Direction: 282 degs. Time elapsed: 0 yrs 7 mths 27 days

NB54259 REES RIVER NEW ZEALAND 44d46mS 168d26mE 01/11/85 +2 F NEW ZEALAND BANDING SCHEME
05 13 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 16/08/86 +2 F VICTORIAN WADER STUDY GROUP
Distance: 2042.62 km Direction: 282 degs. Time elapsed: 0 yrs 9 mths 15 days

141 LARGE SAND PLOVER CHARADRIUS LESCHENAULTII

051-15876 ROEBUCK BAY WA 18d 4mS 122d19mE 02/09/81 +2 U WA WADER STUDY GROUP
15 05 MARKET BEIHAI GRANGXI PROVINCE CHINA 21d29mN 109d10mE 12/08/82 U U JMG GUANG
Distance: 4603.89 km Direction: 341 degs. Time elapsed: 0 yrs 11 mths 10 days

051-24631 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 03/11/83 +2 U WA WADER STUDY GROUP
01 02 BEIHAI KWANG-SI CHINA 21d29mN 109d 5mE 04/08/85 U U WU KAI-YUNG
Distance: 4701.93 km Direction: 342 degs. Time elapsed: 1 yrs 9 mths 1 days

149 EASTERN CURLEW NUMENIUS MADAGASCARIENSIS

090-19229 KURNELL BOTANY BAY NSW 34d 0mS 151d13mE 13/02/63 +2 U BATTAM
99 03 KYODONG-DO BONG SO HI SOUTH KOREA 37d45mN 126d16mE 00/00/65 U U WAN JAI
Distance: 8352.73 km Direction: 339 degs. Time elapsed: 1 yrs 9 mths 15 days

100-39163 KOORAGANG ISLAND NSW 32d52mS 151d46mE 29/01/77 +1 U VAN GESSEL
99 03 MARSHALL LAGOON CENTRAL PROVINCE PNG 10d 5mS 148d11mE 18/04/77 U U PEPENA
Distance: 2549.56 km Direction: 350 degs. Time elapsed: 0 yrs 2 mths 20 days

150 WHIMBREL — NUMENIUS PHAEOPUS

081-15346 PELICAN ISLAND PORT MACQUARIE NSW 31d26mS 152d54mE 27/03/83 +2 U CLANCY
61 03 KARAGINSKI ISLAND NE KAMCHATKA USSR 58d50mN 164d 0mE 20/08/83 U U TOMKOVICH
Distance: 10056.1 km Direction: 5 degs. Time elapsed: 0 yrs 4 mths 24 days

153 BAR-TAILED GODWIT — LIMOSA LAPPONICA

082-43509 ROEBUCK BAY WA 18d 4mS 122d19mE 02/09/81 2 M WA WADER STUDY GROUP
01 00 SHANGHAI SHI CHONGMING DAO CHINA 31d38mN 121d27mE 01/05/85 U U NATIONAL BIRD BANDING CENTER
Distance: 5500.35 km Direction: 359 degs. Time elapsed: 3 yrs 7 mths 29 days

082-43963 BOTANY BAY NSW 33d57mS 151d11mE 20/03/81 +2 F LANE
54 29 BEACH NEAR MOKPO CITY SOUTH KOREA 34d47mN 126d23mE 10/05/82 U U SUH
Distance: 8036.09 km Direction: 338 degs. Time elapsed: 1 yrs 1 mths 21 days

155 GREY-TAILED TATTLER — TRINGA BREVIPES

051-00412 ROEBUCK BAY WA 18d 4mS 122d19mE 30/08/81 +1 U WA WADER STUDY GROUP
15 05 BEACH TSANKIANG GUANG DONG CHINA 21d10mN 110d20mE 21/05/82 U U PENG
Distance: 4532.46 km Direction: 342 degs. Time elapsed: 0 yrs 8 mths 22 days

051-04613 BONNA POINT BOTANY BAY NSW 34d 0mS 151d10mE 21/04/78 +1 U DALE
03 13 OBITSU ESTUARY JAPAN 35d25mN 139d54mE 23/05/79 U U YAMASHINA INST FOR ORNITHOLO
Distance: 7773.54 km Direction: 350 degs. Time elapsed: 1 yrs 1 mths 2 days

