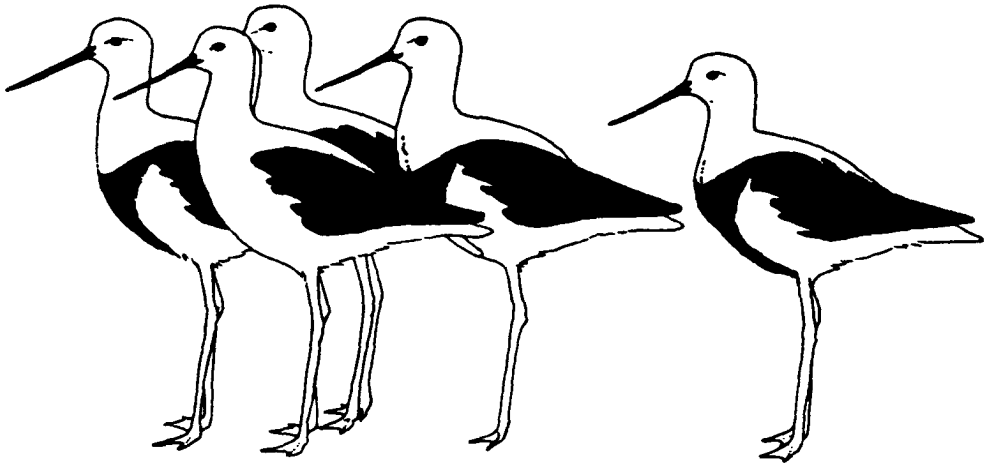
The Stilt



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BULLETIN OF THE AUSTRALASIAN WADER STUDIES GROUP

OF THE

ROYAL AUSTRALASIAN ORNITHOLOGISTS UNION

Number 13 October 1988

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.

VIEWS AND OPINIONS EXPRESSED IN 'THE STILT' ARE THOSE OF THE AUTHOR (S) AND NOT NECESSARILY THOSE OF THE AWSG.

ABSOLUTE DEADLINES ARE:

APRIL	**END OF JANUARY**
OCTOBER	**END OF JULY**

SUBSCRIPTIONS FOR 1989:

AUSTRALASIA	AUS $15
OVERSEAS	AUS $20
LIBRARIES	AUS $25

ALL ENQUIRIES SHOULD BE DIRECTED TO BRENDA MURLIS, ADMINISTRATIVE SECRETARY.

EDITORIAL

Unfortunately this is to be my last *Stilt*. Pressures for my non-work time are now such that I can no longer provide the time and effort *Stilt* deserves.

I have enjoyed the experience, watching the rapid growth in material submitted and editing the various texts against self-imposed deadlines. To see the finished produce is always a satisfying moment.

The new Editor will be Mr. David Thomas who has had over 25 years of experience with waders and many papers to his credit. His address appears on the inside back cover for all correspondence.

Only one error for *Stilt* 12! On the contents page, Roger Jaensch's article on Pectoral Sandpipers and Long Toed Stilts should have read Long Toed Stints. My apologies to Roger for the mistake.

Wandering Waders this issue takes on a southern flavour as the only reports I received were from Tasmania. Apparently no-one on the mainland of Australia, New Zealand, Indonesia or Asia saw any unusual waders! Not one! Please send such sighting to your Regional Representative or to Mark Barter as these little snippets of data are interesting, are valuable and most importantly, are useful to record.

The present issue of *Stilt* provides plenty of news, reports, papers and more! As always it has been a delight to produce, and I wish to thank "my" Typists, Margaret and Noelene, for their outstanding quality and tolerance. I hope everyone will continue to support David in the same manner. Happy wadering to you all!

Eric Woehler, Retired.

20TH INTERNATIONAL ORNITHOLOGICAL CONGRESS 1990

Second Notice

The 20th International Ornithological Congress will take place in Christchurch, New Zealand, on 2-9 December 1990. The Congress programme will include 6 plenary lectures, 48 symposia, contributed papers (spoken and poster), workshops, discussion groups and films. There will be a mid-Congress excursion day. Longer excursions are planned to interesting ornithological sites in New Zealand before and after the Congress. In late 1990 New Zealand will also host the 20th World Conference of the International Council for Bird Preservation in Hamilton on 21-27 November 1990 and a Pacific Festival of Nature Films in Dunedin on 27 November-1 December 1990. Photographic and stamp exhibitions will be held in Christchurch in association with the International Ornithological Congress. Requests for the First Circular, which includes information on the above events, should be sent to:

Dr. Ben D. Bell, Secretary-General,
20th International Ornithological Congress,
Department of Zoology,
Victoria University of Wellington,
Private Bag, Wellington, New Zealand
[Telex NZ30882 VUWLIB; Facsimile NZ (04) 712070]

CONSERVATION NEWS

Since the last report on action taken concerning conservation of waders and their habitat *(The Stilt* 12) much has been initiated but as is often the case with these matters little has yet been resolved.

One project that has recently been completed is the production of a major report on the avifauna of Swan Bay (Victoria) which is threatened by proposed developments including a marina. Submissions by the AWSG (amongst many other groups and individuals) have also resulted in the shelving of plans for a marina at the old Merrett Rifle Range site in Williamstown (Victoria).

Enquiries are continuing into the future of Moreton Bay (Queensland), probably S.E. Queensland's most important wader site, which appears to be threatened by several development proposals. Other wetland conservation problems in that state are being investigated.

Once again it is apparent that the majority of issues being dealt with concern Victorian wader sites, although co-operation with the RAOU Conservation Committee is alerting me to some problems in other states. In order to alter this situation I must once more make a plea to all AWSG members to bring to my notice problems in your state.

Jeff Campbell.

WADER WATCHERS OF THE WORLD UNITE!

As reported in *Stilt* 12, officers of the AWSG and the WSG (Wader Study Group) have been pursuing reciprocal membership arrangements in order to strengthen links between wader enthusiasts around the world. To this end we have now developed an easy and convenient way to subscribe to the two organisations. To join the WSG, complete the enclosed application form and send it, along with the appropriate payment in Australian dollars, to the AWSG's administrative secretary, Brenda Murlis (34 Centre Avenue, Vermont, Victoria, 3133, Australia). Full details of the Group are to be found on the form. It couldn't be easier! But what do you get for your money?

Like the AWSG, the WSG has a lot to offer and much work to do. The Group relies on its membership for funds, much of which goes into the production of the Wader Study Group Bulletin, a now well-established and highly respected publication for those interested in waders. The Bulletin is published three times each year and provides the means for informal exchange of ideas, news of current projects, and the preliminary or interim publication of results. It is essential to all wader enthusiasts who wish to stay in touch; the pulse which keeps co-operative studies alive!

But what has the WSG achieved? The fact that the Group is in its nineteenth year and is currently producing WSG Bulletin 54 is a major achievement in itself. There have also been successful co-operative projects, such as various studies of migration along the East Atlantic Flyway, comprehensive breeding wader surveys, an entire survey of wintering waders on the non-estuarine shores of the United Kingdom, and an investigation into the effects of severe winter weather on waders. Many more projects are on-going. Read about them in the Bulletin. All are generating important results; information of direct value to the understanding and conservation of waders.

Two further landmarks in WSG history are worthy of special note. The publication in December 1986 of Breeding Waders in Europe, compiled by Theunis Piersma, is an enormously interesting and useful

overview of European breeding wader populations, supplemented by an 85-page bibliography of the relevant literature. Then, in April 1987, came The Conservation of International Flyway Populations of Waders, containing the proceedings of the 1986 WSG annual meeting and Workshop on this subject. This document includes key reviews of the four major flyways of the world (Eastern Asia/Australasia, Western Asia/East Africa, East Atlantic and New World) as well as a further 20 papers reporting on recent studies and achievements, approaches to flyway conservation and future directions for research and conservation of waders. Both these documents were supplied free to members. Both are still available, price $13.00 via Brenda Murlis at the address above. They are key references in the wader literature.

What more is there to do? Anyone who knows anything about waders will immediately reply, lots! Why? To begin with, waders are such a diverse group of birds, whose populations fluctuate markedly from year to year and with the passing of the seasons. They undertake lengthy and complex migrations and exhibit an array of fascinating breeding strategies. We have only a limited understanding of them. The WSG will continue to play its role in publicising, advising and encouraging the work of wader researchers worldwide; enlisting the help of amateurs and professionals alike and channelling their energies and enthusiasm into co-operative research. You can certainly help, either directly by helping with co-operative projects or just by letting us know of your own studies. We should be delighted to welcome you to join our obsession!

Jeff Kirby, Wader Study Group, PO Box 247, Tring, Hertfordshire, HP23 5SN, United Kingdom.

WADER STUDY GROUP (WSG) NEWS

The WADER STUDY GROUP (WSG) is an association of amateurs and professionals from all parts of the world interested in the Charadrii (waders or shorebirds). Membership of the WSG is currently over 500 people, approximately half of which live in Britain (where the group was formed in 1970) with the others in Europe, the Americas, Asia, Africa and Australia. The interests of the Group have diversified from the original concentration on migration-related studies to embrace all aspects of wader biology.

The aims of the WSG are:

- to maintain contact between amateurs and professionals studying waders
- to help organise co-operative studies
- to provide a vehicle for exchange of information.

The main means of achieving these aims is by the publication of the Wader Study Group Bulletin. WSG maintains contacts with many regional, national and international bodies interested in bird research and conservation, notably the International Waterfowl Research Bureau and the British Trust for Ornithology, and often works alongside them in co-operative studies. The Group has been involved also in the organisation of expeditions to remote areas to fill gaps in our knowledge of waders. Projects co-ordinated by WSG currently on-going include: studies of the spring migration of waders on the East Atlantic flyway, a large-scale investigation of spring migration through the Americas, a long-term monitoring of the usage of inland migration sites in Europe and a breeding wader monitoring scheme in Britain. Recently completed co-operative projects include an intensive study of breeding wader distribution and densities in the Outer Hebrides of Scotland, where rapid changes in agricultural practice are being made, an entire survey of the non-estuarine shores of the United Kingdom for wintering waders and an investigation into the effects of severe winter weather on waders. WSG also co-ordinates (on behalf of several national authorities) the colour-marking of waders, and attempts to forward sightings of these.

Membership of the WSG is open to all individuals or groups interested in waders. Applicants wishing to pay in Australian dollars should contact Brenda Murlis, 34 Centre Road, Vermont, 3133, Australia. All cheques should be made payable to "AUSTRALASIAN WADER STUDIES GROUP (WSG)". Members receive Wader Study Group bulletin three times per year posted from the UK.

The bulletin provides a forum for news, notices, ringing recoveries, recent publications, new catching and study methods, articles and preliminary or interim publication of results from all parts of the world. The editors try to maintain a balance of material ranging from newsletter, informal descriptions of research activities, meetings and expeditions to formal presentation of results or preliminary analyses.

The bulletin appears in April, August and December. The deadlines for inclusion of notices are 1 February, 1 June and 1 October respectively. Articles however, must be received well before these dates. Articles, notes, papers, notices, obituaries, requests for information, books for review, reprints of papers and other items should be sent to the Editor: Dr. N.C. Davidson, C/- NCC, Northminster House, Peterborough, PE1 1UA, UK. Material relating to the New World may be sent to the Editors of the New World Section whose addresses appear within the front cover of the bulletin. Matters relating to the circulation of the bulletin should be sent to the UK Membership Secretary: Jeff Kirby, PO Box 247, Tring, Herts., HP23 5SN, UK.

1989 RAOU SCIENTIFIC DAY

CALL FOR PAPERS 1989 RAOU SCIENTIFIC DAY 27TH MAY 1989

The RAOU 1989 Scientific Day will cover the theme "A Decade of Wader Research". The aim of the day is to present some of the results of research into the status, distribution, biology and conservation of Australasia's waders, both migratory and resident. Research conducted on waders in Australasia has increased dramatically in the last decade and a meeting devoted to this group is timely.

Papers are invited from anyone, amateur or professional, on the theme. If you wish to make a presentation, or would like more information on how to contribute, please contact:

Brett Lane
Research Co-ordinator
Australasian Wader Studies Group
11/272 Barkly Street
North Fitzroy 3068 Victoria.

BIRD OBSERVERS CLUB OF AUSTRALIA (BOC) NEWS.

The Bird Observers Club of Australia has more than 3000 members throughout the country. Non-members may be aware of some of the useful leaflets the Club publishes from time to time, but may not be aware of some of the long-term projects which are part of the Club's programme.

Birds & Gardens Survey 1988. Survey sheets are mailed out for the recording of garden birds, plus details of their food. Over 280 species have been recorded so far, with some most unexpected sightings.

Australian Bird Environment Fund. Since 1983 projects worth more than $35,000 have been funded throughout Australia. This Fund is financed from within Club funds by grants from the Council, by donations and from fund-raising efforts. A proportion of the extra fees paid by Supporting Members goes directly to ABEF. Brochure is available on request.

A Field Guide to Australian Birdsong. Three cassettes have been produced in a series planned to eventually cover all Australian species in taxonomic order.

A catalogue of the wide range of tapes sold by the Club is available from headquarters.

All members receive 11 copies per year of the Club's professionally produced newsletter The Bird Observer. Our quarterly journal, The Australian Bird Watcher, is also posted to subscribers (samples available on request).

Address enquiries to: The Secretary, Bird Observers Club of Australia, P.O. Box 185, Nunawading, Vic. 3131. Tel. (03) 877 5342.

WADER BUFFS AND THE RAOU HANDBOOK.

The RAOU Handbook

Many who have studies migratory waders in Australia will have found "The Handbook of the Birds of the Western Palearctic" Cramp and Simmons (1977 *et seq.*), one of the most valuable references available. Unfortunately, BWP does not cover many of our birds. This is one reason why the RAOU has undertaken to produce "The Handbook of Australian, New Zealand and Antarctic Birds".

There will be four volumes in the RAOU Handbook. Preparation of the second, which covers waders, will begin early in 1989. People who study Australian waders can do a great deal to improve the second volume.

The BATH Project

In April 1988, all Australian banders were sent a newsletter describing the "Bander's Aiding the Handbook" (BATH) project. Interested people who missed out on the Newsletter can get a copy from any of the addresses below.

The BATH project is designed to obtain new life history information for the RAOU Handbook, particularly for the sections on plumage, bare parts, moult, measurements and geographical variation. This information will be published in a series of supplements to the book "Bander's Aid - A Guide to Ageing and Sexing Bush Birds" (Rogers *et. al.* 1986) where it will be available to all, including Handbook workers, for field testing and use. At the end of the project, a completely revised and far more comprehensive edition of Bander's Aid will be prepared.

People interested in participating in BATH are encouraged to contact the RAOU, telling us what sort of information they can contribute on the species they are interested in so that we can build up a picture of coverage and of areas not covered. We will gladly help contributors in any way we can, e.g. with statistical analysis or with the presentation of their contributions.

Information Sought

What sort of information will be useful to the Handbook workers?

The Handbook is intended to summarise everything reported about the species covered, but it would be unreasonable to expect banders to provide all the information that can be taken from a bird caught for banding. Some areas of particular interest to handbookers are discussed below.

Plumages

The Handbook aims to include complete descriptions of all recognizable plumages of the birds covered. Most of these descriptions will be taken from museum skins by the Handbook workers, since the descriptions will be more detailed than those that can be taken quickly from live birds, and because colours are being standardised with the excellent, but expensive and time-consuming, F.B. Smith (1974) colour guide. Wader banders can, however, help a good deal by describing and/or photographing plumages not represented in museum collections, and by providing descriptions which can be used to age museum specimens. Most museum specimens in Australia are skins with closed wings, and it is difficult to describe the wings properly. Recording plumage changes of retraps is the most reliable way of establishing the age of birds with a given plumage.

Taking systematic plumage descriptions in the field is not as time-consuming or impractical a task as it might initially appear. While writing Bander's Aid we found the best approach was to take a complete description from one bird (for which the Banding Scheme's plumage description sheets are invaluable, and to describe differences seen on birds caught later. After the lengthy initial description, later descriptions could be brief and informative; a typical example might be "as (band number of bird described earlier) but with buff tips to primary coverts". A single note "buff tips to primary coverts" is less useful when analysing data. You can never be sure that there weren't other interesting plumage features that were not recorded because you were hurried.

It is not necessary to describe every bird. Descriptions need only be taken of each age and sex of each species caught in a catch. As the data build up, fewer descriptions will need to be taken.

Bare Parts

The descriptive approach above is particularly useful for recording colours of bare parts e.g. bill, gape, eye, feet and legs. Bare parts discolour in museum skins. Handbook workers have had difficulty in finding the true colours for some species in the first volume, and have had to rely a good deal on photographs. Some waders only appear to enjoy being photographed while they stand in deep water, and it can be difficult to find what colour their legs and feet are.

Moult

The sequences of moult are important for understanding birds' energetic requirements and are, of course, closely related to migration strategies. The required information can best be recorded from live birds; museum skins are uncooperatively rigid and sample sizes can be small. By taking complete moults of about ten birds of a given age per catch, it should be possible to describe the full pattern of moult. Pressing questions to be answered include:

- When does primary moult begin and end?
- Does moult occur at the same time every year?

- Does one sex moult earlier than the other?

- Do different ages moult at different times?

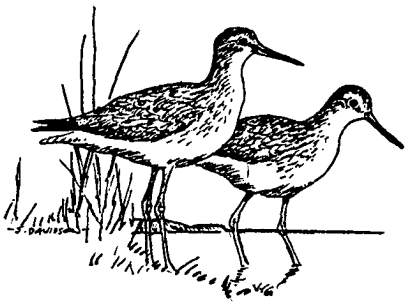
- Some Australian waders are known to undergo a partial primary moult. How old are these birds? Do all birds in these age groups undergo a partial primary moult? Are any other feathers moulted during a partial primary moult?

Measurements

The larger the sample size used for measurements in the Handbook, the better. Banders can supply much better measurement data than museum workers, since they handle far more birds. Total Head Length is one of the most reproducible measurements known, but can not be used on museum skins, in which the base of the skull is removed. Almost all museum measurements except tarsus, and mid-toe and claw, have been shown to be subject to shrinkage. Large samples may enable banders to work out sex proportions at a site, to see whether there is geographical variation in size, and to see whether subspecies defined on the basis of very few measurements are worthy of recognition.

Other Notes

Another area that may be fun to follow up is that of cloacae and brood patches, both of which may be valuable sexing characters. In Palearctic passerines, the female is generally the only sex to develop a brood patch (Svensson 1984). When writing Bander's Aid, we were surprised to find that both sexes developed a brood patch in many Australian species. Does this apply to our resident waders as well? I know of no Australian information on the topic. More data is needed even on the relatively well studied waders of the Holarctic (Prater *et. al.* 1977). Most, perhaps all, species of petrel lay an enormous egg. Laying the thing distorts the cloaca, a character which can be used to sex female petrels for a time after laying. Waders also lay a very large egg. Can this sexing technique be used on resident Australian waders?



Bander's Aid was based on the sort of information that I have mentioned in this article. In three years, we had gathered enough data to write a book with original ageing and sexing information on about a hundred species of bush birds. This shows, I hope, that a little of this sort of data goes a long way. Interested banders should be able to answer many ageing, sexing and other questions before December 1990, after which it will not be possible to include new information in the second volume of the handbook.

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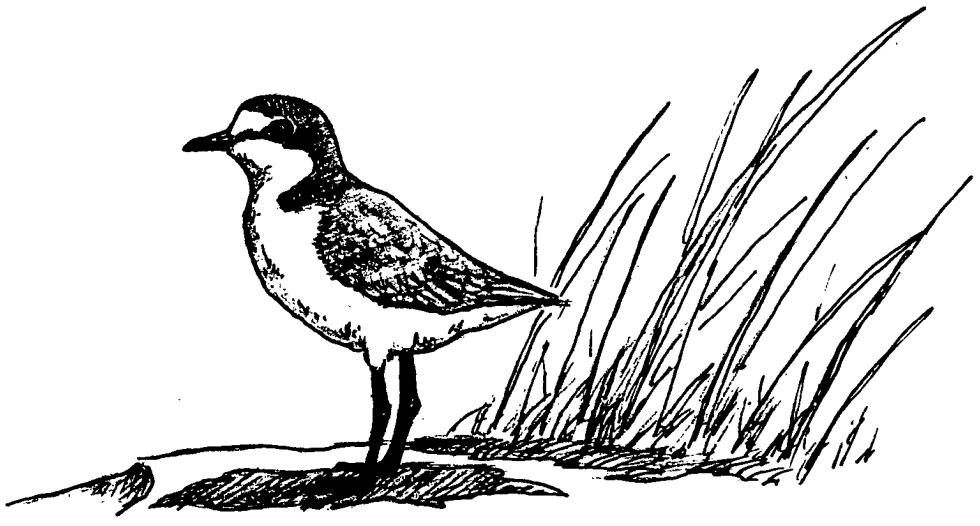
GENERAL INDEX (STILTS 7 - 12)

AUTHOR INDEX (STILTS 7 - 12)

SPECIES INDEX (STILTS 7 - 12)

Hudsonian Godwit 9.37, 11.23, 11.29, 11.55
Inland Dotterel 7.22
Kentish Plover 10.32, 12.52
Large Sand Plover 7.3, 8.9, 9.26, 9.30, 9.37, 10.4, 10.21, 10.32, 10.36, 10.39, 11.5, 11.10, 11.20, 11.29, 12.33, 12.44, 12.54, 12.58
Latham's Snipe 7.23, 9.26, 10.4, 10.28, 10.45, 11.29
Least Sandpiper 9.36
Lesser Golden Plover 7.3, 7.23, 8.9, 9.26, 9.32, 9.35, 10.4, 10.21, 10.28, 10.32, 10.36, 10.38, 11.3, 11.5, 11.10, 11.20, 11.29, 11.40, 12.12, 12.44, 12.54, 12.58
Lesser Yellowlegs 11.23
Little Curlew 7.3, 8.9, 8.22, 10.4, 11.5, 11.10, 11.20, 11.29, 12.58
Little Ringed Plover 11.23, 11.51, 12.52
Little Stint 10.28, 11.23, 11.36, 11.55, 12.52
Long-toed Stint 9.26, 10.4, 11.10, 11.20, 11.23, 11.51, 12.54, 12.58
Malaysian Plover 10.32
Marsh Sandpiper 7.3, 8.9, 9.26, 10.4, 10.32, 11.3, 11.5, 11.10, 11.20, 11.29, 11.55, 12.44, 12.53, 12.54, 12.58
Masked Lapwing 7.3, 7.21, 7.23, 9.26, 9.37, 9.41, 10.4, 11.3, 11.5, 11.10, 11.20, 11.29, 12.44, 12.54
Mongolian Plover 7.3, 7.23, 8.9, 8.14, 8.23, 9.26, 9.37, 10.21, 10.32, 10.36, 10.38, 11.5, 11.10, 11.20, 11.29, 11.51, 12.12, 12.23, 12.44, 12.52, 12.54, 12.58
Nordmann's Greenshank 10.32, 11.51
New Zealand Dotterel 12.52
Oriental Plover 7.3, 8.9, 9.26, 9.37, 10.32, 11.5, 11.10, 11.29
Oriental Pratincole 7.3, 10.32, 12.58
Painted Snipe 10.4
Pectoral Sandpiper 9.26, 9.37, 10.4, 11.25, 11.29, 11.55, 12.23, 12.54
Pied Oystercatcher 7.3, 8.9, 9.26, 9.32, 9.35, 10.4, 10.32, 10.37, 11.3, 11.5, 11.10, 11.20, 11.29, 12.23, 12.44, 12.52, 12.54, 12.58, 12.62
Red-capped Plover 7.3, 7.23, 8.9, 8.23, 9.26, 9.30, 9.42, 10.4, 11.3, 11.5, 11.10, 11.20, 11.29, 12.23, 12.44, 12.54, 12.58
Red-kneed Dotterel 7.3, 8.21, 9.26, 9.41, 10.4, 11.10, 11.20, 11.29, 12.44
Red Knot 7.3, 7.23, 8.9, 9.26, 9.32, 9.37, 10.4, 10.22, 10.28, 10.32, 10.44, 11.5, 11.10, 11.20, 11.29, 11.55, 12.23, 12.29, 12.44, 12.52, 12.58
Red-necked Avocet 7.3, 9.26, 9.37, 9.43, 10.4, 10.15, 11.3, 11.10, 11.20, 11.29, 12.25, 12.44, 12.53, 12.54, 12.58
Red-necked Phalarope 10.36, 11.3, 11.23, 11.29
Red-necked Stint 7.3, 7.18, 7.23, 8.9, 9.26, 9.32, 9.37, 9.43, 10.4, 10.22, 10.28, 10.32, 10.36, 10.42, 11.3, 11.5, 11.10, 11.20, 11.29, 11.36, 11.40, 11.51, 11.55, 12.12, 12.25, 12.44, 12.54, 12.58, 12.63
Redshank 7.3, 10.32, 11.5, 11.10, 11.50, 12.52
Ringed Plover 9.36

Ruddy Turnstone 7.3, 8.9, 9.26, 9.32, 9.37, 9.43, 10.4, 10.21, 10.32, 10.36, 11.5, 11.10, 11.20, 11.29, 11.55, 12.44, 12.52, 12.54, 12.58
Ruff/Reeve 9.26, 11.23, 11.29
Sanderling 7.3, 8.9, 9.26, 9.37, 10.4, 10.32, 11.3, 11.10, 11.20, 11.29, 11.55, 12.44, 12.58
Sharp-tailed Sandpiper 7.3, 7.23, 8.9, 8.23, 9.26, 9.30, 9.37, 9.43, 10.4, 10.22, 10.43, 11.3, 11.5, 11.10, 11.20, 11.29, 11.55, 12.23, 12.44, 12.58, 12.60
Snipe sp.
Sooty Oystercatcher 7.3, 9.26, 10.4, 10.32, 10.37, 11.3, 11.10, 11.20, 11.29, 12.44, 12.54
Swinhoe's Snipe 10.45, 11.10
Tattler Sp. 7.3, 9.26, 11.5, 11.20, 11.29, 11.55, 12.44
Terek Sandpiper 7.3, 8.9, 9.26, 9.37, 10.4, 10.32, 10.36, 10.40, 11.5, 11.10, 11.20, 11.29, 11.55, 12.44, 12.52, 12.58
Wandering Tattler 7.3, 10.4
Western Sandpiper 9.36
Whimbrel 7.3, 8.9, 9.26, 9.37, 10.4, 10.32, 10.36, 10.37, 10.40, 11.5, 11.10, 11.20, 11.29, 11.55, 12.12, 12.44, 12.52, 12.54
Wood Sandpiper 7.3, 9.26, 10.4, 10.29, 10.32, 11.10, 11.20
Wrybill 9.32, 9.35, 11.55, 12.52



AWSG RESIDENT WADER STUDY

The objects of this new co-operative study which was announced in the last issue of *Stilt* are:

a) to gather data on the breeding distribution, breeding seasonality and habitat requirements during breeding of Australia's resident waders,

b) to gather data from which to estimate the reproductive rates of the resident waders and to identify the factors which may affect this,

c) to collect these data over as wide an area of Australia as possible,

d) to determine the relation between breeding success, time of breeding and movements in the resident waders.

The study will involve several approaches, most of which involve existing studies:

a) The RAOU Nest Record Scheme. The table below, kindly supplied by Jon Starks at RAOU headquarters, presents the status of each species of resident wader in the NRS before the 1988-9 breeding season.

Species	Number of cards/sheets
Comb-crested Jacana	33
Bush Thick-knee	47
Beach Thick-knee	17
Painted Snipe	16
Pied Oystercatcher	611
Sooty Oystercatcher	114
Masked Lapwing	1499
Banded Lapwing	405
Red-kneed Dotterel	83
Hooded Plover	98
Red-capped Plover	491
Black-fronted Plover	239
Inland Dotterel	38
Black-winged Stilt	272
Banded Stilt	0
Red-necked Avocet	101
Australian Pratincole	48

There are perhaps 20 papers dealing with the breeding biology of Australian waders. In the case of the most recorded species, the Masked Lapwing, there are papers covering three years near Hobart, Tasmania, and one year near Melbourne, Victoria. These represent a very small fraction of the species' breeding range and even for this species a great deal more data are required.

There are two kinds of nest record sheets, one recording a single visit to the nest and the other containing details of multiple visits which permit the estimation of factors such as incubation period to be determined.

b) Banding. As stated in the last issue of *Stilt* banding, especially colour-banding, can be used to determine local, regional and larger scale movements on a seasonal basis or in relation to the timing of breeding. This provides an opportunity for people outside the city-based banding groups to participate in the study.

c) Population Monitoring. The AWSG Regular Wader Count and Population Monitoring counts provide valuable information on the resident species, and data from these projects will prove a valuable adjunct to data generated through the Nest Record Scheme and banding. Martin Schulz has requested help in monitoring the population of the Hooded Plover (see following item).

It is believed that participation in the scheme will encourage participants to become involved in more detailed studies depending on their personal interests.

Initially I would like to concentrate on a few species, (Pied Oystercatcher, Masked Lapwing, Hooded Plover, Black-fronted Plover, Black-winged Stilt) but this does not mean that others should be ignored. All records are valuable and the more that are obtained, the better!

I would like to establish a register of people who are already working on any aspect of resident wader biology. Please contact me:

David Thomas
1/Brightwater Villas
Blackmans Bay 7050
Tasmania.

Anyone wishing for any further information should also contact me.

David Thomas

THE HOODED PLOVER - A PLEA FOR HELP

The Hooded Plover is an endemic Australian species found predominantly on ocean beaches in south-eastern Australia. In Western Australia it occurs both on ocean beaches and around inland lakes and saltpans. Since European settlement the range of the Hooded Plover in south-eastern Australia has declined and even where it still occurs it is now less abundant (Schulz and Bamford 1987). The situation in Western Australia is uncertain, but the species is recognised as vulnerable.

In Victoria censuses have been carried out every two years since 1980. However, no full-scale surveys have been undertaken in any other state. There is an immediate need for detailed counts in all states to:

1. Obtain an overview of the status of the species in Australia.

2. To provide the basis for a monitoring program to establish where the species is on the decline and where regular monitoring sites should be established.

3. For an assessment of the effectiveness of current management practices, and for the establishment of future management plans.

4. To identify the best time of the year to undertake large-scale Hooded Plover counts (i.e. whether in the breeding or non-breeding season).

At present very little is known, for example, on which islands the Hooded Plover occurs in Bass Strait, or the densities of the species on the central west coast of Tasmania. The logistics and availability of observers makes counts covering the entire coastline of states such as Tasmania and South Australia very difficult. In light of this when you are walking along a beach in any state (excluding Victoria) we would be grateful if you could count the numbers of Hooded Plovers seen and send this information to:

Mr. David Thomas
1/Brightwater Villas,
Blackmans Bay
Tasmania, 7050.

The information to record is:

1. Locality. If a whole stretch of beach is not covered, state the start and finish points.

2. Date.

3. Tide phase.

4. Number of Hooded Plovers observed. Note: Nil counts are also very useful.

5. Any evidence of nesting.

6. Number of juvenile birds.

7. Any banded birds present. If so are they colour banded and what is the combination of bands on both the left and right legs.

If you have any counts (especially over a period of time) from any beaches in southern Australia these would be gratefully received. We are especially interested in long term counts from single stretches of beaches to ascertain whether there are any apparent population trends.

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Patricia White.

WANDERING WADERS: FEBRUARY TO AUGUST 1988.

The following reports have been received by either myself or the regional representatives. In future, please pass on any records of unusual or interesting sightings etc. to either the regional representative or the Editor for inclusion.

Tasmania

42 Grey Plovers: Robbins Island 13 Feb. (greatest no. recorded for Tas.)

300 Double-banded Plovers: Longford Jan/Jul 1987.

1 Black-winged Stilt: West Tamar Marshes 15 Jan (first record for 19 years).

5 to 10,000 Ruddy Turnstone: Christmas Island, Bass Strait 22 Nov 1987 (largest flock ever recorded in Australia).

1 Little Curlew: Cape Portland 24 Jan 1988 (3rd record for Tas.)

70 Red Knot: Robbins Island 13 Feb.

20 Sharp-tailed Sandpiper: Shipwreck Point June 1987 (major overwinter flock).

1 Buff-breasted Sandpiper: October 1987-March 1988 (2nd record for Tas).

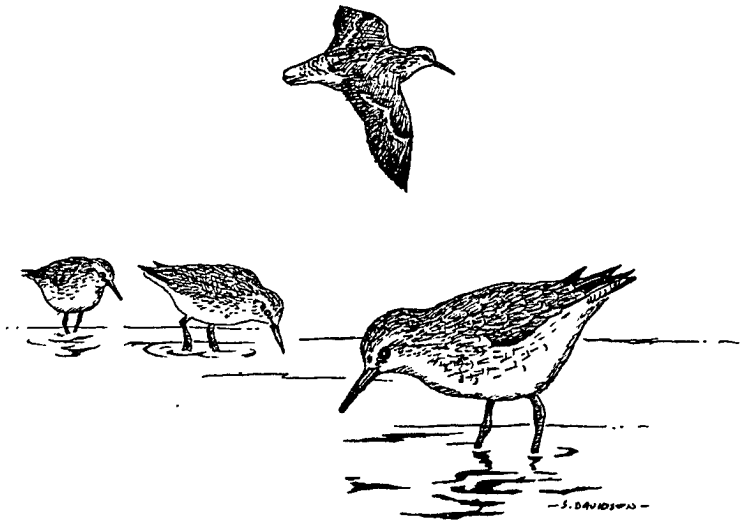
1 Ruff: November 1987- March 1988.

1 Cox's Sandpiper: Calverts Lagoon 19 Feb. (First Tas record?).

1 Little Stint: Orielton Lagoon 21 Nov 1987.

75 Red-capped Plover: Marion Bay 26 Jun (Single roosting flock).

2 Common Sandpiper: Meredith River, Swansea 10 Feb 1987 to 18 Oct 1987.



BIOMETRICS AND MOULT OF LESSER GOLDEN PLOVERS *Pluvialis dominica fulva* IN VICTORIA.

M.A. Barter, 21 Chivalry Avenue, Glen Waverley, Victoria 3150, Australia.

SUMMARY

Data obtained from 166 Lesser Golden Plovers caught in Victoria, Australia, have been analysed for wing, bill and total-head lengths, weight, primary moult and amount of breeding plumage. The average wing length of adult birds (173.8mm) lies roughly half way between the typical values for *dominica* (c.182mm) and Siberian *fulva* (c.164mm), and the wing length average and range (161-186 mm) is consistent with that given for the longer-winged Alaskan *fulva* (170.5mm;164-180mm), if allowance is made for specimen shrinkage. The existence of a group of birds which are intermediate in wing length between *dominica* and Siberian *fulva* casts doubt on the claimed ability to separate the *dominica* and *fulva* forms by use of a discriminant function analysis technique which depends mainly on wing length. Average bill lengths (23.7mm) agree with those quoted for adult *fulva*. Whilst Victorian Lesser Golden Plover appear to come from Alaska those on Niue Island and Wake Island seem to be from Siberia, indicating that the migration paths of these different *fulva* populations cross each other in the Pacific Ocean. Average weights are similar to those quoted for Wake Island plovers, both in the middle of the non-breeding season (Victoria 129.3g, Wake Island 130g) and prior to migration (Victoria March 158.2g, Wake Island April 153g). It is estimated that Victorian *fulva* have sufficient fat reserves to fly in excess of 4000 km non-stop on their first northward migration stage. This would enable them to reach the Marshall Islands, to the north-east of Queensland, in one stage. Adults appear to commence primary moult in early October, probably after arrival in Victoria, and finish in March. Average moult duration is about four months and is similar to that of Hawaiian plovers. There is strong evidence, based on birds found in suspended moult, that a few plovers commence primary moult before reaching Victoria, either on the breeding grounds or at an intermediate staging site. These birds are probably immatures. Juvenile *fulva* do not moult primaries, at least up to the date of the last Victorian sample which was caught in early March. Adults gain some breeding plumage prior to departure and have a little retained breeding plumage upon return to Victoria in October. A few first year plovers attain some breeding plumage before departure, although to a lesser extent than adults.

INTRODUCTION

Until recently it had been generally accepted that the Lesser Golden Plover occurred as two sub-species, *Pluvialis dominica* and *P.d. fulva*. *Dominica* breeds from Baffin Island, in Canada, west to north-west Alaska and spends the non-breeding season in southern South America, whilst *fulva* nests from the Yamal Peninsula, in Siberia, east to north-west Alaska and migrates during the non-breeding period to south-east Asia, the Pacific Islands and Australasia. The two forms breed sympatrically in west and north-west Alaska.

Lately, Connors (1983) had claimed that the two forms should be classified as different species. His evidence was based on discriminant function analysis, with wing length being the most important element, which correctly separated 96% of specimens into the two forms and showed that there is no evidence of interbreeding in sympatric areas. This evidence, together with that of moult (Johnson 1985) and migration pattern, has lead the British Ornithologists' Union to treat *dominica* and *fulva* as separate species (BOURC 1986). Previously to this, the Ornithological Society of New Zealand (OSNZ 1980) had decided to elevate the *dominica* and *fulva* forms to species status on the basis of differences in moult, migration strategy, plumage and time to reach maturity.

Wing and bill length measurements, from various sources, are given in Tables 1 and 2.

It can be seen that the average wing lengths of the two forms are significantly different from each other ($p<0.005$), i.e. *dominica* c.182mm and Siberian *fulva* c.165mm, and also that Alaskan *fulva* are longer-winged, i.e. c.170mm, than their Siberian counterparts. Comparison of Connors' measurements with those from other sources is made difficult because of the use of different measuring techniques, i.e. Connors-chord, the others-flattened and straightened wing. Interestingly, Connors' average *dominica* wing length is 5mm less than those of the other two sources, whilst his *fulva* values are similar to those of the other measurers. Wing length differences between the sexes for both forms are not significant ($p>0.05$).

Both Johnston and McFarlane (1967) and Kinsky and Yaldwyn (1981) found that the wing lengths of Wake Island and Niue Island birds resembled those of Siberian *fulva*.

Bill length data of the two forms from the various sources is conflicting, although differences between the sexes are not significant ($p>0.05$).

There is a general consensus that breeding adults do not commence primary moult until they reach the non-breeding area. Moult duration is four to five months with moult finishing by mid-February (Johnson and Johnson 1983, Kinsky and Yaldwyn 1981).

First and second year birds remaining on the non-breeding grounds commence primary moult in June-July, before migrants return (Johnson and Johnson 1983). There is evidence that some birds commence primary moult on the breeding grounds (Streseman and Streseman 1966, Johnston and McFarlane, Cramp and Simmons 1983). In Kinsky and Yaldwyn's view these birds are immature plovers, whilst Johnson and Johnson believe they are more likely to be first year birds.

Fulva do not undergo primary moult in their first year (Johnson and Johnson 1983), whilst *dominica* do (Johnson 1985).

On Wake Island, plovers were found to weigh, on average, 133g in August, 130g in December and 153g in April. Weights ranged in the latter month from 122-192g (Johnston and McFarlane 1967).

This paper contains the results and discussion of the analysis of data obtained from 166 Lesser Golden Plovers (including 44 first-year birds) caught in Victoria from 1978 to 1987.

METHODS

The great majority of birds were caught with cannon-nets. Monthly totals were relatively evenly distributed throughout the non-breeding season as follows:

October	22	January	11
November	40	February	26
December	36	March	30
		April	1

Bill, wing and total-head lengths were measured for most birds and standard methods were used. Primary moult scores were obtained from all birds.

Birds were aged by primary feather wear and plumage pattern. The Australian Bird and Bat Banding Schemes ageing convention was used, e.g.

3+ - in third year or older
2+ - in second year or older
2 - in second year
1 - in first year

Anniversary date is 1st August.

Birds can usually be aged as 3+, second year or first years in the October to December period. Following completion of primary moult 3+ and second year birds become indistinguishable from each other and are aged as 2+.

RESULTS AND DISCUSSION

Measurements.

Wing, bill and total-head length measurements are given in Tables 3-5.

It can be seen that, in general, the average wing lengths of 3+ and 2+ birds (173.8, 173.7mm) lie midway between those given for *dominica* and *fulva* in Table 1, although they are much closer to the relatively short wing length for *dominica* quoted by Connors. The wing length range of 161-186mm for adults agrees well with that of 164-180mm for Alaskan *fulva* given by both Vaurie (1964) and Prater *et al.* (1977). Therefore, it seems that Victorian Lesser Golden Plovers come from Alaska. This is an interesting contrast to the birds on both Niue Island and Wake Island Which seem to come from Siberia.

The existence of a group of intermediate-sized plovers that, apparently, were not included in Connors' analysis, makes it very important to locate the breeding area(s) of Victorian birds so that their status can be determined versus the *fulva* and *dominica* forms. It seems that Connors' claim to be able to separate the two forms into species, using discriminant analysis, may be based on incomplete data.