060-01758 KOORAGANG ISLAND NSW 32d52mS 151d46mE 27/04/74 +1 U VAN GESSEL
61 00 KHATYRKA RIVER BERINGOVSKII MAGADAN USSR 62d37mN 174d58mE 20/07/76 U U SOVIET BANDING SCHEME
Distance: 10785.3 km Direction: 10 degs. Time elapsed: 2 yrs 2 mths 23 days

061-31094 STOCKTON BRIDGE STOCKTON NSW 32d54mS 151d47mE 12/11/77 +1 U LANE
05 13 OBITSU ESTUARY JAPAN 35d25mN 139d54mE 29/08/85 +1 U YAMASHINA INST FOR ORNITHOLO
Distance: 7667.11 km Direction: 349 degs. Time elapsed: 7 yrs 9 mths 17 days

J05000374 MOUTH OF HANAMI RIVER CHIBA JAPAN 35d39mN 140d 4mE 20/05/75 +2 U YAMASHINA INST FOR ORNITHOLO
99 05 DELUGE INLET HINCHINBROOK ISLAND QLD 18d25mS 146d13mE 26/01/76 U U MARKWELL
Distance: 6018.20 km Direction: 172 degs. Time elapsed: 0 yrs 8 mths 6 days

J05010345 OBITSU ESTUARY JAPAN 35d25mN 139d54mE 03/09/77 +2 U YAMASHINA INST FOR ORNITHOLO
61 05 POSSESSION ISLAND QLD 10d44mS 142d24mE 10/05/80 U U C/- ROBERT DRAFFAN
Distance: 5114.59 km Direction: 176 degs. Time elapsed: 2 yrs 8 mths 7 days

X05005166 ICHIKAWA CHIBA JAPAN 35d30mN 139d57mE 29/08/65 +1 U MIGRATORY ANIMAL PATH. SURV
99 03 MANLY QLD 27d 0mS 153d15mE 11/09/66 U U
Distance: 7057.71 km Direction: 166 degs. Time elapsed: 1 yrs 0 mths 13 days

160 TEREK SANDPIPER — TRINGA TEREK

051-01176 KOORAGANG ISLAND NSW 32d52mS 151d46mE 26/04/76 +1 U VAN GESSEL
43 02 UNKNOWN AREA (?SHANGHAI) CHINA 31d38mN 121d27mE 00/00/79 U U JIANZHONG
Distance: 7818.44 km Direction: 332 degs. Time elapsed: 2 yrs 7 mths 4 days

J04010895 OBITSU ESTUARY JAPAN 35d25mN 139d54mE 01/09/78 +2 U YAMASHINA INST FOR ORNITHOLO
02 13 KOORAGANG ISLAND NSW 32d52mS 151d46mE 22/11/80 U U VAN GESSEL
Distance: 7659.56 km Direction: 169 degs. Time elapsed: 2 yrs 2 mths 21 days

J04015?26 YAMATO KANTUKU FUKOKA NORTH KYUSHU JAPAN 33d 5mN 130d24mE 00/08/79 U U YAMASHINA INST FOR ORNITHOLO
02 14 LYTTON BRISBANE QLD 27d24mS 153d10mE 24/04/83 +2 U WOODALL
Distance: 7113.85 km Direction: 157 degs. Time elapsed: 3 yrs 8 mths 24 days

161 CURLEW SANDPIPER — CALIDRIS FERRUGINEA

040-71148 KOORAGANG ISLAND NSW 32d52mS 151d46mE 29/01/77 +1 U VAN GESSEL
40 05 CHUNGSHAN COUNTY CHINA 22d31mN 113d22mE 14/05/78 U U GUI-GHAN SHOU

Distance: 7362.70 km Direction: 321 degs. Time elapsed: 1 yrs 3 mths 16 days

040-92431 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 20/11/76 +1 U ROBERTSON
02 14 POINT CALIMERE TAMIL NADU INDIA 10d18mN 79d51mE 29/08/80 U U BOMBAY NATURAL HISTORY SOCIE
Distance: 8579.60 km Direction: 294 degs. Time elapsed: 3 yrs 9 mths 9 days

040-92807 STOCKTON BRIDGE STOCKTON NSW 32d54mS 151d47mE 03/01/81 +2 U LANE
15 13 SHANGHAI SHI CHONGMING DAO CHINA 31d38mN 121d27mE 14/05/81 U U NATIONAL BIRD BANDING CENTER
Distance: 7822.44 km Direction: 332 degs. Time elapsed: 0 yrs 4 mths 11 days