Second year birds have an average wing length (165.2mm) which is more than 6mm shorter than that of first year birds (171.6mm). This difference is consistent with the fact that first year *fulva* do not undergo primary moult and, consequently, suffer severe wear of the outer primaries prior to undergoing their first primary moult as second year birds.

Wing lengths of first year birds are about 2mm shorter than those of adults and are midway between those given by Prater *et al.* (1977) for juvenile *dominica* and *fulva*. The difference in wing lengths between first years and adults is somewhat shorter than that recorded by Cramp and Simmons (3.5mm).

Average bill lengths for 3+ and 2+ birds (23.7,23.6mm) agree well with those given for *fulva* by Connors and by Cramp and Simmons (see Table 2), but are more than 1mm longer than those given by Prater *et al.* (1977). First year bills (23.4mm) are, on average, 1.6mm longer than those quoted for juvenile *fulva* by Prater *et al.* (1977).

Bill length differences between the age groups are not significantly different ($p>0.05$).

The total head length of 3+ birds is significantly shorter than that of 2+ birds ($p>0.050$). The reason for this is not obvious but it may be caused by different sex ratios in the two age groups.

Weight.

Monthly average weight data for the various age groups is given in Table 6 and is shown graphically in Fig. 1.

Average adult weights vary from 126-130g during the October to January period, with a weighted average of 129.3g (range 116-140, sd=5.9g). The average weight of first year birds over the same period (131.9g) is a little higher than that of adults, and a good deal more variable (110-157g, sd=11.2g).

Adults commence gaining weight before juveniles, but by March first years are only 5g lighter, on average, than adults (153.5 vs. 158.2). The heaviest adult bird weighed 178g and first year, 175g. Average Victorian weights and weight ranges during the non-breeding season and prior to migration are similar to those of Wake Island birds.

Using the Summers and Waltner (1978) flight distance equation, and assuming that the average lean weight of adults is 120.2g (7% fat in average weight or 129.3g) and that the mean flight speed is 75 km/h, it can be calculated that plovers with an average March weight of 158.2g should be able to fly approximately 3000 km, whilst the heaviest bird (178g) can travel 4400 km. First year birds of average March weight will be able to fly some 2-300 km less than adults. Potential flight ranges are probably well in excess of 4000 km because:

(a) the actual take-off weight is more likely to approximate that of the heavier birds in the sample;

(b) waders generally wait for favourable weather conditions (i.e. the presence of following winds) before departing (Lane and Jessop 1985, Richardson 1979); and

(c) available fat reserves are probably well in excess of those assumed in the calculation above, as Johnston and McFarlane (1967) found the average fat free weight, by extraction, to be 113.7g (n=11).

The Marshall Islands (3500 km from Victoria), which are on the great circle route between Victoria and Alaska, are well within the reach of the heavier adult and first year birds.

Juveniles rarely spend the non-breeding season in Victoria (Hewish 1988) and have more than sufficient fat reserves to reach northern Australia in one stage. Whether they travel further is unknown, although at least a proportion of immature birds to remain in Queensland during the southern winter (Hewish 1988).

Primary Moult.

Average moult score information for the separate catches is given in Figure 2.

In late October - early November (earliest catches) all adults were in primary moult with catch median primary moult scores (MPMS) of around 20. The MPMS progression follows the usual sigmoidal pattern and reaches 50 in late January-early February. Almost 90% of adults have completed primary moult by the end of February. From Figure 2, moult duration in adults is estimated to be about four months and this is confirmed by the data for individual birds shown in Figure 3. This moult duration is consistent with that recorded for plovers in Hawaii.

Second year birds have similar MPMS values to adults in late October-early November.

No first year birds were found to be moulting primaries up to the date of the last Victorian sample on 1st March. This confirms previous observations that first year *fulva* do not moult during the southern summer.

There is strong supporting evidence for the view that some plovers (probably immatures) commence primary moult either on the breeding grounds or at a staging site during migration. Details are as follows:

(a) 31/10/87 - two adults in suspended moult, with three and five inner feathers suspended;

(b) 2/11/85 - two second years in active moult, with three and five inner feathers suspended;

(c) 23/11/86 - one adult in active moult, with inner five feathers suspended;

- one second year in active moult, with inner four feather suspended;

(d) 7/1/84 - four adults in active moult, with inner two or three feathers suspended.

Breeding Plumage.

The small amount of data collected on breeding plumage levels indicates that adult plovers moult partially, at least, into nuptial plumage before departure (eg. on 1/3/86 average breeding plumage fraction = 0.11 (n=18), range = 0 to 0.5) and still retain some breeding plumage upon return (e.g. trace to 0.25 on 31/10/87). Some first year birds also attain breeding plumage (e.g. 1/3/86 average breeding plumage fraction = 0.05 (n=10), range = 0 to 0.25).

These results indicate that plovers are still moulting into breeding plumage whilst on migration to the breeding grounds and have mainly moulted into non-breeding plumage before returning to Victoria.

CONCLUSIONS.

Wing length measurements indicate that Victorian plovers are of the Alaskan-breeding *fulva* form, which is longer-winged than Siberian *fulva*. The presence of a group of plovers that have an average wing length which is intermediate in size between *dominica* and Siberian *fulva* casts doubt on whether *fulva* can be successfully separated from *dominica* on the basis of wing-length.

Victorian adult birds have an average weight of 129g in mid non-breeding season, this being similar to that of Wake Island birds. The heavier March birds, i.e. those over 170g, are calculated to be capable of flying a first migration stage of more than 4000 km.

Primary moult in adults begins in early October, probably following arrival in Australia, and finishes in March, with the average duration being about four months. A few birds, probably immatures, moult up to five of their inner primaries before arriving in Victoria. First-year birds have not commenced primary moult by early March just prior to their departure from Victoria.

Adults leave and arrive in Australia with varying degrees of breeding plumage. Some first year birds also attain a degree of breeding plumage prior to leaving Victoria.

ACKNOWLEDGEMENTS

I would particularly like to thank the Victorian Wader Study Group for allowing me to have access to their data and also those numerous colleagues in the Group with whom I've enjoyed many early morning attempts to catch these wonderful birds.

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Table 1. Wing length data for dominica and fulva specimens (mm).

		MALE				FEMALE				
Form	Age	n	$\bar{x}$	sd	Range	n	$\bar{x}$	sd	Range	Source
dominica	Adult	21	182.5	-	173-193	19	182.5	-	175-188	(1)
dominica	Adult	42	177.6	4.3	-	35	176.8	3.9	-	(2)
dominica	Adult	88	182	7.5	156-192	60	182	7.4	166-189	(3)
dominica (b)	Adult				Range 176-193mm					(1)
dominica	Juv	7	180.4	-	175-185	13	177.8	-	169-187	(1)
fulva	Adult	32	163.7	-	157-173	28	162.1	-	152-168	(1)
fulva	Adult	44	165.1	4.2	-	16	165.5	5.5	-	(2)
fulva	Adult	34	165	3.8	159-174	17	166	4.7	158-173	(3)
fulva (a)	Adult	17	165.3	-	156-174	15	165.8	-	160-173	(4)
fulva (b)	Adult	30	169.5	-	164-177	16	171.6	-	164-180	(4)
fulva (b)	Adult				Range 164-180mm					(1)
fulva	Adult	23	165.9	-	147-182	11	167.2	-	156-188	(5)
fulva	Adult	28	163.2	-	152-171	15	163.5	-	159-168	(6)
fulva	Juv	14	164.4	-	154-171	18	164.3	-	160-169	(1)

(n=sample size, $\bar{x}$=mean, sd=standard deviation; (a)=Siberia, (b)=Alaska; (1)=Prater et al. 1977, (2)=Connors 1983,(3)=Cramp and Simmons 1983, (4)=Vaurie 1964, (5)=Ridgway 1919, (6)=Johnston and McFarlane 1967)

Table 2. Bill length data for dominica and fulva specimens (mm).

		MALE				FEMALE				
Form	Age	n	$\bar{x}$	sd	Range	n	$\bar{x}$	sd	Range	Source
dominica	Adult	42	22.7	1.1	-	35	22.6	1.1	-	(2)
dominica	Adult	87	23.2	1.3	19-25	60	23.3	1.1	21-26	(3)
dominica	Adult				n=54, x=23.1, Range=20-27					(1)
dominica	Juv				n=29, x=22.7, Range=21-25					(1)
fulva	Adult	44	23.6	1.0	-	16	23.5	1.5	-	(2)
fulva	Adult	34	23.4	1.3	21-25	17	23.4	0.9	22-25	(3)
fulva	Adult				n=70, x=22.5, Range=20-25					(1)
fulva	Juv				n=48, x=21.8, Range=18-24					(1)

Table 3. Wing length data for adult (3+/2+), second and first year birds in mm.

Age	n	$\bar{x}$	sd	Range
3+	35	173.8	5.1	161-183
2+	44	173.7	5.6	164-186
2	24	165.2	4.3	155-176
1	21	171.6	6.5	166-182

Table 4. Bill length data for adult (3+/2+), second and first year birds in mm.

Age	n	$\bar{x}$	sd	Range
3+	31	23.7	1.54	20.3-26.3
2+	69	23.6	0.95	21.7-26.6
2	23	24.0	0.98	22.0-25.9
1	35	23.4	0.97	21.5-25.3

Table 5. Total head length data for adult (3+/2+), second and first year birds in mm.

Age	n	$\bar{x}$	sd	Range
3+	30	57.2	2.1	52.9-61.2
2+	59	57.9	1.4	51.8-61.9
2	24	57.9	1.5	55.3-59.1
1	31	57.1	1.2	55.1-59.1

Table 6. Average weight data by age and month in grams.

Month	Age	n	$\bar{x}$	sd	Range
October	3+	15	130.3	5.1	119-136
	2	6	135.2	7.0	126-145
November	3+	16	129.4	7.1	118-140
	2	16	125.8	6.8	112-138
	1	6	127.7	11.5	110-142
December	2+	28	129.1	6.0	116-139
	1	10	134.9	11.0	122-157
January	2+	4	126.3	0.5	126-127
	1	3	130.0	12.5	120-144
February	2+	12	147.9	12.0	142-174
	1	14	133.2	8.5	120-145
March	2+	19	158.2	13.4	125-178
	1	10	153.5	13.2	140-175
April	2+	1	172.0		172

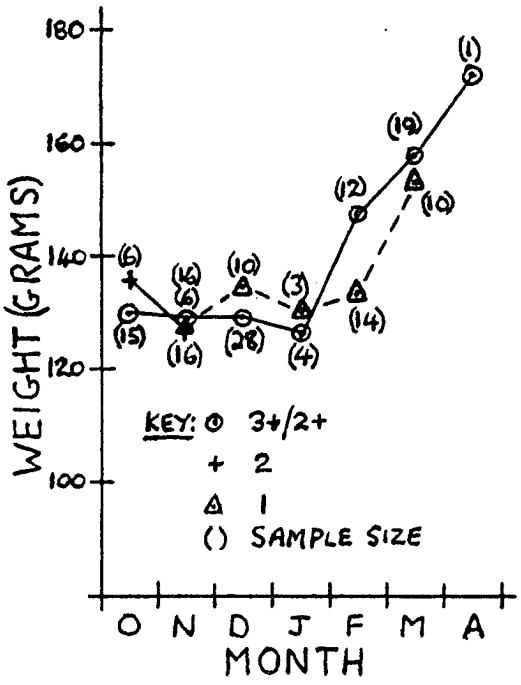

Fig 1. Average weight data by age and month in grams.

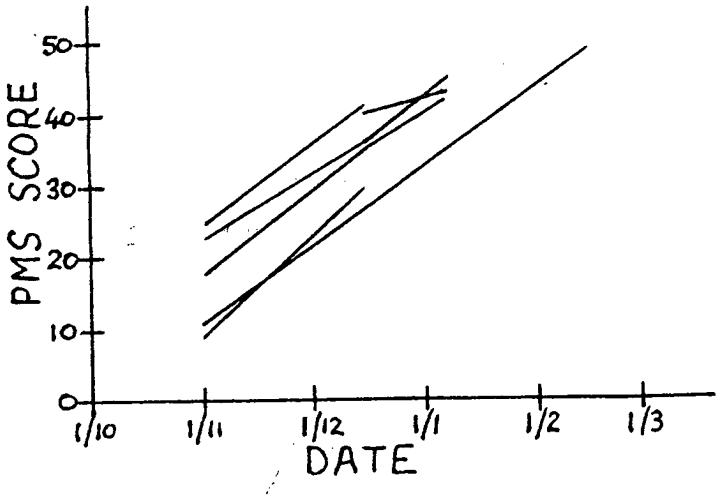

Fig 3. Primary Moult Scores (PMS) by date for individual adult birds recaptured in a later year.

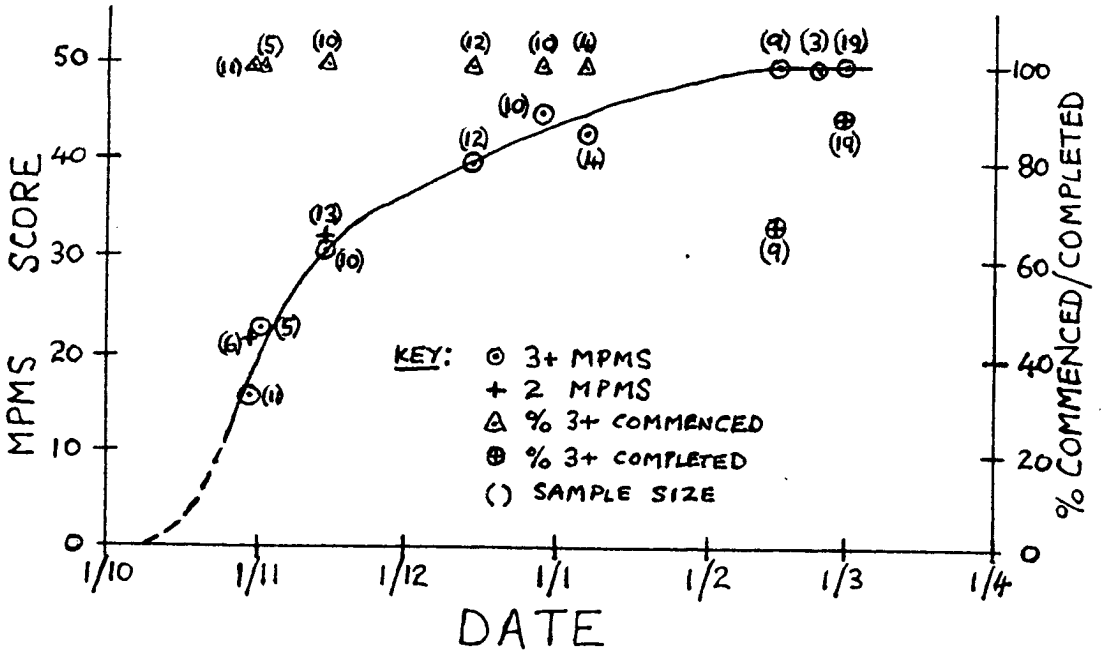

Fig 2. Median Primary Moult Score (MPMS) and % commenced/completed moult for different catches

RED KNOT *Calidris canutus rogersi* IN AUSTRALIA, PART 2: BIOMETRICS AND MOULT IN VICTORIA AND NORTH-WESTERN AUSTRALIA.

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SUMMARY

Data obtained from approximately 1450 Red Knot caught in north-western Australia (NWA) and Victoria from 1978 to 1988 have been analysed with respect to biometrics, primary feather and breeding plumage moult, age structure, longevity and site fidelity. On average, adults have wing-lengths of about 166mm and first-years of 150mm. Bill (c. 33mm) and total-head lengths (c. 61mm) vary little according to age. Victorian adult and second-year birds weigh, on average, about 117g and first-years 110g. All age groups in NWA are approximately 6g lighter than those in Victoria. Weights of both adult and first-year birds are variable throughout the non-breeding season in Victoria, and this is probably caused by the presence of birds on passage to and from New Zealand. Adult primary moult in Victoria has a duration of about four months which is similar to that of Curlew Sandpipers (125 days) and Red-necked Stints (130 days). Primary moult in adult birds in NWA commences in the second half of August and is six to seven weeks in advance of the same age groups in Victoria. Second-years are completing moult at both sites at the same time as adults are beginning. A majority of first-year birds undergo some degree of primary moult during the January/April period although only a proportion appear to achieve a complete moult. The primary moult situation in Victoria in October/November is complex with adults and second years falling into three categories - moulting, non-moulting and suspended moult. It is suggested that the latter two categories could contain passage migrants on their way to New Zealand. Adult Red Knot commence moult into breeding plumage before departure and still have retained breeding plumage upon return. Data on breeding success, which is based on the percentage of first-years in catches, is limited but agrees with count data and 1985 was confirmed as a good breeding year for Red Knot. The longest interval between original banding and recapture is eight years, this record being for a first-year bird. Red Knot exhibit high non-breeding site fidelity in both NWA and Victoria, with any movements being of short distance and confined generally to first-year birds in Victoria. More information is needed on moult and weight of aged birds in order that the moult and migration strategies of Red Knot in Australia can be better understood.

INTRODUCTION AND METHODS

Part 1 of this paper (Barter *et al.* 1988) covered sub-species confirmation and the distribution and migration of Red Knot spending the non-breeding season in Australia. It was confirmed that Red Knot in Australia are of the *rogersi* sub-species and estimated that at least 160,000 individuals spend the non-breeding season in Australasia, with the majority being located in northern Australia and New Zealand. There have been thirteen movements of banded birds linking Australia with China and New Zealand. North-western Australian Red Knot appear to be capable of flying non-stop from there to China, however little is known about the migration strategies of birds which spend the non-breeding season in Victoria and New Zealand.

Since Part 1 was written a further 722 Red Knot have been caught in north-western Australia (NWA) during the March/April 1988 Australasian Wader Studies Group Expedition and data from these birds have been included in the current analysis, which covers birds caught in NWA and Victoria during the 1978 to 1988 period.

Methods are as described in Part 1. The ageing convention is:

3+ - in third year or older
2+ - in second year or older
2 - in second year
1 - in first year

3+ and 2+ birds are also referred to as adults and first-years as juveniles. First-year birds become second-years on the 1st August.

RESULTS AND DISCUSSION

Wing, bill and total-head length measurements.

Average data by age group are given in Tables 1-6. Wing-length measurements were taken to the nearest whole mm and total-head lengths to the nearest 0.1 mm. Bill-lengths were measured, at different times, to accuracies of 0.1, 0.5 and 1.0 mm. The results obtained using the different accuracies were not significantly different ($p > 0.05$) and have been combined.

Average adult (3+ and 2+) wing lengths in Victoria and NWA are similar (c.166mm) and are about 7mm longer than those of first-year birds (c.159mm) (see Tables 1 and 2).

Average wing-lengths of second-year birds are longer than those of first-years due to the fact that a proportion of first-years undergo a complete primary moult in the January/April period (see Primary Feather Moult) and replace old and worn outer primaries with new and longer feathers of similar length to those of adults. For example, a June catch of eleven month old birds in Victoria gave a significantly longer average wing-length ($p<0.005$) for those with new outer primaries (166.2mm) compared to those with old (158.4).

The average bill-length of adult (3+ and 2+) birds in both NWA and Victoria are similar, ie. 32.8mm, whilst those of second-years in Victoria (32.9mm) and first-years in both NWA and Victoria (32.5 and 32.8mm, respectively,) are either the same as or not significantly different to the adult average ($p>0.05$).

The similarity of the total-head length measurements for the different age groups and sites (c. 61mm - see Tables 5 and 6) indicates that this measurement is probably more consistent, and thus more reliable, than either wing or bill-length.

Weight.

The average weight data by region, age group and month are given in Tables 7 and 8, with the results being shown graphically in Fig 1. Weight comparisons for re-trapped adults (different years) and first-year birds in Victoria are shown in Figs 2a and b.

Victorian adult Red Knot appear to be about 6g heavier, on average, than their NWA counterparts, ie. 117/118g vs. 110/112g, during the October/November period. Great Knot *Calidris tenuirostris* were also found to be heavier in Victoria than in NWA (Barter 1987). The weights of second year birds in the two regions are similar to those of adults.
Victorian first-years are also heavier, on average, than those in NWA although the absolute difference is difficult to determine due to the high weight variability of Victorian birds. Disregarding obvious peaks in weight, Victorian first-years

average between 106 and 115g whilst NWA birds of the same age vary from 100 to 105g.

Similar latitudinal weight differences have been found in the European-African non-breeding area (Dick and Pienkowski 1979), where Red Knot in England were found to be up to 23% (adults) and 66% (first-years) heavier than their counterparts in north-west Africa during the September/November period. Dick and Pienkowski (1979) suggest that the weight differences are due to the need for birds in the colder non-breeding areas to have fat reserves in order to withstand the harsher conditions and the higher probability of low prey availability. They further suggest that where adverse conditions are infrequent "the cost of storing and carrying reserves are likely to exceed the benefits" The weight differences are less within Australia (6-7% for each of the three age groups) and this is probably due to the much milder conditions which exist during the non-breeding season in Victoria than in England.

The average weights of both Victorian adult and first-year birds is quite variable throughout the non-breeding season. It is known that birds pass through Victoria to New Zealand on southward migration (Barter *et al.* 1988) and, thus, the weight variations may be due to pre-migratory fattening of passage birds.

The variation in average weekly weights of adults in NWA during the March/April period, as detailed in Table 8, indicates that migration turnover is occurring. This is shown more clearly in Fig 3 in which weight histograms for four successive catches at Anna Plains are shown (ie. 29th and 31st March, 1st and 3rd April 1988). Migration was observed, by use of radar, to occur on 25th and 26th March and 1st April (Murlis *et al.* 1988). Weights were seen to increase steadily from 29 March to 1st April and then to decline sharply following the departure of the heavier birds, ie. those above about 165g.

Primary Feather Moult.

Primary feather moult data are shown graphically in Figs 4 to 8.

On average, Victorian adult Red Knot commence moulting during the second-half of October and complete moult in late February/early March (Fig 4). The moult duration of about four months is similar to that previously recorded of 125 days for Curlew Sandpiper *Calidris ferruginia* in Tasmania (Barter 1986a) and 130 days for Red-necked Stint C. *ruficollis* in Victoria (Paton and Wykes 1978). However, more data are required, especially in the January/February period, in order to allow a more accurate definition of the moult period to be obtained. Data from retraps, all in different years, are shown in Fig 5 and are consistent with a moult duration of approximately 120 days.

In Victoria, primary moult in second-year birds commences at the innermost primary and is about two months ahead of that of adults (Fig 6), i.e. Median Primary Moult Score (MPMS) = 30 reached in mid-October by second-years and mid-December by 3+ birds. Second-years start to complete moult in October, which is about the same time that adults are commencing moult. This moult is completely separate to the primary moult undergone by some first-year birds. Often, feathers of three different ages are found in the same wing, ie. juvenile, first-year moult (February/April) and active second-year moult.

Adults in NWA start primary moult in the second-half of August and have reached MPMS 30 by end October/early November (Fig 7). Thus, they are six to seven weeks ahead of Victorian birds of the same age. NWA second-year birds have a MPMS of 40 to 50 by the end of August and, as with Victorian second-years, are completing moult as adults are commencing.

The timing of primary moult in Red Knot in both NWA and Victoria is consistent with the general observation (although there are exceptions) that waders which breed in the palearctic, and spend the non-breeding season in the southern hemisphere, do not commence primary moult until they reach their non-breeding destinations (see, for example, Pearson 1981, 1984, Elliot *et al.* 1976, Barter (1986a, 1986b, 1987).

Differences in the timing of primary moult in the two regions and between the two age groups may be explained by the earlier arrival of adults in NWA compared to Victoria (i.e. mid-August vs. early October) and the fact that many, if not all, first year birds spend the non-breeding season near, or at, the non-breeding sites, thus allowing them to commence primary moult, as second-years, before the returning adults.

Analysis of primary moult data for adult and second-year birds in Victoria is complicated by the through-passage in the October/November period of Red Knot bound for New Zealand. Data from three adults banded in Victoria during this period, and subsequently controlled in New Zealand, shows that none of the birds were in primary moult and all were heavier than the flock averages, although not significantly so ($p>0.05$). However, a number of other birds, which had also not commenced primary moult at the same time as the subsequent New Zealand controls, were caught later in Victoria and, therefore, the presence or absence of primary feather moult cannot alone be used to separate passage birds from those which choose to remain in Victoria.

A substantial portion of both 3+ and second-year birds caught in the October/November period are in suspended moult (see Table 9), with the inner group of feathers being the newest. 3+ birds in suspended moult are far more advanced in moult score than those adults in active moult (i.e. MPMS 20 vs. 2 on 19/10/85, 30 vs. 9 on 8/11/86), whereas second-year birds are behind (i.e. MPMS 30 vs. 43 and 35 vs. 39, respectively). The sites at which moult commences for those adults and second-years which are in suspended moult is not known. However, they could be NWA in the case of adults and Queenscliff for second-year birds.

The average weight of 3+ and second-year birds in the three moult categories, "non-moulting", "suspended moult" and "moulting", are given in Table 9 for three Queenscliff catches during the October/November period. It can be seen that non-moulting 3+ birds are lighter than moulting birds in mid-October, but by early November they are significantly heavier ($p=0.01$). The standard deviation of weight is greater for non-moulting than moulting birds in all catches. The average weight of adults in suspended moult do not vary over the period, and are not significantly different from those of either non-moulting or moulting birds ($p>0.05$). However, the standard deviations of weight of those birds in suspended moult are much greater than those of birds in the other two moult categories, indicating the possible presence of passage birds.

Second-year birds in suspended moult are significantly heavier than non-moulting birds in both the October and November catches ($p<0.01$, $p<0.001$, respectively). Standard deviations of weight are also higher for the former than the latter.

The average Red Knot would need to weigh about 130g or more in order to migrate successfully to New Zealand (Barter *et al.* 1988). The percentages of

Table 1. Wing-length data for different age groups of Victorian Red Knot (mm).

Age	Sample Size	Mean	sd	Range
3+	250	165.7	4.4	149-177
2+	130	165.2	4.4	153-176
2	63	161.4	7.4	143-174
1	312	158.8	5.6	146-174

Table 2. Wing-length data for different age groups of NWA Red Knot (mm).

Age	Sample Size	Mean	sd	Range
3+	131	164.3	4.5	148-176
2+	439	166.3	4.3	156-177
2	35	160.6	5.6	145-170
1	68	160.1	6.3	146-168

Table 3. Bill-length data for different age groups of Victorian Red Knot (mm).

Age	Sample Size	Mean	sd	Range
3+	277	32.7	1.6	28.5-39.4
2+	166	33.1	1.8	27.1-38.8
2	135	32.9	1.7	27.0-37.5
1	371	32.8	1.8	28.3-37.9

Table 4. Bill-length data for different age groups of NWA Red Knot (mm).
Only 3 second-year birds were measured and have not been included.

Age	Sample Size	Mean	sd	Range
3+	59	33.1	1.9	29.0-38.5
2+	373	32.8	1.6	29.0-37.0
1	45	32.5	1.4	29.7-35.6

Table 5. Total head-length data for different age groups of Victorian Red Knot (mm).

Age	Sample Size	Mean	sd	Range
3+	72	61.0	2.0	55.8-64.5
2+	133	61.0	2.3	55.1-66.0
2	10	60.7	2.2	56.9-63.7
1	139	60.9	2.1	57.3-68.5

Table 6. Total head-length data for different age groups of NWA Red Knot (mm).

Age	Sample Size	Mean	sd	Range
3+	70	61.1	2.0	56.2-65.3
2+	188	60.8	2.1	55.1-66.0
2	29	60.3	2.2	57.4-64.0
1	20	61.1	1.0	58.6-62.6

Table 7. Victorian weight data by age and month (g).

Age	Month	Sample Size	Mean	sd	Range
3+-2+	Oct	186	117.9	11.4	95-142
	Nov	79	116.6	12.0	92-150
	Dec	27	122.6	7.2	110-140
	Feb	20	127.5	9.4	110-142
	Mar 1st half	4	127.3	13.2	116-146
	Mar 2nd half	21	175.1	13.2	150-200
2	Oct	43	119.2	13.9	90-155
	Nov	88	114.8	11.7	89-141
1	Oct	21	106.1	13.0	88-140
	Nov	65	114.8	12.9	89-143
	Dec	77	126.6	13.6	86-168
	Jan	32	117.0	8.2	98-130
	Feb	37	115.1	7.6	102-131
	Mar 1st half	17	110.3	9.3	100-122
	Mar 2nd half	9	128.4	20.1	87-158
	Apr	31	126.1	14.7	100-168
	Jun	31	128.7	15.8	104-162
	Jul	70	114.8	9.4	95-141

Table 8. NWA weight data by age and months (g).

Age	Months	Sample Size	Mean	sd	Range
3+-2+	Aug-Sept	83	110.2	7.7	91-128
	Oct-Nov	81	111.8	8.1	95-152
	3rd week Mar	119	128.4	15.2	100-166
	4th week Mar	399	138.1	16.7	100-187
	1st week Apr	190	142.1	15.1	94-179
	2nd week Apr	148	119.7	12.3	95-136
	3rd week Apr	67	125.3	14.4	97-153
2	Aug-Sept	34	108.7	8.8	96-121
	Oct-Nov	13	109.2	7.9	92-122
1	Oct-Nov	30	100.5	10.5	81-119
	3rd week Mar	30	101.3	10.1	86-130
	4th week Mar	30	100.7	6.8	91-117
	1st week Apr	26	99.1	7.3	85-112
	2nd week Apr	2	108.0	-	108
	3rd week Apr	20	104.5	12.1	80-124

the two age groups, by moult category, which weigh 130g or more are given in Tables 10 and 11. It can be seen that, in all cases, a smaller percentage of birds in active wing moult have reached the theoretical migration weight than in the other two categories, i.e. non-moulting and suspended moult.

The weight data (average weight, standard deviation and percentage greater than 130g) indicates that some, at least, of the non-moulting or suspended moult 3+ and second-year birds are using Queenscliff as a staging site before migrating further to New Zealand. A more complete understanding of the migration strategy of the two age groups will require additional moult and weight data, especially from birds caught more than once in the same season.

Many first-year birds undergo a partial or complete primary feather moult. Data for Victorian birds are shown in Fig. 8 and for NWA birds in Table 12. Some Victorian first-years commence moulting their primaries as early as January, with the MPMS increasing sharply from late February (1-3) through to early April (27). The percentage of first-years in primary moult in Victoria also increases to between 50 and 100% of a catch by March/April. However, in two good-sized catches of Red Knot in June and July, i.e. of first-years remaining in Australia during the breeding season, the MPMS values had decreased to 8 and 0, respectively, with 59 and 38% of the birds having commenced moult and only 9 and 4% respectively, having completed a full primary moult. The results suggest that many of the birds that have commenced primary moult in Victoria in the January to April period leave for more northerly latitudes during the southern winter and that those that do not moult, or do so late, together with, perhaps, first-years from New Zealand remain in Victoria during the breeding season.

The percentage of first-years which undergo a full primary moult is unknown, although less than 10% of those remaining during the southern winter have replaced all their feathers. In north-western Australia, it seems probable that more than 20% complete primary moult, and in late-March and mid-April MPMS values in this region are similar to those for Victorian birds (see Table 12).

The symmetry and starting point of moult in first-year birds is highly variable. In Victoria, out of a total of 76 birds analysed, 56% had the same moult score for both wings whilst 31% differed by more than 5 points. For those birds in which the starting point(s) for moult could be determined, 42% had commenced at the innermost feathers, 31% amongst the outer feathers, 19% were moulting in both regions and 8% had started moulting from the centre.

Breeding Plumage.

In some of the catches the amount of breeding plumage was assessed subjectively for each bird and catch averages for Victorian and NWA are given in Tables 13 and 14. The degree of breeding plumage is given as a decimal fraction, e.g. 1.0=100%.

In Victoria, adult Red Knot commence moult into breeding plumage in February and, on average, have attained around 60% breeding plumage prior to departure in late March/early April. Some still retain a small amount of breeding plumage at the beginning of November. Interestingly, 70-80% of the first-year birds spending the non-breeding season in Victoria gain traces of breeding plumage.

In NWA, breeding plumage levels are variable in the March/April period and were noticeably higher in 1988 (compared to 1985) when lengthy adverse weather conditions delayed departures. Average catch weights were also much higher in 1988. The reason for the difference in breeding plumage levels between years is not clear but it could be due to the enforced late departure in 1988 of Red Knot in well-developed breeding plumage which had spent the non-breeding season in NWA, whereas in 1985 these birds had left by late March and had then been replaced by Knot with less-well developed breeding plumage from south-eastern Australia and New Zealand.

Adult Red Knot arriving in NWA in late August/early September still retain 30-40% breeding plumage.

Breeding Success.

Determination of breeding success is complicated by the obvious preference of first-year Victorian birds for Werribee and Yallock Creek, when compared to Queenscliff. Details of population age structure are given in Table 15, which contains the accumulated data for the three sites during November/March in the 1978-1987 period. It can be seen that the percentage of first-years ranges from 81-95% at Werribee and Yallock Creek, but is only 21% at Queenscliff.

Catches at all three sites have been fairly evenly distributed over the ten year period, although larger numbers have been caught at Queenscliff during the latter years. Whilst catches were made with mist-nets in the earlier years at Werribee, comparison with cannon-net results at the same site in later years shows that the difference in proportion of first-years caught by the two methods is not significant ($p>0.05$).

Details of the ages of birds caught annually at Queenscliff in the November/March period are given in Table 16. The data, on their own, are too limited to allow any definite conclusions to be drawn concerning annual differences in breeding success, except that the high proportion of second-year birds in 1986/87 (37%) is consistent with the high percentage of first years in the previous season (32%), thus confirming that the 1985 breeding season was successful for Red Knot. Although the data is limited, it is in fact consistent with breeding success results obtained from count data, in which the numbers of first-years remaining in Australia during the breeding season are compared with the total numbers of Red Knot present during the previous non-breeding season (Hewish 1987).

Longevity.

There is insufficient data available to allow an estimation of the average life of Red Knot to be made. However, so far, the greatest interval between banding and retrap date for an individual bird is 8 years and 2 days, which closely approximates the duration of the catching programme in Victoria. This particular bird was in its first-year when originally caught. Two other birds have intervals of approximately 7 years between banding and recapture. As all of these birds were caught in the 1986/87 season (the latest season for which data is available), there is a good chance that older birds will be recaptured in future years. Despite these retraps probably being well above average age for Red Knot in Australia, they have a long way to go in order to emulate the Red Knot which was recently caught in England twenty three years after being first banded (C.D.T. Minton pers. comm.).

Site Fidelity.

Only nine birds out of 83 retrapped in Victoria had changed site, with all of these being movements from Werribee to Queenscliff, a distance of 27 kilometres. Seven of the birds were first-years when banded and thus provide further evidence that

Table 9. Weight data for Victorian 3+ and second-year birds in different moult categories.

Age	Date	Non-Moulting			Suspended Moult			Moulting		
		Sample Size	Mean	sd	Sample Size	Mean	sd	Sample Size	Mean	sd
3+	19/10/85	111	116.4	11.8	20	116.5	15.0	14	120.2	8.1
	31/10/82	14	121.4	8.6	-	-	-	29	121.1	8.2
	8/11/86	35	120.7	13.0	10	115.1	15.6	28	114.2	7.0
2	19/10/85	-	-	-	16	125.6	13.4	13	111.8	12.9
	8/11/86	5	115.4	13.0	16	120.3	12.3	51	112.4	10.4

Table 10. Percentage of 3+ Red Knot weighing more than 130g on three dates during potential passage period to New Zealand. ( ) = Sample Size.

Date	Non-Moulting	Suspended Moult	Moulting
19/10/85	20 (106)	33 (21)	14 (14)
31/10/82	21 (14)	-	10 (30)
9/11/86	24 (38)	10 (10)	0 (28)

Table 11. Percentage of second-year Red Knot weighing more than 130g on two dates during potential passage period to New Zealand. ( ) = Sample Size.

Date	Non-Moulting	Suspended Moult	Moulting
19/10/85		43 (14)	17 (12)
9/11/86		24 (17)	8 (48)

Table 12. Primary moult data for first-year Red Knot in NWA. MPMS = Median Primary Moult Score.

Date	Sample Size	MPMS	% Moulting	% Completed
24-26/3/85	35	25	89	3
23-26/3/88	22	0	41	0
04-06/4/88	24	0	67	0
19/4/85	19	25	63	21

Table 13. Breeding plumage levels for 3+/2+ and first-year Red Knot in Victoria.

Age	Date	Sample Size	Breeding Plumage
3+/2+	31/10/82	44	0.06
	8/11/86	76	0.11
	21/02/87	20	0.21
	22/03/80	21	0.60
1	3/06/84	31	0.20
	24/07/83	69	0.18

Table 14. Breeding plumage levels for 3+/2+ and second-year Red Knot in NWA.

Age	Date	Sample Size	Breeding Plumage
3+/2+	24/08/82	29	0.42
	2/09/82	7	0.32
	23/03/88	72	0.84
	24/03/85	43	0.52
	25/03/85	35	0.53
	25/03/88	34	0.73
	26/03/85	35	0.53
	29/03/88	183	0.87
	31/03/88	163	0.83
	1/04/88	46	0.87
	3/04/88	50	0.86
	6/04/88	58	0.83
	13/04/85	149	0.66
	17/04/85	56	0.58
2	24/08/82	23	0.08

Table 15. Age-structure of Red Knot caught at three Victorian sites during November to March in the 1978/87 period.

Site	No. of Adults	No. of 2s	No. of 1s	% 1s
Werribee	27	3	128	81
Yallock Creek	1	-	20	95
Queenscliff	283	109	104	21

Table 16. Age-structure of Red Knot caught during the November/March period at Queenscliff, Victoria. * = essentially one catch, as others were of single birds. N.B. No data for 1982/83.

Season	No. of Adults	No. of 2s	No. of 1s	% 1s	No. of catches
1979/80	23	-	7	23	3 *
1980/81	2	-	7	-	1
1981/82	28	3	7	18	2 *
1983/84	-	-	1	-	1
1984/85	51	-	7	12	1
1985/86	50	-	24	32	1
1986/87	129	106	51	18	2

Werribee is the site used by juveniles which have been out-competed by adults in Queenscliff.

All retraps in NWA occurred at the original banding site.

FURTHER WORK

Wing, bill and total-head lengths of the different age groups of Red Knot in Australia have been well defined and there does not appear to be any reason to continue collecting such data.

However, it is still necessary to obtain wing moult and weight data for aged birds, especially in the November to February period in Victoria, in order to improve our understanding of the moult and migration strategies of Red Knot within Australasia.

ACKNOWLEDGEMENTS

We would like to thank members of the Australasian Wader Studies Group and the Victorian Wader Study Group for both collecting the data and allowing us to analyse and publish the results.

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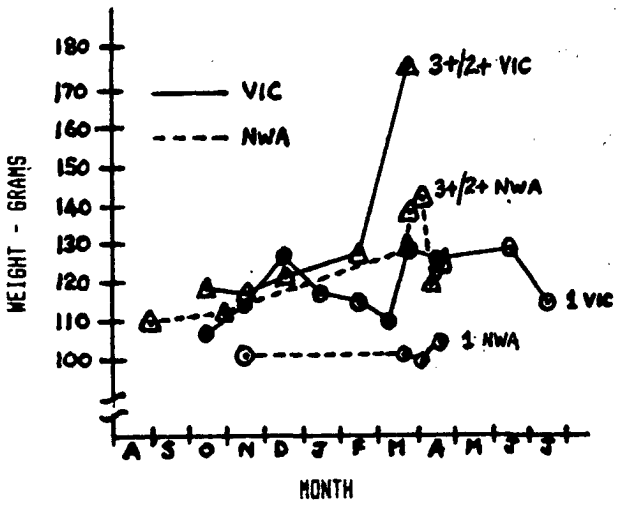

Fig 1. Red Knot weights in Victoria and NWA. (see Tables 7 and 8 for sample sizes and standard deviations)

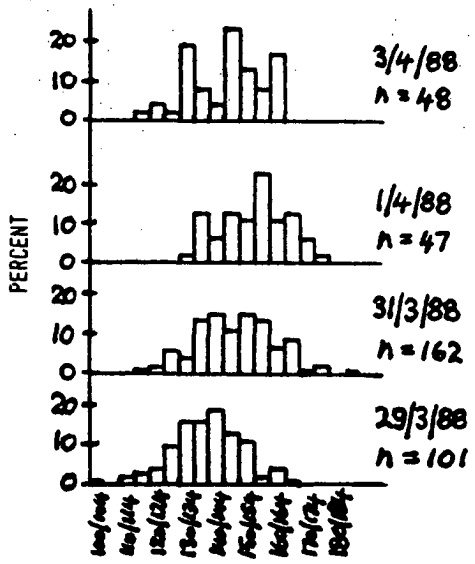

Fig 3. Histograms of four successive catches of adult Red Knot in NWA, with major departure occurring on 1/4/88.