040-95238 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 10/03/79 +2 U VICTORIAN WADER STUDY GROUP
15 03 MANUK ESTUARY INDRAMAYU W JAVA INDONESIA 06d15mS 108d15mE 21/09/85 U U KARDJA
Distance: 5078.86 km Direction: 304 degs. Time elapsed: 6 yrs 6 mths 11 days

040-95458 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 24/03/79 +2 U VICTORIAN WADER STUDY GROUP
03 13 SAN TIN HONG KONG 22d30mN 114d 4mE 11/04/80 U U MELVILLE
Distance: 7421.05 km Direction: 329 degs. Time elapsed: 1 yrs 0 mths 18 days

040-97136 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 13/01/80 +2 U VICTORIAN WADER STUDY GROUP
40 00 NING-BO CHINA 29d54mN 121d33mE 12/05/80 U U SHI-LAI
Distance: 7893.13 km Direction: 338 degs. Time elapsed: 0 yrs 3 mths 30 days

040-97184 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 26/10/80 +2 U VICTORIAN WADER STUDY GROUP
15 05 GESIK CIREBON DIST WEST JAVA INDONESIA 06d34mS 108d32mE 01/08/85 U U CHARLIM
Distance: 5031.28 km Direction: 304 degs. Time elapsed: 4 yrs 9 mths 6 days

040-97590 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 26/01/80 +2 U VICTORIAN WADER STUDY GROUP
15 03 SHANGHAI SHI CHONGMING DAO CHINA 31d38mN 121d27mE 15/05/81 U U NATIONAL BIRD BANDING CENTER
Distance: 8077.95 km Direction: 339 degs. Time elapsed: 1 yrs 3 mths 20 days

040-97759 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 26/01/80 +2 U VICTORIAN WADER STUDY GROUP
40 00 GAOHU FUJIAN CHINA 26d 0mN 119d18mE 05/05/84 U U NATIONAL BIRD BANDING CENTER
Distance: 7563.74 km Direction: 335 degs. Time elapsed: 4 yrs 3 mths 10 days

041-00221 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 08/03/80 +2 U VICTORIAN WADER STUDY GROUP
40 00 HABAROVSKI REGION CHEGDOMYN USSR 51d 7mN 133d 2mE 25/05/80 U U SOVIET BANDING SCHEME
Distance: 9941.82 km Direction: 352 degs. Time elapsed: 0 yrs 2 mths 17 days

041-04246 RALPHS BAY (WEST) TAS 43d 1mS 147d26mE 05/12/82 J U SHOREBIRD STUDY GROUP (BOAT)
55 00 OFF THAILAND COAST 12d30mS 100d45mE 03/04/85 U U UMYINTLWIN
Distance: 5604.62 km Direction: 292 degs. Time elapsed: 2 yrs 3 mths 29 days

041-05498 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 18/02/84 +1 U VICTORIAN WADER STUDY GROUP
57 02 BAN TAN YONG LU LO PATTANI THAILAND 6d55mN 101d15mE 00/04/84 U U STARKS
Distance: 6697.35 km Direction: 308 degs. Time elapsed: 0 yrs 1 mths 11 days

041-12982 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 26/01/85 +2 U VICTORIAN WADER STUDY GROUP
01 00 FUJIAN PROVINCE LONGHAI CO. CHINA 24d24mN 117d48mE 15/05/85 U U NATIONAL BIRD BANDING CENTER
Distance: 7481.10 km Direction: 333 degs. Time elapsed: 0 yrs 3 mths 20 days

041-13697 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 02/11/83 +3 U WA WADER STUDY GROUP
05 13 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 19/01/86 +2 U VICTORIAN WADER STUDY GROUP
Distance: 3134.23 km Direction: 137 degs. Time elapsed: 2 yrs 2 mths 17 days

041-13864 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 05/11/83 +2 U WA WADER STUDY GROUP
01 00 LUHUA VILLAGE FUJIAN PROVINCE CHINA 25d44mN 119d22mE 26/03/86 U U RENGUAN
Distance: 4981.59 km Direction: 357 degs. Time elapsed: 2 yrs 4 mths 21 days

M12903 SERANGOON SEWERAGE WORKS SINGAPORE 1d23mN 103d55mE 09/10/76 +1 U THE UNIVERSITY OF MALAYA
03 14 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 03/03/78 +1 U ROBERTSON
Distance: 6035.25 km Direction: 140 degs. Time elapsed: 1 yrs 4 mths 25 days