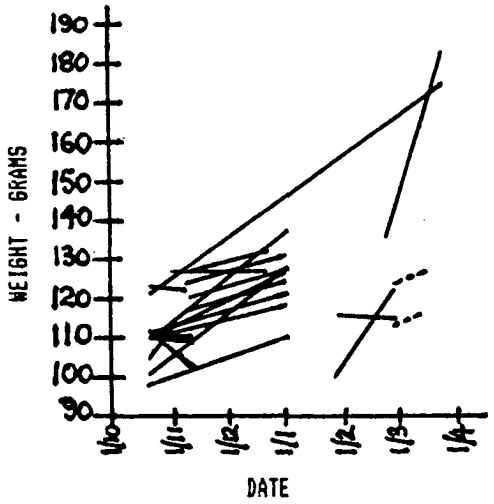

Fig 2a. Victorian adult (3+ and 2+) Red Knot retrap weights.

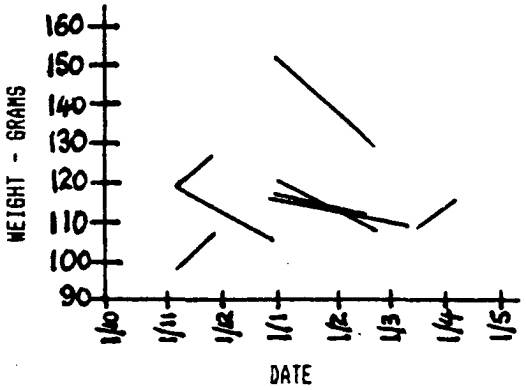

Fig 2b. Victorian first-year Red Knot retrap weights.

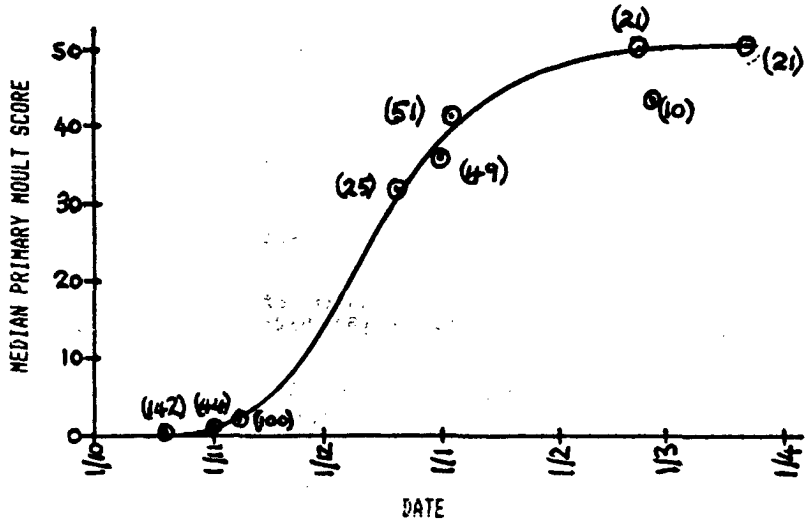

Fig 4. Victorian adult (3+ and 2+) Red Knot primary moult data.

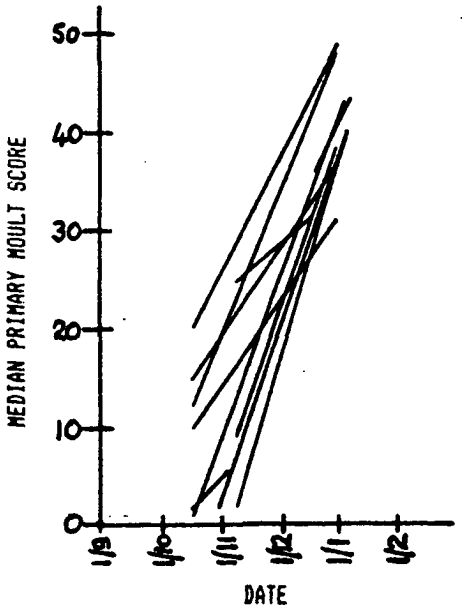

Fig 5. Moult scores of individual Victorian adult Red Knot retrapped in different years.

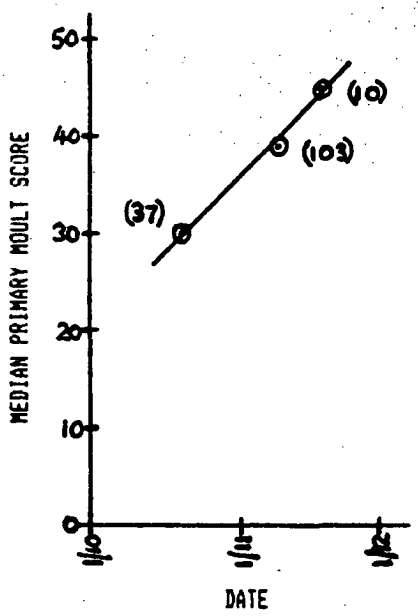

Fig 6. Victorian second-year Red Knot primary moult data.

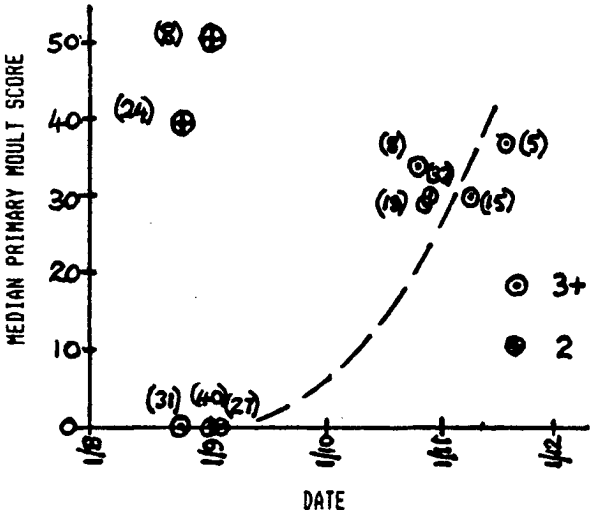

Fig 7. NWA 3+ and second-year Red Knot primary moult data.

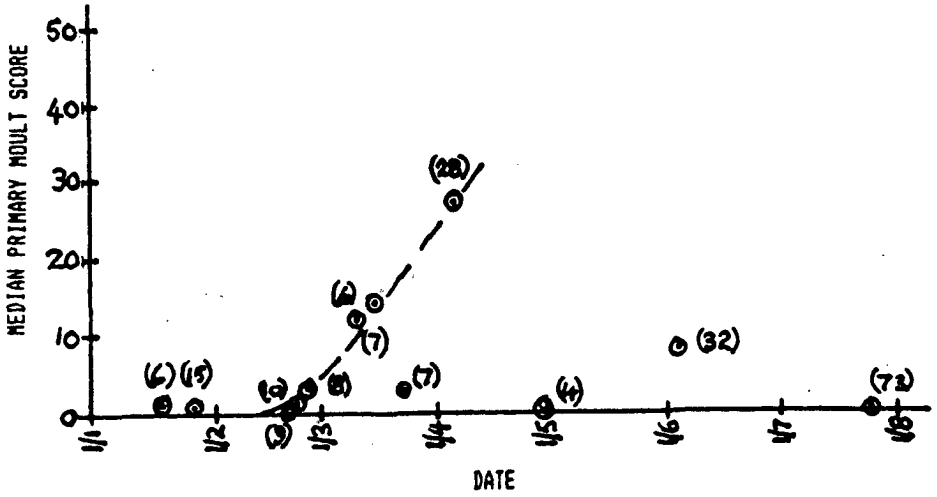

Fig 8. Victorian first-year Red Knot primary moult data.

THE CONCEPT OF THE VARIABLE NICHE IN A TIDAL ENVIRONMENT.

D.G. Thomas, 1/Brightwater Villas, Blackmans Bay, **Tasmania**, 7050.

In considering wader communities in a tidal environment, it is necessary to discuss niche space under tidal conditions as tidal habitats differ from terrestrial ones in many respects. At high tide little or no habitat is available for foraging. The amount of habitat increases, reaching a maximum at low tide, after which it decreases to a minimum at the next high tide. Tidal habitats are also essentially two-dimensional, with all birds confined to the same horizontal plane.

The converse of the compression model of the niche proposed by MacArthur and Wilson (1967) can be used to illustrate the form of niches in a tidal environment. Not only is this model convenient, but it depicts accurately the sequence of events that occurs during the ebb. The model assumes that as species 'invade' the expanding habitat, the amount of habitat occupied by a species increases. It is assumed that the range of food items taken remains substantially the same although the proportions of the individual items will vary. MacArthur and Pianka (1966) gave a formal proof of this.

A hypothetical two-dimensional model has been constructed for a tidal environment occupied by eight species (Figure 1). The habitat axis can be considered to be a strip starting at the water's edge at high tide and perpendicular to it. It is further assumed that the substrate does not change significantly. A typical substrate might be mud without areas of sea-grass, areas of rock, etc. between high and low water marks.

At high water only those species adapted to forage while wading can do so (Figure 1a) although they may not do so if suitable food is unavailable. During the first stages of the ebb all waders start foraging in the restricted area available. This applies to most species in south-eastern Tasmania but may not at the high population densities that occur elsewhere during migration. Shortage of space may give rise to delayed foraging movements (Recher 1966). Species segregation is pronounced (Figure 1b). Birds congregate on both sides of the water's edge which they follow as it recedes.

As low water is approached foraging space approaches its maximum. Species segregation becomes far less distinct (Figure 1c). For simplicity, figures 1a and b have been drawn showing no niches overlapping in two dimensions, which is a reasonable generalisation during the early stages of the ebb. Once the water level has fallen by a certain extent, about 25% in south-eastern Tasmania, spatial overlaps are so great that this simplification is no longer valid, even as a broad generalisation. The species flocks break up into smaller flocks which become distributed over much of the habitat and birds may no longer follow the water's edge. A patchy distribution results with birds of many species spread over the area, both below and above the water's edge, and species segregation may be hard to detect. Allowance for this, and the overlaps arising from decreased density, has been included in Figure 1c. No change in the range of food, be this kind and/or size, is shown for any species. At low water birds have spread back over the exposed mud and, as the water rises again, they become concentrated in a diminishing area, but species segregation remains indistinct. Birds normally leave for loafing areas, or to continue feeding in non-tidal areas where these are present, before the habitat has shrunk to such an extent that species segregation becomes distinct again.

The variable tidal conditions encountered in south-eastern Tasmania are such that variations to the above sequence are encountered. For example, a considerable amount of mud may be exposed on a low high tide and the species distribution shown in Figure 1C may apply. Similarly, on a 'normal' high tide following a high low tide species may continue to feed almost up to high water, and species segregation may be pronounced, particularly where there are no non-tidal feeding areas available.

In Figure 1 the species involved may be:

1. Bar-tailed Godwit
2. Pied Oystercatcher
3. Eastern Curlew
4. Red-necked Stint
5. Curlew Sandpiper
6. Greenshank
7. Red-capped Plover and
8. Masked Lapwing.

A somewhat different set of species is involved if the substrate is not bare mud. Where *Zostera* beds are present, Red-necked Stint, Curlew Sandpiper, Bar-tailed Godwit and Red-capped Plover drop out, and the Lesser Golden Plover and Sharp-tailed Sandpiper come in. Other substrates have different sets of species again.

If competition (for food or space) is important in nature, active avoidance of interspecific competition would be expected in a stable community. In a tidal habitat the effects of competition would be most marked when the resources are in short supply, as they are when foraging space and/or time is/are limited. Species segregation is most pronounced when foraging space is severely limited after a normal high tide. It is then that the morphological and behavioural adaptations associated with foraging are most important. Comparative foraging studies should be most rewarding if undertaken at such times.

South-eastern Tasmania is at the limit of the winter range of Palaearctic breeding species. It is free from large influxes of off-passage migrants and it is debatable whether the carrying capacity of the area has been reached. This may account for differences in niche occupation patterns between south-eastern Tasmania as shown in Figure 1 and those described for California (with its large transient flocks of migrants) by Recher (1966).

If the variable niche concept is valid, one way to achieve optimum species-packing is for birds to forage in flocks, particularly during the early stages of the ebb when foraging space is limited. Hale (1980) discussed flocking in waders. He accepted the views of Ward and Zahavi (1973) that these assemblages of birds have evolved primarily to act as 'information centres' for the exploitation of unevenly distributed food supplies. Hale envisaged this as operating in the following way: birds joining a roost may follow experienced birds to known good feeding areas. While this may be so, it appears to be a somewhat simplistic explanation. Foraging (and roosting) in flocks may provide a mechanism that enables numbers to be adjusted to the amount of food available at that time.

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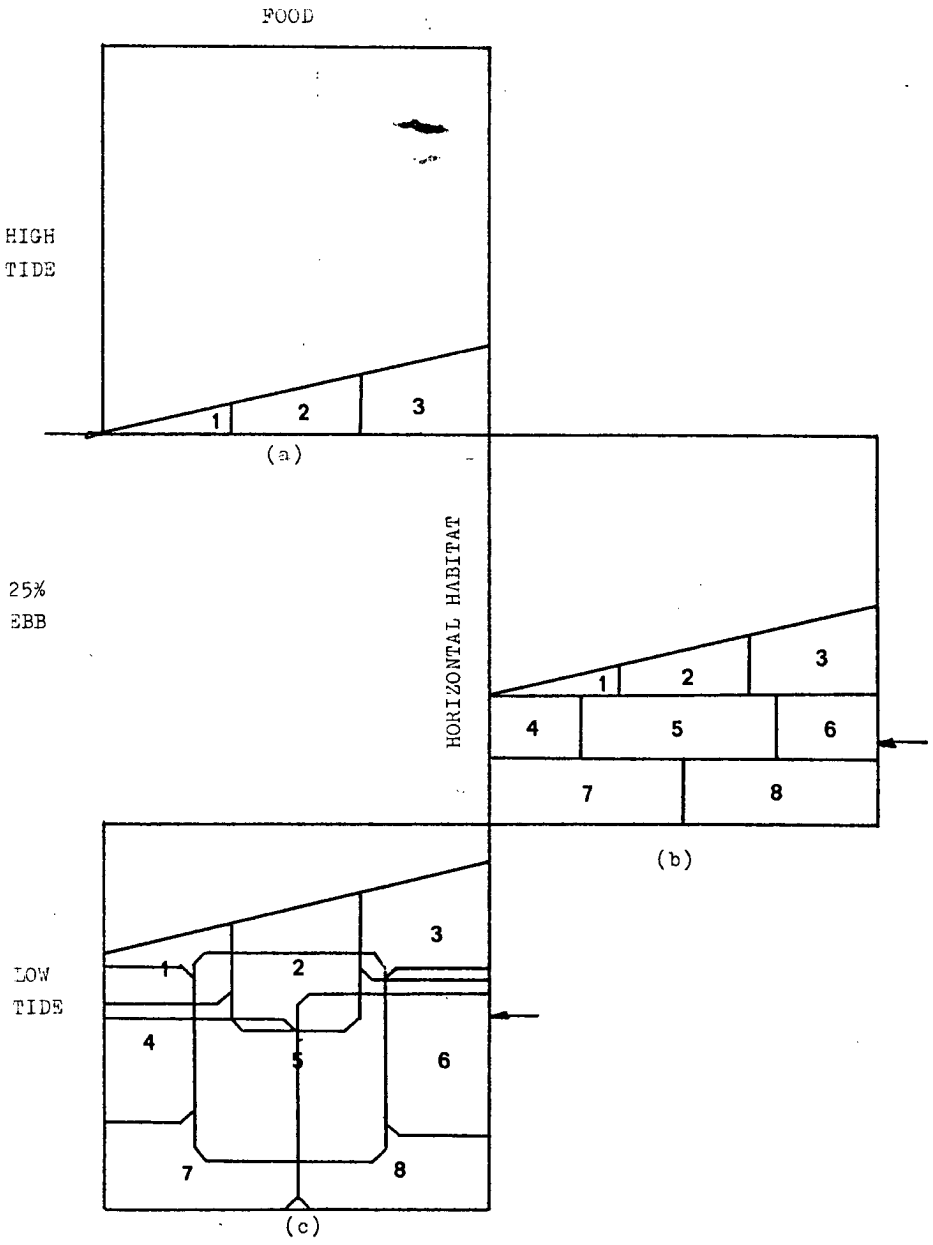
Figure 1. Niches in a tidal environment: a) high tide, b) 25% ebb and c) low tide. The arrows show the position of the water line.



PECKING RATES OF WADERS IN SOUTH-EASTERN TASMANIA.

D.G. Thomas, 1/Brightwater Villas, Blackmans Bay, Tasmania, 7050.

INTRODUCTION

A behavioural character which can be used to show differences in the feeding behaviour of waders is the pecking rate. Pecking rates may be determined by behavioural factors such as method of prey location and prey-attack behaviour as well as by prey availability and nature (kind and size). In this paper I present the results of pecking rate determinations made in south-eastern Tasmania together with schematic representations of the foraging methods of the commoner species.

METHODS

A stopwatch calibrated in tenths of a second was used to measure the time required for an individual to execute ten pecks and/or probes. "Stitching", the rapid execution of a series of pecks, was treated as a single peck following Burton (1974). Observations for most species were made on many occasions and were continued until the cumulative mean was substantially unchanged by three additional observations. Whenever possible observations were made in tidal situations during the early part of the ebb, i.e. less than 25% of the habitat exposed. The reasons for this are given elsewhere in this issue (Thomas 1988). Additional observations were made in non-tidal areas for species that rarely occurred elsewhere and for uncommon species provided that the birds were feeding actively. The original observations were made in the 1969-70 wader season. Further observations were made in the 1987-8 season. These later observations were designed to illustrate the effects of prey-attack behaviour and the type of items taken on the pecking rate.

RESULTS

Pecking rates (times for 10 pecks) are shown as grouped frequency distributions in Figure 1 for the commoner species. Generally a minimum of 30 independent observations is recommended (Morrison 1984). This criterion is met for 8 of the 13 species included in Figure 1 and is approached for a further 2 species. The mean pecking rate, expressed as pecks per minute, and its range in seconds are given in Table 1. The range, B, was calculated from the niche breadth formula suggested by Levins (1963)

$$\beta = 1/\Sigma p_{ij}^2$$

where the P_i are the proportions of observations for species i in time interval j. Data for five additional species are included in Table 1. It is assumed that sufficient determinations were made for differences in mean values to reflect differences in foraging method and/or diet and that they have not arisen from prey density variations associated with patchiness of the environment. An additional reason for restricting observations to the early stages of the ebb is that Burton (1974) has shown that for the Dunlin *Calidris alpina* the pecking rate is faster during the ebb than during the flood.

The histograms shown in Figure 1 show considerable deviation from the normal distribution. This is one reason why the Levin's niche breadth formula was used to determine the "spread" of results rather than using the standard deviation. To help explain the nature of the observed distributions the feeding actions of the common species were studied during the 1987-8 season. The results are shown schematically in Figure 2. The letters used to describe foraging actions are:

A. Peck - bill touches or takes item from substrate surface.

B. Jab - up to half the bill inserted into the substrate.

C. Bill length = maximum depth to which a bird can probe the substrate (see D)

D. Probe - more than half the bill inserted into the substrate and withdrawn immediately.

E. Prolonged probe - more than half the bill inserted into the substrate and not withdrawn immediately.

F. Multiple pecks - repeated pecking at the same object.

G. Head lowered usually followed by a peck if prey located or, if not, a move to another location.

H. Multiple probes - as D but bill reinserted in same place, presumably to capture same item.

I. Jab followed by probe - as B followed by a pause before bill inserted to more than half its length without withdrawal from the substrate.

J. Prey captured by probing dropped on substrate before being picked up, usually by pecking, and swallowed.

In most species small prey is swallowed as the bill is extracted from the substrate or immediately after it is picked off the surface and identification is impossible. Larger items such as crabs and the larger worms can usually be identified as such although rarely at the specific level. Data obtained from the stomachs of birds of several species collected in south-eastern Tasmania were given by Thomas and Dartnall (1971) and Thomas (1986).

Oystercatchers.