S55331? KHADYN LAKE, 40 K STH KYZYL, TUVA SSR USSR 51d18mN 94d36mE 28/08/82 J U SOVIET BANDING SCHEME
05 14 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 03/11/83 +1 U WA WADER STUDY GROUP

Distance: 8241.97 km Direction: 153 degs. Time elapsed: 1 yrs 2 mths 6 days

162 RED-NECKED STINT CALIDRIS RUFICOLLIS

032-10151	PELICAN POINT, SWAN RIVER	WA	31d59mS	115d49mE	28/03/74	+1	U LANE
40 00	CIREBON JAVA INDONESIA		06d44mS	108d34mE	00/02/76	U	U SLAMET
Distance:	2895.12 km Direction: 343 degs.		Time elapsed: 1 yrs 10 mths 3 days				
032-10431	LASHMARS LAGOON KANGAROO ISLAND	SA	35d49mS	138d 3mE	16/02/75	+1	U LASHMAR
15 00	SHANGHAI SHI CHONGMING DAO CHINA		31d38mN	121d27mE	15/05/81	+2	M NATIONAL BIRD BANDING CENTER
Distance:	7665.13 km Direction: 344 degs.		Time elapsed: 6 yrs 2 mths 27 days				
032-10734	PELICAN POINT, SWAN RIVER	WA	31d59mS	115d49mE	06/11/74	+1	U LANE
15 00	SHANGHAI SHI CHONGMING DAO CHINA		31d38mN	121d27mE	17/04/81	U	U NATIONAL BIRD BANDING CENTER
Distance:	7066.19 km Direction: 5 degs.		Time elapsed: 6 yrs 5 mths 11 days				
032-10865	PELICAN POINT, SWAN RIVER	WA	31d59mS	115d49mE	03/01/75	+1	U LANE
15 05	GESIK CIREBON DIST WEST JAVA INDONESIA		06d34mS	108d32mE	01/01/81	U	U LEMAIN
Distance:	2913.46 km Direction: 343 degs.		Time elapsed: 5 yrs 11 mths 29 days				
032-11759	STOCKYARD POINT WESTERN PORT	VIC	38d25mS	145d23mE	12/12/74	+1	U EVANS
61 05	TAREII LAKE BORZJA CHITA USSR		50d19mN	116d23mE	10/09/77	U	U SOVIET BANDING SCHEME
Distance:	10232.3 km Direction: 341 degs.		Time elapsed: 2 yrs 8 mths 29 days				
032-14105	ROEBUCK BAY	WA	18d 4mS	122d19mE	30/08/81	+1	U WA WADER STUDY GROUP
02 00	DIAN CHENG GUANGDONG CHINA		21d33mN	111d20mE	22/12/83	U	U JIAN
Distance:	4542.98 km Direction: 344 degs.		Time elapsed: 2 yrs 3 mths 23 days				
032-17581	WERRIBEE SEWERAGE FARM (SPIT, PT WILSON)	VIC	38d 3mS	144d32mE	11/03/79	J	U VICTORIAN WADER STUDY GROUP
01 05	QUINHON VIETNAM		13d46mN	109d14mE	20/04/86	U	U HUOL
Distance:	6816.47 km Direction: 320 degs.		Time elapsed: 7 yrs 1 mths 9 days				
032-19920	WERRIBEE SEWERAGE FARM (SPIT, PT WILSON)	VIC	38d 3mS	144d32mE	22/09/79	+2	U VICTORIAN WADER STUDY GROUP
15 05	GESIK CIREBON DIST WEST JAVA INDONESIA		06d34mS	108d32mE	01/01/82	U	U ADJID
Distance:	5031.28 km Direction: 304 degs.		Time elapsed: 2 yrs 3 mths 9 days				
032-20571	PIPECLAY LAGOON (EAST SIDE)	TAS	42d58mS	147d32mE	23/11/79	+2	U SHOREBIRD STUDY GROUP (BOAT)
01 00	LUHUA VILLAGE FUJIAN PROVINCE CHINA		25d44mN	119d22mE	26/03/86	U	U RENGUAN
Distance:	8135.93 km Direction: 333 degs.		Time elapsed: 6 yrs 4 mths 3 days				
032-24453	WERRIBEE SEWERAGE FARM (SPIT, PT WILSON)	VIC	38d 3mS	144d32mE	26/01/80	J	U VICTORIAN WADER STUDY GROUP
02 00	DA NANG VIETNAM		16d 4mN	108d14mE	01/05/83	U	U MINH XUAN
Distance:	7089.76 km Direction: 320 degs.		Time elapsed: 3 yrs 3 mths 6 days				
032-29193	RALPHS BAY (WEST)	TAS	43d 1mS	147d26mE	20/09/81	+2	U SHOREBIRD STUDY GROUP (BOAT)
01 00	SHANGHAI CHONGMING DAO CHINA		31d36mN	121d18mE	00/05/85	U	U NATIONAL BIRD BANDING CENTER
Distance:	8682.25 km Direction: 337 degs.		Time elapsed: 3 yrs 7 mths 10 days				
032-29403	PIPECLAY LAGOON (EAST SIDE)	TAS	42d58mS	147d32mE	29/11/81	J	U SHOREBIRD STUDY GROUP (BOAT)
01 00	TIANJING TANGGU CHINA		36d 0mN	117d36mE	15/05/85	U	U NATIONAL BIRD BANDING CENTER
Distance:	9257.31 km Direction: 335 degs.		Time elapsed: 3 yrs 5 mths 16 days				
032-30357	ICI SALTFIELDS NEAR ADELAIDE	SA	34d42mS	138d29mE	15/02/80	+2	U SHURCLIFF
02 00	SHANGHAI SHI CHONGMING DAO CHINA		31d38mN	121d27mE	30/04/81	U	U NATIONAL BIRD BANDING CENTER
Distance:	7556.16 km Direction: 344 degs.		Time elapsed: 1 yrs 2 mths 15 days				
032-31696	5 KM SW USELESS LOOP SHARK BAY	WA	26d13mS	113d23mE	28/09/81	+2	U WA WADER STUDY GROUP
15 05	TAN YONG LU LO E OF PATTANI THAILAND		6d55mN	101d15mE	01/01/84	U	U TEH
Distance:	3893.16 km Direction: 338 degs.		Time elapsed: 2 yrs 3 mths 3 days				
032-33596	WERRIBEE SEWERAGE FARM (SPIT, PT WILSON)	VIC	38d 3mS	144d32mE	25/11/81	+2	U VICTORIAN WADER STUDY GROUP
61 03	KHASAN DISTRICT PRIMORYE REGION USSR		42d28mN	130d48mE	01/10/82	U	U TATARINOV
Distance:	9024.45 km Direction: 349 degs.		Time elapsed: 0 yrs 10 mths 6 days				

032-35435 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 24/07/82 1 U VICTORIAN WADER STUDY GROUP
01 00 SHANGHAI CHONGMING DAO CHINA 31d36mN 121d18mE 00/06/84 U U NATIONAL BIRD BANDING CENTER
Distance: 8079.09 km Direction: 339 degs. Time elapsed: 1 yrs 10 mths 7 days

032-35985 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 04/12/82 1 U VICTORIAN WADER STUDY GROUP
61 03 KOMPONG BINSULOK SABAH 5d33mN 115d45mE 25/04/83 U U SHELDON
Distance: 5736.89 km Direction: 320 degs. Time elapsed: 0 yrs 4 mths 21 days

032-36273 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 04/12/82 +2 U VICTORIAN WADER STUDY GROUP
15 05 PABEAN CI MANUK ESTUARY W JAVA INDONESIA 06d16mS 108d18mE 24/10/85 U U KARDJA
Distance: 5151.18 km Direction: 303 degs. Time elapsed: 2 yrs 10 mths 20 days

032-38839 BARRY BEACH CORNER INLET VIC 38d42mS 146d23mE 09/01/83 +2 U VICTORIAN WADER STUDY GROUP
02 00 DA NANG VIETNAM 16d 4mN 108d14mE 01/05/83 U U MINH XUAN
Distance: 7249.20 km Direction: 319 degs. Time elapsed: 0 yrs 3 mths 23 days

NB19517 SAN TIN HONG KONG 22d30mN 114d 4mE 12/05/80 +2 U BTO RINGING & MIGRATION SECT
05 13 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 27/03/82 +2 U VICTORIAN WADER STUDY GROUP
Distance: 7446.11 km Direction: 154 degs. Time elapsed: 1 yrs 10 mths 15 days

NB19540 SAN TIN HONG KONG 22d30mN 114d 4mE 12/05/80 +1 U BTO RINGING & MIGRATION SECT
05 14 PIPECLAY LAGOON (EAST SIDE) TAS 42d58mS 147d32mE 22/11/80 U U SHOREBIRD STUDY GROUP (BOAT)
Distance: 8019.23 km Direction: 154 degs. Time elapsed: 0 yrs 6 mths 10 days