Both Pied and Sooty Oystercatchers *Haematopus ostralegus* and *H. fuliginosus* forage in similar ways when feeding on muddy and sandy substrates. Both locate prey while moving. They are known to take large worms and the larger bivalve molluscs such as *Anapella cycladea* as well as grapsid crabs. Most prey is captured below the substrate surface, mainly by probing (D) and prolonged probing (E). Bivalve molluscs are normally caught by prolonged probing. The bill is inserted between the valves which are opened by gaping, the animal is extracted and swallowed as the bill is withdrawn from the substrate. Timed probes ranged from 1.69 to 4.62 seconds (mean 2.93 ± 0.91, n = 17), although times longer than 10 seconds have been observed. During a prolonged probe the bird may pivot on its bill, usually through 90±20° although angles as great as 180° have been observed. The bill remains inserted to its maximum depth during such manoeuvres. In Figure 2 oystercatchers are shown as pecking (A). This technique may be employed to catch a crab, which is often taken to deeper water and washed. However, the commonest peck is a momentary touching of the surface by the bill tip which is immediately withdrawn without any prey being taken. Possibly the bill tip, which is equipped with sensitive nerves, is used to detect movement below the surface.

Lapwings.

Only the Masked Lapwing *Vanellus miles* occurs in tidal areas in Tasmania. Masked Lapwings locate prey on the substrate surface while they are stationary. Several items may be taken before the

bird moves. A stationary bird may lower its head before it locates prey (G).

Plovers.

In south-eastern Tasmania the common species occurring in estuarine areas are the Lesser Golden Plover *Pluvialis fulva*, Red-capped Plover *Charadrius ruficapillus* and Double-banded Plover *C. bicinctus*. Prey is located while the bird is stationary. Once it is located the bird moves to capture it (pouncing). Most prey is picked off the surface (A) although large items such as grapsid crabs may be eaten piecemeal by multiple pecks (F). Head lowering (G) may be used to enable prey to be located.

Ruddy Turnstone *Arenaria interpres*.

An uncommon species in south-eastern Tasmania. Some observations of the foraging of a small transient flock are included in Table 1. The birds were foraging on wet mud close to the water's edge in a non-tidal area. They foraged in a manner typical of *Calidris* spp - "sewing machine" probing (D).

Eastern Curlews *Numenius madagascariensis*.

The Eastern Curlew feeds on the move mainly by probing (D) and prolonged probing (E) with the bill held horizontally. It occasionally touches the substrate surface with its bill tip (A). Limited observation of a single Whimbrel *N. phaeopus* suggests that it feeds in a similar way. Piersma (1986) described a more specialised technique by which Eastern Curlews catch crabs. Although it is known to eat crabs in south-eastern Tasmania it has not yet been seen using such a method.

Greenshank *Tringa nebularia*.

Greenshanks feed either by "mowing" or probing. "Mowing" is a prolonged action usually while walking forward with the bill held nearly vertical with the tip in contact with the substrate or through vegetation, particularly *Zostera* beds. Greenshanks readily pursue free-swimming animals disturbed when "mowing".

Bar-tailed Godwit *Limosa lapponica*.

Bar-tailed Godwits are known to eat worms and crustaceans. Its feeding action, jabbing (B), probing (D), multiple probing (H) and a combined jab-probe (H) suggest some reliance on worms. Godwits feed while on the move.

Red-necked Stint *Calidris ruficollis*.

Stints feed with the typical *Calidris* "sewing machine" action. It pecks at items on the surface (A), which must be located visually, as well as by jabbing (B) and probing (D) (Thomas and Dartnall 1971). The time for 10 pecks probably increases as the proportion of pecks decreases. For example, on 11 Dec. 1987, the mean time for 10 pecks for birds feeding above the water's edge was 5.8 sec. compared to 9.2 sec. for birds feeding below the water's edge.

Curlew Sandpiper *C. ferruginea*.

Feeds with a "sewing machine" action. Probing (D) is the commonest feeding action. Food items are usually swallowed as the bill is withdrawn from the substrate. When feeding on the larger worms these may be withdrawn, dropped on the substrate surface, picked up by an end and swallowed whole. This may increase the time for 10 pecks from 13.4 to 29.8 sec. for birds foraging in close proximity to each other.

DISCUSSION

A generalised breakdown of the individual elements of wader feeding is given in Figure 3. Each element contributes to differences in the pecking rate and to the departure of the distribution curves (Figure 1) from normality:

Search.

Search techniques can be divided into two major categories: pursue or search. For waders, pursuers locate their prey while they are stationary whereas searchers move continually seeking their prey. Search technique influences the pecking rate indirectly through its effect on bird density and individual distance and territoriality. This aspect will be discussed in a subsequent paper. Search technique is also important in determining community organisation (MacArthur and Wilson 1967). Members of the *Charadriidae* are pursuers while members of the *Haematopidae* and *Scolopacidae* are searchers.

Locate.

Pursuers locate prey visually. Searchers may locate prey visually or from tactile stimulae. Red-necked Stints feeding on surface organisms obviously use visual means and probably most searchers feeding by pecking locate their prey by sight. However, species such as oystercatchers and Eastern Curlews may "peck" at the surface to detect movement of animals below the surface. Birds feeding by probing may probe at random or use visual clues, such as the entrance to the burrow of a crab.

Capture.

Small items are captured simply by being picked up. Larger items may require the expenditure of energy and time to capture. Large worms and crabs may have to be grasped and pulled to the surface. Large bi-valve molluscs may have to be opened and the animal extracted. Greenshanks may expend considerable time and energy chasing free-swimming animals. (Although Greenshanks actively pursue prey they are classed as searchers because they locate their prey while they are walking through the habitat).

Wash.

Some prey items may be washed before being eaten. (Thomas 1986).

Manipulate.

Prey items may have to be manipulated before being swallowed. Eastern Curlews may shake the larger crabs to remove their legs. Curlew Sandpipers may drop large worms and then pick them up by an end before swallowing them whole. Small plovers may dismember large prey which is swallowed piecemeal.

Many of the above elements may not be readily separable in the field, particularly when birds are feeding on small items. Locate, capture and manipulate may appear as a single action. This is greatly facilitated by the rhyncho-kinetic upper jaw of most waders, except for the oystercatchers, that enables prey to be handled without it having to leave the bill. Variations in the various elements together with a patchy distribution of prey contribute to the forms of the distributions in Figure 1.

The sample sizes used in this work are small. I believe that a series of small samples may be more revealing than a few large samples. I further believe that a study of pecking rates is a useful tool for determining relationships between waders

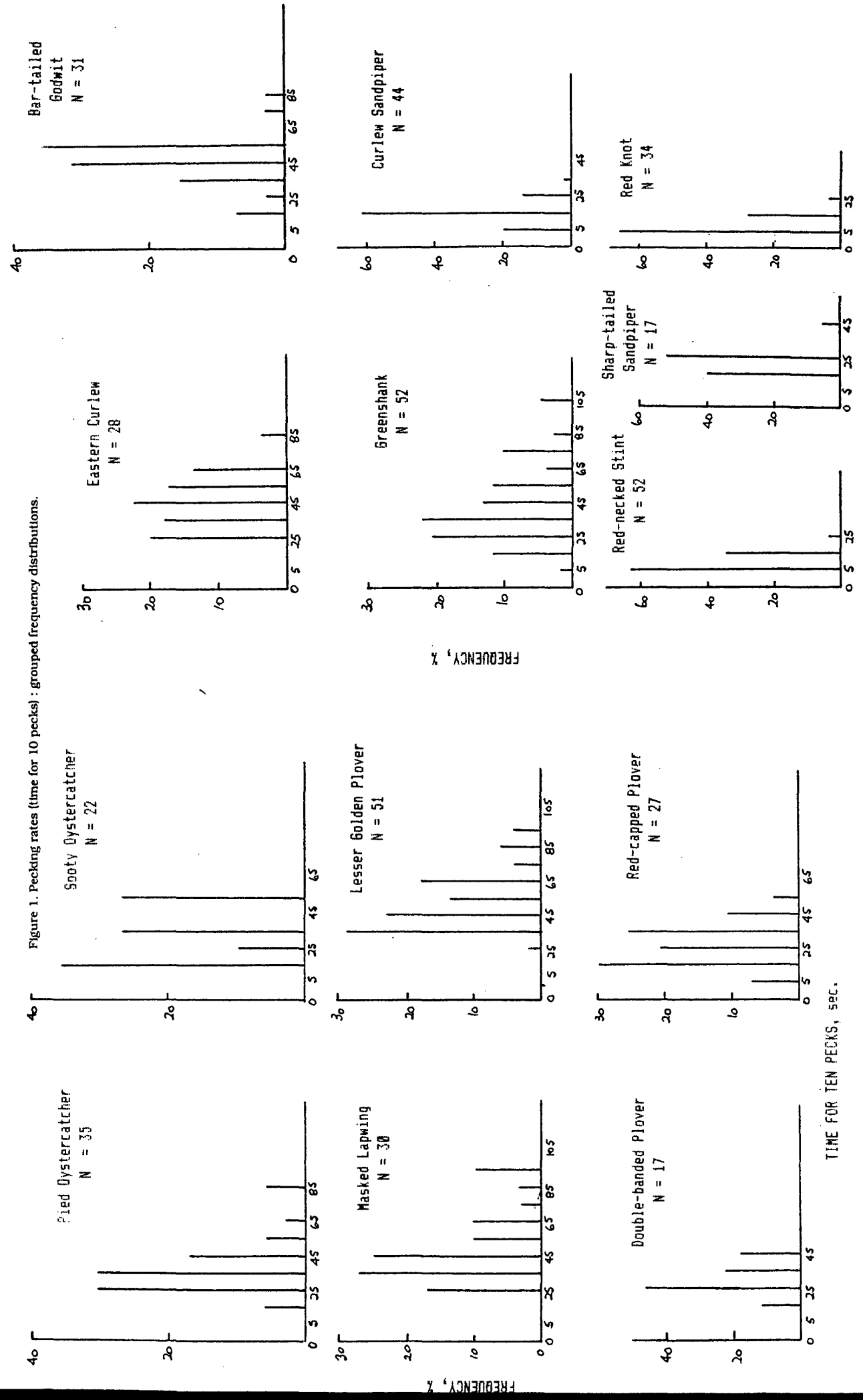
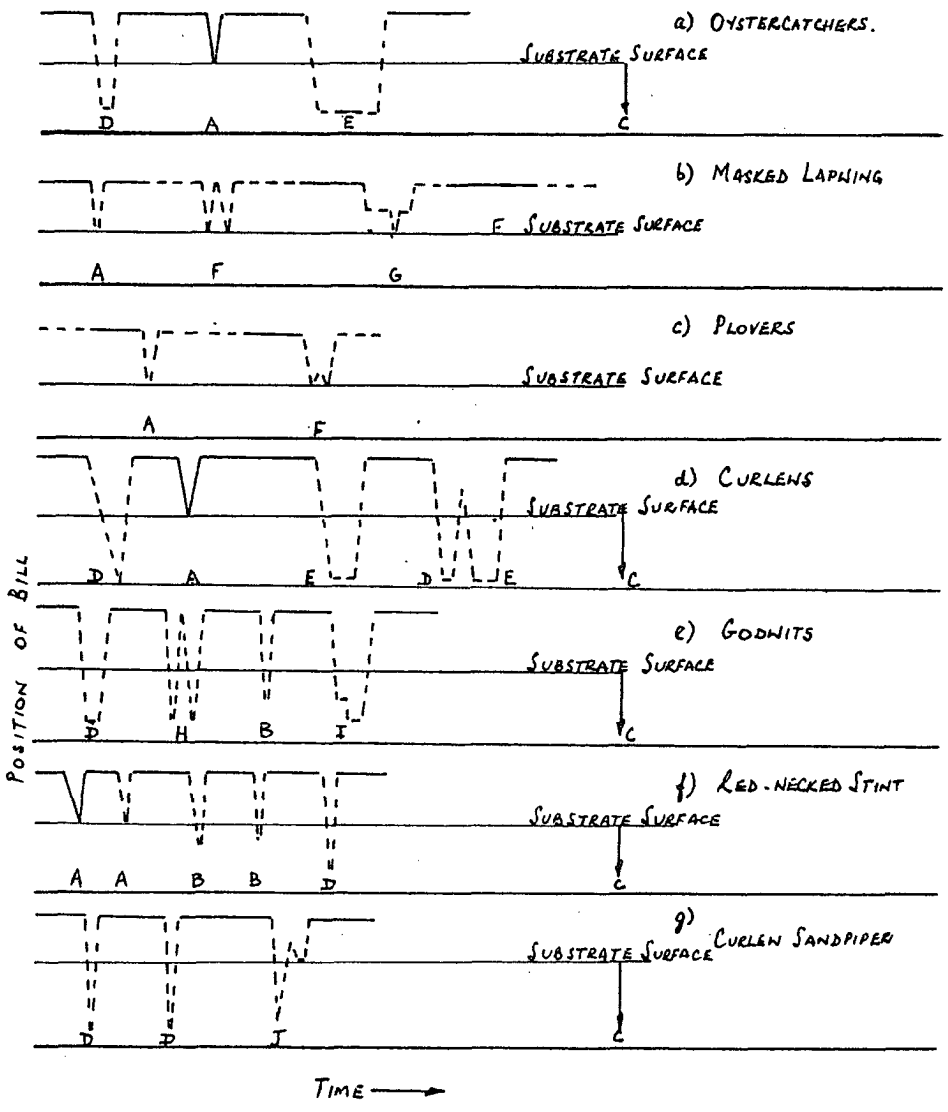


Figure 1. Pecking rates (time for 10 pecks) : grouped frequency distributions.

Figure 2. Schematic representation of wader foraging techniques. Bird moving - closed line, bird stationary - dashed line.



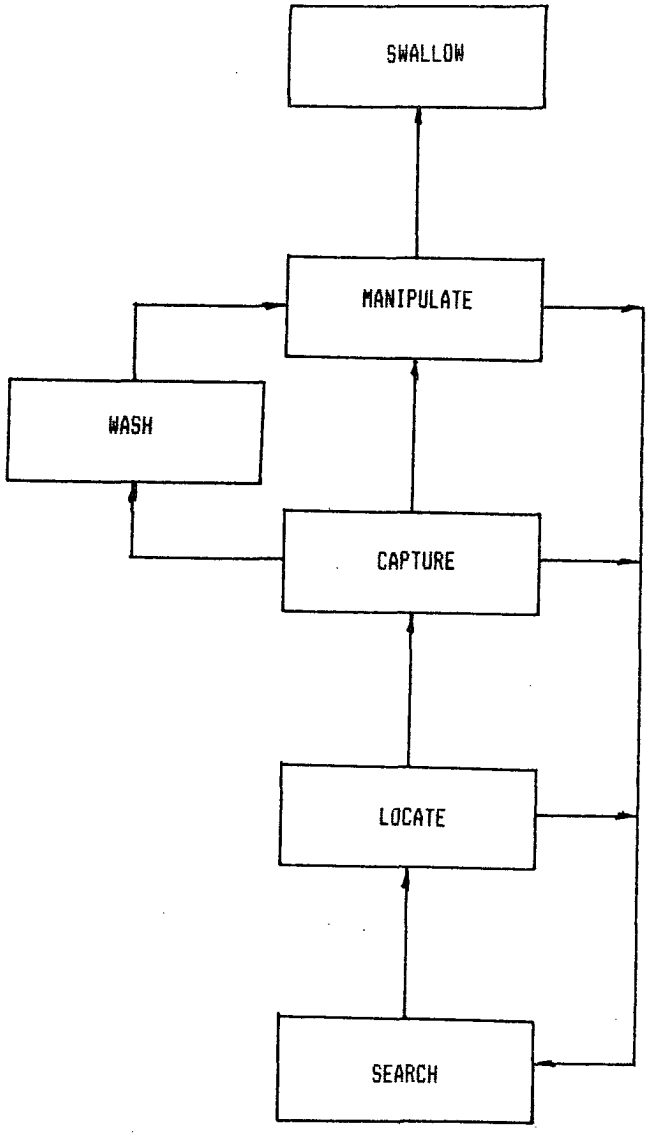


Figure 3. Model of wader foraging.

and their environment. Some pertinent questions are:

1) Are pecking rates species specific,

2) How do pecking rates vary with the tidal cycle, including differences in the nature of the substrate,

3) Do pecking rates vary with the phase of the bird's annual cycle (e.g. stage of moult, pre-migratory fattening),

4) Do pecking rates vary with locality,

5) Where birds are feeding in flocks do pecking rates differ between birds in the centre and on the periphery of the flock,

6) What effect does the kind/size of prey have on the pecking rate,

7) And, most difficult of all, what effect does the density of available (not total) prey have on the pecking rate?

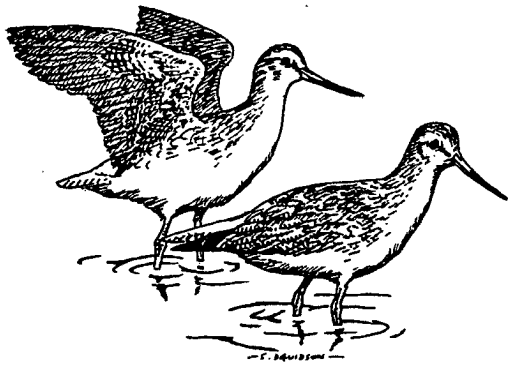


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Table 1. Mean time for 10 pecks and breadth calculated from $B = 1/\Sigma p_{ij}^2$

Species	Mean Time for 10 pecks sec	Niche Breadth sec	Pecking Rate pecks/min	No. of Observations
Pied Oystercatcher	37.6	43	15	35
Sooty Oystercatcher	31.1	42	19	11
Masked Lapwing	51.5	59	12	30
Grey Plover	78.5	-	8	7
Lesser Golden Plover	50.8	51	12	52
Double-banded Plover	30.7	27	20	17
Red-capped Plover	27.0	45	22	30
Black-fronted Plover	25.0	-	24	4
Ruddy Turnstone	12.8	-	47	12
Eastern Curlew	44.6	60	13	30
Grey-tailed Tattler	16.0	-	38	19
Greenshank	40.2	63	15	52
Bar-tailed Godwit	46.1	40	13	31
Red Knot	10.2	11	59	34
Sharp-tailed Sandpiper	21.8	22	28	17
Pectoral Sandpiper	16.7	-	36	3
Red-necked Stint	10.1	10	59	52
Curlew Sandpiper	14.6	15	41	44

ASIAN SECTION.

This section gives details of wader and wetland conservation work being carried out in Asia by the Asian Wetland Bureau (AWB). The Bureau's activities covers many aspects of wetland research, management and conservation, including waterbird studies, which are being continued within AWB as the Interwader Programme. News of waterbird and wetland conservation developments in the region follows AWB Activities.

AWB Activities.

Regional and Headquarters activities in 1988 have included the compilation of environmental guidelines for developments in wetland areas for the Asian Development Bank; review of documents relating to the development of Indonesia's peat swamp resources; preliminary surveys of swamp forests in Peninsular Malaysia; and development of projects in China, Malaysia, Indonesia and the Philippines. AWB's International Coordinator also attended the IUCN General Assembly in Costa Rica in February. The early part of the year saw the organisation of training courses at Lake Poyang in China and the participation of three Asians in the NW Australia Expedition. Later, shorebird banding courses were held in Taiwan, and Thailand, Hong Kong and China were visited.

Workshops on Shorebird Banding.

AWB continued its training activities for shorebird banders during northward migration in 1988 with funding from the Australian National Parks and Wildlife Service. The program was divided into two phases; one with three Asian biologists participating in work in Australia, and the second with an experienced Australian bander visiting banding groups in Asia.

The three Asians who visited Australia were Bubphar Amget and Sawat Wongtirawatana of the Royal Forest Department of Thailand and Hew Khiam Phin of AWB. They joined a three week study program in north-Western Australia which involved mist-netting, cannon - netting, shorebird banding, collection of biometric data, shorebird counting, and the use of radar in migration studies. The work was very successful with the banding of approximately 6700 birds and including the recapture of a Japanese-banded Terek Sandpiper and a Hong Kong-banded Bar-tailed Godwit!

During the second phase, Doug Watkins from Western Australia visited shorebird study groups and Government Departments in Thailand, Taiwan, Hong Kong and China.

In Thailand one week was spent with the Royal Forest Department where discussions were held regarding the possibility of setting up a shorebird banding program (at present there is no active banding scheme).

Three weeks of training were then held with the three shorebird study groups in Taiwan. This was organised by the Wild Bird Society of Taipei with funding from the Council of Agriculture. Training was conducted with three groups in Taipei, Taichung and Kaoshiung. Training concentrated on catching methods, collection of biometrics, ageing and analysis of data. In the 1987/88 year they expect to band between 3000 and 4000 shorebirds. During the visit a Grey-tailed Tattler was recaptured that had been banded approximately six weeks previously in north-Western Australia.