J02056374 GAMOU SENDAI-SHI MIYAGI JAPAN 38d15mN 141d 1mE 30/08/76 U U YAMASHINA INST FOR ORNITHOLO
03 13 KOORAGANG ISLAND NSW 32d45mS 151d47mE 22/10/76 U U LANE
Distance: 7939.05 km Direction: 170 degs. Time elapsed: 0 yrs 1 mths 23 days

P729029 KHADYN LAKE, 40 K STH KYZYL, TUVA SSR USSR 51d18mN 94d36mE 07/09/84 J U SOVIET BANDING SCHEME
05 14 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 19/04/85 1 U AUSTRALASIAN WADER STUDY GRO
Distance: 8140.04 km Direction: 152 degs. Time elapsed: 0 yrs 7 mths 12 days

S925103 MAGADAN CHUCKOTKA UELEN USSR 66d 9mN 169d47mE 17/06/79 +2 F SOVIET BANDING SCHEME
02 13 POINT WAYLEN PERTH WA 32d 2mS 115d48mE 25/10/80 U U LANE
Distance: 11812.5 km Direction: 225 degs. Time elapsed: 1 yrs 4 mths 8 days

163 SHARP-TAILED SANDPIPER — CALIDRIS ACUMINATA

040-13531 PELICAN POINT PERTH WA 31d59mS 115d49mE 05/01/61 +2 M NICHOLLS
40 03 12KM NORTH BATAGAJ USSR 67d40mN 135d20mE 28/05/61 U U SOVIET BANDING SCHEME
Distance: 11169.4 km Direction: 7 degs. Time elapsed: 0 yrs 4 mths 23 days

040-94391 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 27/01/79 +2 U VICTORIAN WADER STUDY GROUP
40 00 QIANSHAN LIAONING CHINA 41d 0mN 123d 6mE 16/06/80 U U NATIONAL BIRD BANDING CENTER
Distance: 9021.26 km Direction: 343 degs. Time elapsed: 1 yrs 4 mths 20 days

041-01835 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 27/11/81 +2 U VICTORIAN WADER STUDY GROUP
01 13 TADU RV COAST OF TAIWAN STRAIT TAIWAN 24d15mN 120d30mE 02/05/85 U U SEN-SHYOUNG WU
Distance: 7339.43 km Direction: 335 degs. Time elapsed: 3 yrs 5 mths 5 days

050-58964 KOORAGANG ISLAND NSW 32d52mS 151d46mE 29/01/77 +1 U VAN GESSEL
15 19 TAMBAKAN JAVA INDONESIA 07d 3mS 110d40mE 22/11/82 U U COMAN
Distance: 5112.53 km Direction: 294 degs. Time elapsed: 5 yrs 9 mths 24 days

051-01012 WOOLOOWARE BAY BOTANY BAY NSW 34d 2mS 151d 8mE 12/02/77 +1 U WHITE
15 05 HUI AN COUNTY FUJIAN CHINA 25d 7mN 119d 5mE 10/04/77 U U LI MIN
Distance: 7371.49 km Direction: 328 degs. Time elapsed: 0 yrs 1 mths 26 days

051-02682 RUSH LAGOON (NORTHERN END) KANGAROO IS SA 35d50mS 137d32mE 29/02/84 +2 U LASHMAR
01 00 SHANGHAI CHONGMING DAO CHINA 31d36mN 121d18mE 00/04/84 U U NATIONAL BIRD BANDING CENTER
Distance: 7654.76 km Direction: 345 degs. Time elapsed: 0 yrs 1 mths 0 days

164 RED KNOT — CALIDRIS CANUTUS

050-10307 PELICAN POINT, SWAN RIVER WA 31d59mS 115d49mE 30/10/73 +1 U LANE
99 05 OKARO BAY NEW ZEALAND 36d18mS 174d 9mE 20/03/76 U U COOKSEY
Distance: 5320.26 km Direction: 112 degs. Time elapsed: 2 yrs 4 mths 21 days

050-85436 WARD SPIT 10KM WNW PT GERMEIN SA 33d 1mS 137d55mE 27/12/81 +1 U WATERMAN
01 00 SANDONG SHOUGGUONG CO. CHINA 36d48mN 118d42mE 01/05/85 U U NATIONAL BIRD BANDING CENTER
Distance: 7982.94 km Direction: 343 degs. Time elapsed: 3 yrs 4 mths 5 days

050-85642 WARD SPIT 10KM WNW PT GERMEIN SA 33d 1mS 137d55mE 27/12/81 +1 U WATERMAN
40 00 RUI'AN ZHEJIANG CHINA 27d42mN 120d36mE 06/07/84 U U NATIONAL BIRD BANDING CENTER
Distance: 6964.85 km Direction: 342 degs. Time elapsed: 2 yrs 6 mths 10 days

051-00208 STOCKTON BRIDGE STOCKTON NSW 32d54mS 151d47mE 28/12/76 +2 U LANE
06 05 HANGZHOU BAY SHANGHAI CHINA 30d47mN 121d25mE 19/04/86 U U WANG TIANHOU & LU JIN-JIN
Distance: 7739.85 km Direction: 332 degs. Time elapsed: 9 yrs 3 mths 22 days

051-11472 WARD SPIT 10KM WNW PT GERMEIN SA 33d 1mS 137d55mE 27/12/81 +1 U WATERMAN
01 00 SHANDONG YANTAI CHINA 37d30mN 121d24mE 28/07/84 U U NATIONAL BIRD BANDING CENTER
Distance: 7992.55 km Direction: 346 degs. Time elapsed: 2 yrs 7 mths 1 days

051-16176 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 03/06/84 1 U VICTORIAN WADER STUDY GROUP
99 03 STH MANAKAU HARBOUR AUCKLAND NEW ZEALAND 37d 5mS 174d49mE 19/05/85 U U RIEGEN
Distance: 2651.49 km Direction: 96 degs. Time elapsed: 0 yrs 11 mths 16 days

051-28105 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 18/04/85 1 U AUSTRALASIAN WADER STUDY GRO
06 05 HANGZHOU BAY SHANGHAI CHINA 30d47mN 121d25mE 21/05/86 U U TIANHOU
Distance: 5398.91 km Direction: 358 degs. Time elapsed: 1 yrs 1 mths 3 days

061-31435 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 27/01/79 J U VICTORIAN WADER STUDY GROUP
05 13 KAIPARA HARBOUR NORTH ISLAND NEW ZEALAND 36d20mS 174d20mE 02/03/80 U U VEITCH
Distance: 2641.42 km Direction: 95 degs. Time elapsed: 1 yrs 1 mths 6 days

C31629 TARAMAIRE FIRTH OF THAMES NEW ZEALAND 37d20mS 175d20mE 17/08/80 +2 U NEW ZEALAND BANDING SCHEME
35 03 LIGHT TOWER SANDY CAPE MARYBOROUGH QLD 24d42mS 153d15mE 31/03/81 U U SUTTON
Distance: 2521.11 km Direction: 297 degs. Time elapsed: 0 yrs 7 mths 14 days

165 GREAT KNOT — CALIDRIS TENUIROSTRIS

061-38111 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
03 13 HANGZHOU BAY, SHANGHAI SUBURB CHINA 30d47mN 121d25mE 05/04/85 U U WANG TIANHOU
Distance: 5536.32 km Direction: 0 degs. Time elapsed: 2 yrs 7 mths 12 days

061-38249 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 +2 U WA WADER STUDY GROUP
01 00 SHANGHAI CHONGMING DAO CHINA 31d36mN 121d18mE 16/04/86 U U NATIONAL BIRD BANDING CENTER
Distance: 5626.86 km Direction: 359 degs. Time elapsed: 3 yrs 7 mths 23 days

061-38311 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
01 00 SHANGHAI SHI CHONGMING DAO CHINA 31d38mN 121d27mE 01/05/85 U U NATIONAL BIRD BANDING CENTER
Distance: 5630.57 km Direction: 0 degs. Time elapsed: 2 yrs 8 mths 8 days

061-38418 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 1 U WA WADER STUDY GROUP
06 05 HANGZHOU BAY SHANGHAI CHINA 30d47mN 121d25mE 00/04/84 U U WANG TIANHOU & LU JIN-JIN
Distance: 5536.32 km Direction: 0 degs. Time elapsed: 1 yrs 7 mths 7 days

061-38504 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 1 U WA WADER STUDY GROUP
01 00 LUHUA VILLAGE FUJIAN PROVINCE CHINA 25d44mN 119d22mE 26/03/86 U U RENGUAN
Distance: 4981.20 km Direction: 357 degs. Time elapsed: 3 yrs 7 mths 2 days