In Shanghai, work focused on ways of increasing banding during the next migration. The East China Waterbird Ecology Study Group is keen to start banding in Hangzhou Bay. In addition, the National Bird Banding Centre has a banding station on Chong Ming Island which banded approximately 400 shorebirds on northward migration in 1988. The highlight in Shanghai was the reporting of 8 Australian bands recovered by Ma Shiquan in 1983 and 1984!

AWB is planning further banding training in Asia on southward migration 1988 and northward migration 1989.

Other Banding Recoveries.

AWB staff recorded a further 15 Australian bands which were recovered from local hunters by the East China Waterbird Ecology Study Group, together with one Russian band. Thus a total of 23 Australian bands have been reported from China via AWB in 1988, an important contribution to our knowledge of shorebird migration and of particular significance in relation to the China - Australia Migratory Birds Agreement.

Ornithological Training Courses at Poyang Lake, P.R.China.

Two training courses on simple ornithological techniques were jointly organised by WWF International, WWF Hong Kong, AWB and the Jiangxi Forest Department during March 1987. The training courses were carried out at Poyang Lake in Jiangxi Province, China, by AWB and WWF Hong Kong staff.

Poyang Lake is a large freshwater lake surrounded by wet grassland and marshes, fed by five major rivers and backflow from the Yangtze River. Water levels rise dramatically in summer, flooding the surrounding lowlands. During winter the water level drops, leaving many shallow lakes around the periphery of the main lake, providing suitable habitat for migratory and wintering waterbirds. Poyang Lake Migratory Bird Reserve was established in the north-western corner of the lake in 1982. This area of 22,400 ha consists of a system of nine shallow lakes, administered by the Nature Reserve Management Office of the Jiangxi Provincial Forest Department.

The reserve is most famous for its large concentrations of wintering crane species, including most of the known world population of Siberian White Crane *(Grus leucogeranus)*. Apart from cranes the area probably holds in excess of 500,000 waterfowl during the peak winter periods, including 20 species listed as endangered in China.

Prior to the training courses, the reserve staff had adequate knowledge of the cranes but little experience in identifying or monitoring the other species present. A bilingual manual * of ornithological techniques specifically developed for the courses was the main reference used. Class and field sessions taught participants a range of ornithological study techniques such as use of binoculars and telescopes, identifying and counting birds, recording foraging behaviour and habitat preferences and simple data analysis. Open discussions were also held on management policies and options for the future. WWF-I provided 20 pairs of binoculars, 2 telescopes, 3 tripods, 10 tally counters and 2 slide projectors for the course. These were given to the reserve along with books, a dehumidifier unit and other equipment donated by WWF-HK.

A total of 32 reserve research staff, protection staff and nature reserve managers were trained. During the courses the draft techniques manual was expanded, and will be published as an "Introductory Manual for Field Studies on Waterbirds" with particular emphasis on China. Future training needs of the reserve were identified including a course of simple data collection and interpretation for reserve management and a course on waterbird banding.

Although Poyang is a paradise for wintering waterbirds, many threats still remain. Hunting, using nets and poison, is a serious problem throughout the reserve. Water level control, grass-cutting and over-fishing also need to be managed. The value of courses such as this one cannot be over-stressed as they provide the initial stimulus for researchers and managers to identify and solve the problems within their reserves.

Waterbird Migration Poster.

AWB has designed a poster depicting waterbird migration routes through East Asia in conjunction with WWF Malaysia. The poster aims to educate school children and the general public on waterbird migration. It illustrates some common migrants and briefly describes migration, the importance of key stop-over sites, threats from hunting and habitat destruction, the study of birds through banding and means of conserving waterbirds and wetlands.

The poster has been printed in Bahasa Malaysia, English and Chinese (for distribution in China from WWF Hong Kong) and further local language versions are planned for Thailand, Indonesia, the Philippines and other East Asian countries. A limited number of copies are available from the AWSG or the AWB.

Indonesian Programme: Study of Segara Anakan, Central Java.

The first major field survey project to be completed under the recently signed AWB/Interwader - Government of Indonesia Arrangement was a survey of Segara Anakan in Central Java. This study focused on the largest remaining area of mangrove forest in Java surrounding Segara Anakan, a shallow estuarine lagoon on the south coast. The study, carried out by AWB in conjunction with Forest Department (PHPA) staff, examined many aspects of the area including the avifauna, fisheries, macrobenthic fauna, mangrove forest, threats and management priorities and constraints.

The results of the waterbird survey are of interest as the only other information on the area was published in 1938. Eighty-five bird species were recorded, including a significant non-breeding population of Milky Storks (160-180 birds), large numbers of herons and egrets (10 spp) and about 1500-2000 waders (16 spp) counted on the mudflats and roosts inside the lagoon from 7-16th April. The study revealed little hunting pressure in the area and recommended conservation of the mangrove forest around the lagoon.

Brantas - Solo Deltas.

Surveys of the coastal area between the Solo Delta and Probolingo were carried out in February - March, turning up major waterbird colonies in mangrove remnants in fishponds totalling about 17,700 nests of which 10,000 were in one colony in the Solo Delta. 13 species were breeding including 3 *Egretta* spp., 2 *Ardea* spp., Black-headed Ibis and 2 Night-heron spp. The Solo and Porong Deltas held 6,000 and 4,500 waders respectively, including 1,000 Asian Dowitchers in the Solo Delta on 9-10 February. The largest roost found was 8,000 shorebirds, including 7,000 Black-tailed Godwits in the Wonoredjo estuary.

Pulau Rambut, Java.

A visit to P. Rambut on 11-14 January to census breeding waterbirds produced a minimum estimate of 11,450 individuals of 12 spp (not all breeding at the time). Black-crowned Night-heron (4,000 birds) and Little Black Cormorant (3,000 birds) were the dominant species. Twenty Milky Storks were present but showed no signs of breeding.

Philippines Programme: Olango Island, Central Visayas, Philippines.

AWB's Philippines Office has been actively implementing the Philippine Wetland Conservation Programme. The most notable achievement to date has been the progress in protection of Olango Island as a Migratory Bird Sanctuary.

Olango Island (985 ha) has beautiful white sandy beaches, secondary mangrove growth and vast intertidal flats used by 10,000-20,000 migratory shorebirds. Two endangered species feed on the flats, the Asian Dowitcher (48 maximum) and the Chinese Egret (up to 100). The principal species recorded were Greater Sandplover (2000 maximum) and Red-necked Stint (2000 maximum), while numbers of Grey-tailed Tattler (300) and Great Knot (500) have also been recorded in early November.

Following identification of the island as a wetland of international importance for waterbirds in late 1987, AWB Philippines has pressed hard for its protection. The island's residents and concerned organisations have endorsed the proposal to protect the island. It is now up to the Government to gazette the area as a Migratory Bird Sanctuary.

Other Philippines Activities.

Surveys of wetlands in Vasayas, Luzon and Mindanao have been carried out this year, including an assessment of hunting on Luzon. A national wetlands inventory is being compiled, and surveys of wetlands in Mindanao and Palawan are planned for later in the year. A high-profile public awareness and education programme on wetlands has been launched, with exposure on TV, a regular "Wetland Corner" in the national press and a wetland conservation display in the Philippines Information Agency office.

NEWS FROM THE REGION

Singapore's Minister for National Development, Mr. S. Dhanabalan announced in early April that an 85 hectare wetland area around Sungei Buloh in NW Singapore will be set aside as a bird sanctuary. This is in response to a proposal made last year by the Singapore Branch of the Malayan Nature Society that 318 ha be protected in order to preserve an example of Singapore's dwindling waterbird population. The importance of the site lies in the richness of its avifauna, with 126 species recorded including 40 species of wetland birds, and in the complex of wetland habitats - a resource which is fast disappearing in Singapore.

While falling short of the proposal's recommendations, the 85 ha area that will become a bird sanctuary encompasses the core area of the proposed reserve and will protect the critical coastal zone of mangroves and mudflats which is required for shorebirds, together with low-intensity prawn farms. The remainder of the proposed 318 ha area falls within the planned Lim Chu Kang Agrotechnology Park which has been earmarked for high-tech prawn farming. Thus the Government has come to a compromise in the area by losing out on economic gains but preserving one of the last remaining coastal wetlands in Singapore.

Deep Bay Airport Called Off.

Deep Bay, a wetland of international importance lying on the north-western side of Hong Kong's New territories, is currently under pressure from numerous developments including a massive rubbish dump and until recently, an airport.

While the rubbish dump and other plans still stand, it was announced in mid-January that the airport on

the Chinese side of the bay has been called off. This comes as a major relief to all concerned with the preservation of this magnificent wetland, as some 23% of the bay's mudflats would have been reclaimed by the development and the waterfowl of Mai Po Marshes subjected to considerable disturbance (Source: WWF Hong Kong).

New Birdwatching Society for Beidaihe, China.

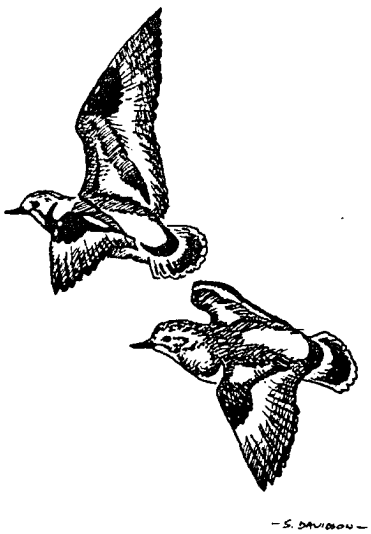
Spring 1988 saw a further development of ornithology in the Beidaihe area of Hebei Province, P.R. China, following a series of expeditions organised by the China Cranewatch team from Cambridge University. The Beidaihe Birdwatching Society (BBS) was formed with Prof Hsu Wei-shu of Beijing Natural History Museum as its President and Martin Williams (ex of Cambridge University) as Vice-president. The Society aims to collate ornithological records from the Beidaihe area, arrange further ornithological work there, promote conservation (including the establishment of a migratory birds refuge) and assist in training local ornithologists.

A visit to the Beidaihe area in spring 1988 produced few migrant cranes, with over 2,000 Common and only 33 Siberian, due to bad weather at the main wintering grounds around Lake Poyang. Small numbers of waders were counted on two estuaries south of Beidaihe, including 650+ Dunlin and 70+ Curlew (Eurasian and Eastern) at a previously unvisited site before 18th March.

AWB Sponsors

The Asian Wetland Bureau is funded on a project-to-project basis by agencies throughout the world. The following agencies have supported our activities in 1988:

Australian National Parks and Wildlife Service, British Ornithologists' Union, Government of the Netherlands, Haribon Foundation, ICBP (Australia), IUCN, UNEP, USAID and WWF Hong Kong, WWF International, WWF Malaysia, WWF Netherlands and WWF-US.



THE FIRTH OF THAMES

R.B. Sibson, C/- Stephen Davies, Auckland.

The narrow winding Auckland Isthmus is squeezed between the great inlets of Kaipara and Manukau Harbours on the west and the Hauraki Gulf on the east. It forms a natural bottleneck for migratory birds, especially on their way north; and its intertidal flats attract tens of thousands of waders which come every year from both north and south. Nowhere else in the South-west Pacific is there such a concentration of shorebirds. The long isolation of New Zealand, the 'lie of the land', the local climate blessed with an abundance of sunshine and rain, the pattern of the tides, all contribute towards making this concentration unique both in quantity and quality.

From the riverbeds and subalpine valleys of the South Island come to spend the winter some 30,000 Pied Oystercatchers *Haematopus finschi* and 5000 Wrybills *Anarhynchus frontalis;* and also from southern districts, but not necessarily from the South Island, many thousands of Pied Stilts *Himantopus himantopus* and a few thousand Banded Dotterels *Charadrius bicinctus.* From arctic or sub-arctic regions to enjoy a southern winter come tens of thousands of Bar-tailed Godwits *Limosa lapponica* and Knots *Calidris canutus,* many hundreds of Turnstones *Arenaria interpres* and Eastern Golden Plovers *Pluvialis fulva,* a sprinkling of Eastern Curlews *Numenius madagascariensis* and Whimbrels *N. phaeopus* and flocks of various sandpipers and stints.

Within 50 miles of downtown Auckland, more than 40 species of migratory birds which breed in the Northern Hemisphere have been recorded in recent years, including not only waders but also six species of terns and skuas. For many migrants the great inlets are journeys' ends where they will rest and moult and renew their strength over half a year before setting out again to distant breeding grounds; for others the inlets are places to pause, sleep and feed before continuing on their travels; because, some, southward bound, have still another thousand miles to go, while those heading north in our late summer have only just begun a trek to lands about the Arctic Circle.

The Firth of Thames, extending south from the Hauraki Gulf to the Hauraki Plains, has many natural advantages. On east and west the higher slopes of the Colville and Hunua Ranges are still comparatively well-forested and numerous clear streams flow to mingle their fresh water with the strong tidal water of the Pacific Ocean. At the southern end larger rivers, such as Waihou and Piako, deposit enriching silt and, since modern methods of drainage were instituted, have undoubtedly contributed to the spread and rapid growth of mangroves. The east and west coasts of the Firth are quite unlike. On the east below the Coromandel Peninsula the rocky shore slopes steeply and there is deep water close inshore. Captain Cook wisely sailed close to the east bank. On the south and west coasts the water is shallow and at low tide broad intertidal flats and many square miles of eutrophic ooze are exposed.

A great variety of marine organisms thrives in the mixed water of the Firth. When their time comes, shellfish die. For countless centuries by the set of the current their dead shells have been swept onto the west shore of the Firth between, roughly, Whakatiwai and Miranda, so that in some places old shell-beaches may be found hundreds of metres inland from the present tideline. The shifting banks which these dead shells form as they are drifted up the Firth serve a useful purpose. Not only do they break the force of northerly gales but also they are packed with waders every day when tides are high. If an inlet or estuary lacks

secure high tide roosts, it will not permanently attract the great flocks of shorebirds which are so typical of the Firth of Thames. These shellbanks have a fascinating instability. Over many months or even years they may grow till they are high enough to attract odd pairs of rare dotterels or colonies of White-fronted Terns to breed; but the next great gale may alter their shape considerably. Such is the size of the shellbanks along the Miranda coast that only in the most exceptional weather are the flocks of waders unable to find a safe retreat. These extensive deposits of shell have inadvertently added another amenity. For many years, back from the main beaches, the shell was excavated and ground to provide agricultural lime. In winter the hollows become shallow ponds, especially attractive to Pied Stilts and those of the long-distance migrants, such as Sharp-tailed Sandpipers *Calidris acuminata*, Asiatic Black-tailed Godwits *Limosa melanutoides* and White-winged Black Terns *Chlidonias leucopterius* which prefer fresh water. In very rough weather too, even the shore-loving species may seek shelter in the hollows.

It was the wealth of birds which first attracted naturalists to the Firth of Thames. Studies of breeding populations and counts of migrants began in the 1940s; and the Ornithological Society now has census figures for winter (June) and summer (December) which go back thirty years. These figures are becoming more and more valuable, because (a) they provide a base-line going back to the 1940s just after legislation was passed to prevent the shooting of migratory shorebirds (b) they provide evidence of trends i.e. whether a species is thriving or declining or remaining reasonably stable (c) they enable an estimate to be made of what numbers may be expected seasonally; and so they may give some indication of the success or failure of the last one or two breeding seasons.

The unique and highly specialised Wrybilled Plover is an endemic species which finds the Firth very much to its liking. In 1895 Captain Mair discovered a large wintering flock near the mouth of the Piako, and Buller wrote "Here they are to be seen in thousands and are so tame that you may knock them over with a stick". More than half a century later they were rediscovered in numbers in the same area; and after some years' study of the species in its northern winter-quarters the population in 1960 was estimated to be about 5000. A similar figure has been found by studies in the mid-1970s. Wrybills breed only on certain subalpine riverbeds of the South Island, where they are present roughly from the end of August to the end of January. Virtually the whole population then migrates to winter north of 38°S Latitude, and from January to August probably two-thirds and possibly four-fifths of all the Wrybills in the world are sustained by the good living obtainable along the Miranda coast. Manukau and Kaipara also support substantial flocks. The remaining few hundred may be located in estuarine environments from Tauranga to Parengarenga. Even in summer Miranda can usually boast a small flock of Wrybills, for some immature non-breeders have little reason to go south and may as well grow up enjoying the benign climate of an Auckland summer.

The following table gives some idea of the expected numbers of five migratory waders for which the Firth of Thames is a very important feeding-ground. The figures are averages of census counts made by members of the Ornithological Society twice yearly. The first two species named breed only in the South Island. The other three are the most numerous of the trans-equatorial migrants which breed near the Arctic Circle and then fly thousands of miles south either to renew their strength or to grow up in a New Zealand summer. The presence of all five species in the Firth 'at the wrong season' is evidence that most waders do not mature till their second or third years and so have no need to fly back to distant breeding grounds. What they do is take a summer off growing up.

AVERAGE NUMBERS OF FIVE VERY DISTINCT MIGRATORY WADERS (1970-1977) IN THE FIRTH OF THAMES

	WINTER (JUNE)	SUMMER (DEC.)
Pied Oystercatcher	4684	881
Wrybilled Plover	3215	144
Bar-tailed Godwit	728	9737
Knot	874	7819
Turnstone	39	113

Because the commoner waders are present in such numbers, rarer migrants and weary strugglers are naturally attracted. There is strength and comfort in numbers. Eastern Curlews, largest of the migratory shorebirds, and Asiatic Whimbrels are fairly regular visitors and give delight with their far-sounding calls to those who have an ear for Nature's music. Flocks of Wrybills serve as decoys to sandpipers and dotterels of several species which are about the same size. Every year ornithologists expect to find Curlew Sandpipers, Sharp-tailed Sandpipers and Red-necked Stints among or near the Wrybills; but it is a cause for special rejoicing when a Terek Sandpiper, Dunlin, a Ringed Plover or some other 'pearl of great price' is clearly seen and certainly identified. Several rare visitors were first found in this country in the Firth of Thames and officially added to the New Zealand checklist. Among them are: Mongolian Dotterel (1945), Grey Plover (1948), Terek Sandpiper (1951), Asiatic Blacktailed Godwit (1952), Broad-billed Sandpiper (1960), and Ringed Plover (1970). The 'muddy' inner (southern) region of the Firth has indeed an enviable reputation as a haunt of shorebirds.

From its southern mangrove-lined estuaries to the clear oceanic water beyond Waiheke, the firth of Thames has a charm all its own and, like Cleopatra, infinite variety. Its legions of birds have brought it a fame which extends far beyond the shores of New Zealand. Some years ago the Miranda Naturalists' Trust was founded to draw attention to this priceless part of our natural heritage, to work for its preservation and the protection of its wildlife; to encourage others in the study of natural history, so that for many years to come the Firth may bring wonder and delight to all dedicated lovers of the New Zealand scene.

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WADERS ON SUBANTARTIC HEARD ISLAND

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Waders are irregular vagrants to Subantarctic islands and those which have been recorded are well-travelled migrants that breed in the Arctic and winter in the southern hemisphere temperate zone (Watson 1975). During the 1987-88 ANARE (Australian National Antarctic Research Expedition) to Subantarctic Heard Island (53° 05'S, 73°30'E) two waders were recorded. Only two other observations had previously been recorded there, both during the 1985 ANARE to the island. Unfortunately, only one of these waders was identified.

On November 25 1987 a Greenshank (*Tringa nebularia*) was heard calling and then observed flying away from a small tarn on the western side of Stephenson Lagoon and beneath Scarlet Hill. It was then observed on all visits made to this area until

December 19. Mostly it was seen resting at the more sheltered southern edge of the same small tarn. However, it was also observed feeding in the shallows of this and three other small tarns (almost certainly catching copepods) and amongst sparse vegetation nearby (probably catching weevils, wingless flies or small spiders). Its departure on about December 19 coincided with the commencement of territorial behaviour by Antarctic Terns (*Sterna vittata*) which nested nearby.

On December 4 1987 another smaller species of wader was observed at the edge of a small pool in an area of meadow and pool complex about 800m north-east of Doppler Hill. Its legs were short relative to its body length, it stood about 12cm high and appeared to be about the size and proportions of a Common Sandpiper (*Arctitis hypoleucos*). It was a dull greyish-brown bird with a dark wing bar and a distinct white (or pale) trailing edge to the wing revealed in flight. Its call, given both on the ground and in flight, was an extended and rapid 'pe pe pe pe pe pe! Unfortunately, only a single and brief sighting of this bird was made and its identity was not determined.