061-39485 6K SW OF BROOME WA 17d58mS 122d16mE 30/03/82 U U WA WADER STUDY GROUP
01 00 SHANGHAI CHONGMING DAO CHINA 31d36mN 121d18mE 16/04/86 U U NATIONAL BIRD BANDING CENTER
Distance: 5485.78 km Direction: 358 degs. Time elapsed: 4 yrs 0 mths 17 days

061-39973 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 05/01/86 +2 U VICTORIAN WADER STUDY GROUP
06 05 HANGZHOU BAY SHANGHAI CHINA 30d47mN 121d25mE 20/04/86 U U WANG TIANHOU & LU JIN-JIN
Distance: 8014.78 km Direction: 339 degs. Time elapsed: 0 yrs 3 mths 15 days

061-41973 SALTWORKS, PORT HEDLAND WA 20d11mS 118d54mE 08/11/83 +3 U WA WADER STUDY GROUP
06 13 HANGZHOU BAY, SHANGHAI SUBURB CHINA 30d47mN 121d25mE 28/03/85 U U WANG TIANHOU
Distance: 5646.06 km Direction: 2 degs. Time elapsed: 1 yrs 4 mths 20 days

168 LATHAM'S SNIPE GALLINAGO HARDWICKII

060-76180 JILLIBY WYONG NSW 32d14mS 151d22mE 23/12/67 +1 U SMITH
25 16 URIMAKU RIVER HOKKAIDO JAPAN 43d 0mN 144d 0mE 17/06/68 U U KAINUMA
Distance: 8364.34 km Direction: 354 degs. Time elapsed: 0 yrs 5 mths 25 days

J06080251 SHIZUKUISHI RIV MORIOKA-SHI IWATE JAPAN 39d42mN 141d 8mE 31/07/74 U U YAMASHINA INST FOR ORNITHOLO
81 05 FARM NEAR HERBERTON QLD 17d23mS 145d23mE 05/09/76 U U CAMPBELL
Distance: 6334.40 km Direction: 175 degs. Time elapsed: 2 yrs 1 mths 5 days

J06081207 GAMOU SENDAI-SHI MIYAGI JAPAN 38d15mN 141d 1mE 14/08/77 +2 U YAMASHINA INST FOR ORNITHOLO
68 03 LAKE CARTCARRONG NEAR WINSLOW VIC 38d15mS 142d26mE 30/11/77 U U WINES
Distance: 8471.77 km Direction: 178 degs. Time elapsed: 0 yrs 3 mths 16 days

J06081234 GAMOU SENDAI-SHI MIYAGI JAPAN 38d15mN 141d 1mE 20/08/78 +2 U YAMASHINA INST FOR ORNITHOLO
68 05 NEAR PAKENHAM VIC 38d 5mS 145d29mE 00/11/78 U U WEBLEY
Distance: 8466.27 km Direction: 176 degs. Time elapsed: 0 yrs 2 mths 11 days

J06082259 SHYUNKUNITAI NEMURO-SHI HOKKAIDO JAPAN 43d16mN 145d28mE 14/08/79 +2 U YAMASHINA INST FOR ORNITHOLO
68 05 KILCUNDA VIC 38d33mS 145d29mE 00/11/79 U U GREEN
Distance: 9060.98 km Direction: 180 degs. Time elapsed: 0 yrs 2 mths 17 days

169 SWINHOE'S SNIPE GALLINAGO MEGALA

061-34370 15KM SE OF DARWIN NT 12d29mS 130d55mE 22/12/84 U U HERTOG
08 00 NEAR BAAO,CAMARINES SUR,PHILIPPINES 13d27mN 123d22mE 28/08/85 U U MAYAO
Distance: 2986.65 km Direction: 343 degs. Time elapsed: 0 yrs 8 mths 6 days

061-34373 15KM SE OF DARWIN NT 12d29mS 130d55mE 22/12/84 U U HERTOG
01 03 CANDELARIA (170KM NW MANILA) PHILIPPINES 15d38mN 119d56mE 11/09/85 U U VERGARA
Distance: 3336.71 km Direction: 338 degs. Time elapsed: 0 yrs 8 mths 20 days

COMPILED 19/2/87 BY K.W. LOWE AUSTRALIAN BIRD & BAT BANDING SCHEMES ANPWS

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