Another small wader had been observed in this same area on October 10 and 21 1985 (R. Jones, pers. comm. and Burton and Williams 1986). However, no further details are available.

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BREEDING RESOURCE PARTITIONING OF A MIXED POPULATION OF PIED AND SOOTY OYSTERCATCHERS.

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SUMMARY

Sooty and Pied Oystercatchers breed alongside one another providing their nest sites are hidden from line of sight. The inter-position of Pied Oystercatcher nests between Sooty Oystercatcher nest sites does not appear to increase the inter-nest distance of the Sooty Oystercatchers. This suggests that the 50m minimum distance between Sooty Oystercatcher nests found in the study area could be further reduced were the tide-line topography more broken.

INTRODUCTION

The population under examination is that living on Chalky Island, one of the Flinders Island group, eastern Bass Strait. Chalky Island lies 10.4km west-north-west of Whitemark and has c400m of sandy beach, c600m of rocky beach and c1000m of steep boulder beach or small cliff shoreline. The islands surface area of 38.5 hectares increases to about twice this size at low tide, the tidal range being some 3.05m at maximum.

METHODS

The population was monitored between the 1976/77 breeding season and the 1982/83 season. A camp was set up on the island out of sight of the beaches. The durations of the visits varied between two and six weeks. All nests sites were marked with aluminium tags on which nest numbers were painted in red. The tags were held in place with metal pegs driven through them into the sand.

After the initial search, the beaches were only visited once every three to four days in order to keep disturbances to a minimum. Every effort was made to locate the young after hatching to monitor their progress and band them with metal CSIRO bands when old enough.

Observations of the birds on the eastern side of the island were made from behind canvas screens or from the cover of vegetation. Elsewhere, by patrolling the shoreline.

RESULTS

Nest Site Selection.

In all but one case the nests were located at or towards the ends of the beaches. The Pied Oystercatchers placed their nests in situations with 180° vista horizontally and 135° vertically. This necessitated their nests being placed at a few feet of elevation above the beach, either on a sandy mound or on top of a boulder. Their nest sites were constant from year to year, as were most occupied by Sooty Oystercatchers. These sites were mainly hidden in rock crevices, under boulders or under bushes. The two in *Poa* grass would have allowed their occupants some 120° horizontal vista, although not unimpaired, and about a similar view of the sky in all directions through the tussock grass.

Only five of the Sooty Oystercatcher sites had visibility similar to the Pied Oystercatchers, and one only 10-15° vision of the sky as it had to enter the nest round a dog-leg between and under boulders.

One nest was placed at c15m from the beach. This site was unsuccessful and used only in one year. Another was located on a broad ledge some 2m wide, 5m above the sea on a small cliff. Chicks hatched here had to have all food brought to them and appeared to remain there for the first 10 days or so after hatching.

Spacing of Nests.

The spacing of the Sooty Oystercatcher nests was at approximately 50m intervals from one another, at their closest. Where two pairs of this species occupied the same beach they nested at opposite ends of the beach and here the nearest neighbour was 100m. These beaches are open, allowing the birds to see one another, either from their nest sites or the open beach. The highest densities were located on the northern and western shores of the island, with only three pairs of Sooty Oystercatchers along the western shoreline. This reflects the state of the intertidal zones, since the steep-shelving beaches of the western side of the island offer too small an intertidal zone for feeding, compared to the shallow-shelving beaches off the east and north coasts.

On Chalky Island, the Sooty Oystercatchers pairs could expect to have between c2.5 and c3.0 hectares of intertidal zone available to forage in, if there were no competition from the Pied Oystercatchers. As there is probably active competition between the species, the intertidal territories could therefore range from c2 to c4.25 hectares if all areas were shared equally. It is doubtful that the pairs on the west coast have anywhere near this area available to them. Further investigation is required into the inter-specific reactions and intertidal requirements for a viable territory.

Egg Laying.

The Pied Oystercatchers lay their egg earlier than the Sooty Oystercatchers, often having partially feathered young by the time of our arrivals on the

island in mid-November. The Sooty Oystercatchers had only the occasional youngster out of the egg, and their eggs had either vanished or all hatched by the end of the first week in December.

Sooty Oystercatchers clutch size was an uniform 2 eggs in all first and replacement clutches.

Only three pairs of those nesting in open sites lost their eggs, at least one clutch being taken by Pacific Gulls. The main mortality occurred either at hatching with chicks dying while trying to break out of the egg, or shortly thereafter. Once one of the chicks had hatched and dried it was escorted from the nest by the parents down onto the foreshore. Further incubation of the unhatched egg appeared sporadic, despite the fact that the chick was calling from within the egg. The eggs did not hatch synchronously either here or on other islands where I have observed the species. The time interval between hatching varied from 24 to 48 hours and, as in many cases, the second egg failed to hatch at all.

Replacement clutches were completed within two to three weeks of the loss of the first clutch or brood. These were laid in the same nest scrape, or a fresh scrape within half a metre of the original nest. One pair of birds that lost their first chick 36 hours after hatching returned to the almost moribund second youngster in the nest. It survived only for a further two days before disappearing. The parent birds underwent what could best be described as a "bereavement reaction", flying back and forth over their territory in front of the advancing tide calling with what could only be described as a "plaintive call". This call was higher pitched than their normal call. It was not until 32 hours later that they settled into silent hunched up posture a few feet apart. Their necks were retracted, bills pointed downward at a few degrees from the vertical and plumage slightly fluffed out giving a most "despondent" appearance.

Feeding of the Young.

The young were accompanied by the adults out onto the intertidal zone once potential food sources were exposed. The chick appeared to play close attention to the pecking activities of its parent. Often one of the parents would move off to the receding tide line c500m distant to forage and fly back to the youngster and mate to feed its offspring.

Where cover was available out on the beach within the feeding territory the young tended to stay close to it, even when on the point of flying.

From our observations the pairs adhered strictly to their own territories.

CONCLUDING REMARKS

As yet we have not observed any pair of Sooty Oystercatchers raising more than one youngster to fledging in any season. This not only applies to the Chalky Island population but those pairs observed down the whole of the eastern seaboard of Tasmania.

We have gained the impression that the birds with most cover out from the shore line have greater success in raising young to fledging. Only the fitter youngster, ie either the luckiest or best able to avoid accidents, predator's attacks, or disease is the one to survive.

ACKNOWLEDGEMENTS

We wish to thank Derek Smith and his daughter Margaret for their help and hospitality; S. Chidgey, M. Turner, A. Wakefield etc., for their assistance in the field and E.J. Woehler for his help in preparing the article.

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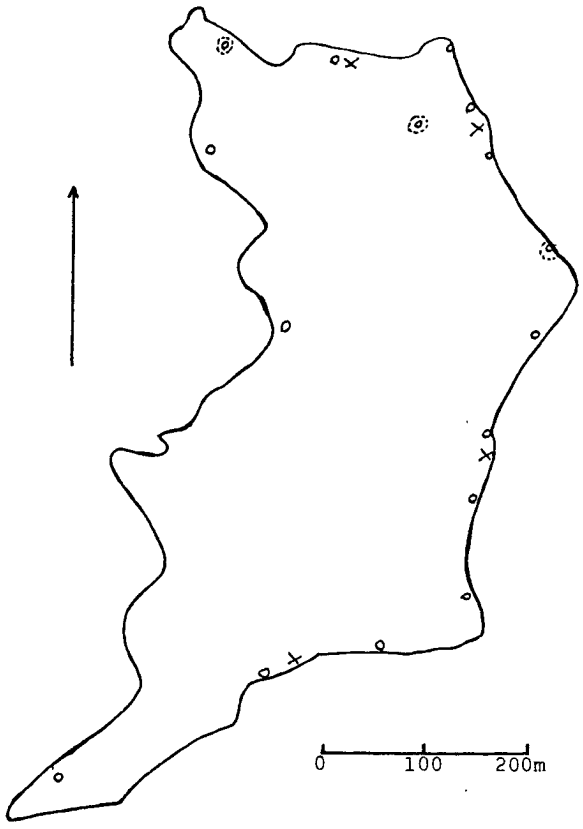
SPACING OF NESTS



The number of pairs of sooty oystercatchers varied between 13 and 16 while pied oystercatchers were fixed at four.

BANDING ROUND-UP

Compiled by Kim Lowe, Australian Bird & Bat Banding Schemes, Australian National Parks & Wildlife Service, GPO Box 8, Canberra ACT 2601.

The following lists are from data supplied to the Australian Bird and Bat Banding Schemes between February and August 1988. Permission must be sought from the banders and clearance given by ABBBS before using these data in publications.

Layout of data:

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

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:

02 = trapped but device is unknown to the banding office;
03 = trapped in a mist net;
04 = trapped with a cage trap;
05 = trapped with a cannon net;
46 = colour marking sighted in field bird one of a cohort marked in this manner;
48 = colour marking sighted in field;
54 = beachwashed;
63 = taken for scientific study;
67 = taken for food or feathers;
99 = found dead, cause unknown.

Status after encounter:

01 = status of bird unknown,band left on bird;
03 = bird is dead, status of band is unknown;
04 = bird is dead, band left on bird;
05 = bird is dead, band removed from bird;
13 = bird released alive with band;
14 = bird released alive, band removed;
26 = bird was alive in the wild with the band;
29 = bird partially decomposed, band removed.

Note: band numbers beginning with letters are from foreign banding schemes. The band numbers beginning with 'UNK' are coded numbers for sightings of colour marked birds for which the real band number is unknown.

130 PIED OYSTERCATCHER HAEMATOPUS LONGIROSTRIS

100-82004 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 02/05/81 +1 U VICTORIAN WADER STUDY GROUP
05 13 LONG ISLAND HASTINGS VIC 38d18mS 145d11mE 12/06/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 63 km Direction: 116 degs. Time elapsed: 7 yrs 1 mths 10 days

100-82081 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 08/03/80 2 U VICTORIAN WADER STUDY GROUP
05 13 LONG ISLAND HASTINGS VIC 38d18mS 145d11mE 12/06/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 63 km Direction: 116 degs. Time elapsed: 8 yrs 3 mths 4 days

100-82094 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 14/11/81 +2 U VICTORIAN WADER STUDY GROUP
05 13 LONG ISLAND HASTINGS VIC 38d18mS 145d11mE 12/06/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 26 km Direction: 249 degs. Time elapsed: 6 yrs 6 mths 28 days

100-82108 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 03/07/82 1 U VICTORIAN WADER STUDY GROUP
05 13 LONG ISLAND HASTINGS VIC 38d18mS 145d11mE 12/06/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 26 km Direction: 249 degs. Time elapsed: 5 yrs 11 mths 9 days

A sample of retraps made on the same day that indicate the longevity and mobility of this species. Eight years is near the longest time elapsed for this species (more than eleven years).

131 SOOTY OYSTERCATCHER HAEMATOPUS FULIGINOSUS

100-80565 SEAL ROCKS PHILLIP ISLAND VIC 38d32mS 145d 6mE 04/01/80 P U WARNEKE
05 13 LONG ISLAND HASTINGS VIC 38d18mS 145d11mE 12/06/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 27 km Direction: 15 degs. Time elapsed: 8 yrs 5 mths 8 days

The longest time elapsed for this species.

139 MONGOLIAN PLOVER CHARADRIUS MONGOLUS

051-18038 OFF MANNS BEACH CORNER INLET VIC 38d35mS 146d50mE 02/01/82 +2 U VICTORIAN WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/00/00 U U ZHOU SHI-E
Distance: 8173 km Direction: 337 degs. Time elapsed: 0 yrs 0 mths 0 days

The second international control for this species and the longest movement. The previous control was to the Philippines.

140 DOUBLE-BANDED PLOVER CHARADRIUS BICINCTUS

041-31245 YALLOCK CREEK, NEAR KOOWEERUP VIC 38d13mS 145d28mE 26/04/87 1 U AUSTRALASIAN WADER STUDY GROUP
99 29 NEAR TWIZEL NEW ZEALAND 44d15mS 170d 6mE 17/12/87 U U REED
Distance: 2162 km Direction: 115 degs. Time elapsed: 0 yrs 7 mths 21 days

B52977 TWIZEL NEW ZEALAND 44d20mS 170d11mE 13/11/84 +2 M NEW ZEALAND BANDING SCHEME
05 13 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 29/05/88 +2 U VICTORIAN WADER STUDY GROUP
Distance: 2251 km Direction: 279 degs. Time elapsed: 3 yrs 6 mths 16 days

UNK00036 GODLEY RIVER AREA NEW ZEALAND 43d30mS 170d34mE 00/00/00 U F NEW ZEALAND BANDING SCHEME
46 26 LONG REEF NEAR DEE WHY NSW 33d45mS 151d19mE 06/04/88 U U MORRIS
Distance: 1988 km Direction: 296 degs. Time elapsed: J yrs 0 mths 0 days

A selection of recent trans-Tasman controls, including a sighting of a colour-banded bird near Sydney.

153 BAR-TAILED GODWIT LIMOSA LAPPONICA

071-63253 ROEBUCK BAY WA 18d 4mS 122d19mE 22/10/83 +3 U WA WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/05/84 U U ZHOU SHI-E
Distance: 5479 km Direction: 359 degs. Time elapsed: 0 yrs 0 mths 0 days

071-63298 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 31/10/83 +3 U WA WADER STUDY GROUP
67 05 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 12/04/88 U U TIANHOU
Distance: 5544 km Direction: 0 degs. Time elapsed: 4 yrs 5 mths 12 days

071-63333 80 MILE BEACH 7 KM SOUTH ANNA PLAINS WA 19d15mS 121d25mE 31/10/83 +3 U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 07/04/84 U U SIQUAN , ECWESG
Distance: 5544 km Direction: 0 degs. Time elapsed: 0 yrs 5 mths 7 days

082-43511 ROEBUCK BAY WA 18d 4mS 122d19mE 02/09/81 U U WA WADER STUDY GROUP
67 05 HANGZHOU BAY SHANGHAI CHINA 30d49mN 121d28mE 12/04/88 U U TIANHOU
Distance: 5410 km Direction: 359 degs. Time elapsed: 6 yrs 7 mths 10 days

DR53416 MAI PO MARSHES HONG KONG 22d29mN 114d 2mE 12/09/87 1 U MELVILLE
05 13 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 24/03/88 U U AUSTRALASIAN WADER STUDY GROUP
Distance: 4569 km Direction: 167 degs. Time elapsed: 0 yrs 6 mths 12 days

A recent influx of 23 controls to China included four of these records. Previous controls were from Shanghai, China and Mokpo, South Korea. The Hong Kong banded bird was retrapped on the last North-west Australian expedition.

155 GREY-TAILED TATTLER TRINGA BREVIPES

061-70864 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 07/04/88 +2 U AUSTRALASIAN WADER STUDY GROUP
03 13 KUANTO TAIWAN 25d 7mN 121d 0mE 15/05/88 +2 U HONG CHUANG
Distance: 4772 km Direction: 358 degs. Time elapsed: 0 yrs 1 mths 8 days

The first control to Taiwan, some five weeks after banding. Previous controls have been to China, Japan, USSR and from Japan.

160 TEREK SANDPIPER TRINGA TEREK

050-43971 KOORAGANG ISLAND NSW 32d52mS 151d46mE 01/04/73 +1 U LANE
03 04 KOORAGANG ISLAND NSW 32d52mS 151d46mE 27/03/88 U U PEPPER-EDWARDS
Distance: 0 km Direction: 0 degs. Time elapsed: 14 yrs 11 mths 26 days

This is the longest time elapsed for this species.

161 CURLEW SANDPIPER CALIDRIS FERRUGINEA

041-43023 WERRIBEE SEWERAGE FARM (SPIT, PT WILSON) VIC 38d 3mS 144d32mE 02/01/88 +2 U VICTORIAN WADER STUDY GROUP
05 13 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 25/03/88 U U AUSTRALASIAN WADER STUDY GROUP
Distance: 3096 km Direction: 309 degs. Time elapsed: 0 yrs 2 mths 23 days

A leg-flagged bird retrapped still wearing (just) the flag. The record also shows the movement within the continent. Interestingly, neither this species nor Red-necked Stint was included in the recent reports from China.

163 SHARP-TAILED SANDPIPER CALIDRIS ACUMINATA

051-06106 SANDERSON SEWAGE FARM 12KM NE OF DARWIN NT 12d22mS 130d54mE 17/11/78 +2 U HERTOG
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 12/04/83 U U SIQUAN , ECWESG
Distance: 4886 km Direction: 348 degs. Time elapsed: 4 yrs 4 mths 24 days

Fourth control to China. Other previous controls were to Indonesia, Taiwan, and the USSR.

164 RED KNOT CALIDRIS CANUTUS

051-18162 SWAN ISLAND QUEENSCLIFF VIC 38d15mS 144d40mE 19/10/85 +3 U VICTORIAN WADER STUDY GROUP
67 05 YANGTZE RIVER ESTUARY CHINA 30d52mN 121d52mE 26/04/87 U U KUAI / DR JIANG XIONGLONG
Distance: 8010 km Direction: 339 degs. Time elapsed: 1 yrs 6 mths 7 days

051-38886 SHORES OF THE 80 MILE BEACH WA 19d15mS 121d20mE 03/04/88 +2 U AUSTRALASIAN WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d49mN 121d28mE 03/05/88 U U TIANHOU
Distance: 5540 km Direction: 0 degs. Time elapsed: 0 yrs 1 mths 0 days

Sixth and seventh control to China. Note the short time elapsed for 051-38886.

165 GREAT KNOT CALIDRIS TENUIROSTRIS

061-00276 ROEBUCK BAY WA 18d 4mS 122d19mE 30/08/81 U U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 08/04/83 U U SIQUAN , ECWESG
Distance: 5413 km Direction: 359 degs. Time elapsed: 1 yrs 7 mths 9 days

061-31238 ROEBUCK BAY WA 18d 4mS 122d19mE 30/08/81 U U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 01/04/83 U U SIQUAN , ECWESG
Distance: 5413 km Direction: 359 degs. Time elapsed: 1 yrs 7 mths 2 days

061-37953 ROEBUCK BAY WA 18d 4mS 122d19mE 30/08/81 U U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 02/04/83 U U SIQUAN , ECWESG
Distance: 5413 km Direction: 359 degs. Time elapsed: 1 yrs 7 mths 3 days

061-38145 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 30/03/83 U U SIQUAN , ECWESG
Distance: 5544 km Direction: 0 degs. Time elapsed: 0 yrs 7 mths 6 days

061-38231 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
67 05 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 04/04/88 U U TIANHOU
Distance: 5544 km Direction: 0 degs. Time elapsed: 5 yrs 7 mths 11 days

061-38245 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 +2 U WA WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/09/87 U U ZHANG
Distance: 5611 km Direction: 0 degs. Time elapsed: 0 yrs 0 mths 0 days

061-38253 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 +2 U WA WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/00/00 U U ZHOU SHI-E
Distance: 5611 km Direction: 0 degs. Time elapsed: 0 yrs 0 mths 0 days

061-38347 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/09/87 U U ZHANG
Distance: 5611 km Direction: 0 degs. Time elapsed: 0 yrs 0 mths 0 days

061-38354 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 01/04/83 U U SIQUAN , ECWESG
Distance: 5544 km Direction: 0 degs. Time elapsed: 0 yrs 7 mths 8 days

061-38528 10 KM SOUTH OF ANNA PLAINS WA 19d15mS 121d20mE 24/08/82 2 U WA WADER STUDY GROUP
67 03 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 08/04/83 U U SIQUAN , ECWESG
Distance: 5544 km Direction: 0 degs. Time elapsed: 0 yrs 7 mths 15 days

061-39638 6K SW OF BROOME WA 17d58mS 122d16mE 30/03/82 U U WA WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/00/00 U U ZHOU SHI-E
Distance: 5468 km Direction: 359 degs. Time elapsed: 0 yrs 0 mths 0 days

061-44278 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 25/03/85 J U AUSTRALASIAN WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/04/86 U U ZHANG
Distance: 5472 km Direction: 359 degs. Time elapsed: 0 yrs 0 mths 0 days

061-44521 SHORES OF THE 80 MILE BEACH WA 19d15mS 121d20mE 13/04/85 1 U AUSTRALASIAN WADER STUDY GROUP
67 05 HANGZHOU BAY SHANGHAI CHINA 30d51mN 121d32mE 14/04/88 U U TIANHOU
Distance: 5544 km Direction: 0 degs. Time elapsed: 3 yrs 0 mths 1 days

061-44896 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 18/04/85 1 U AUSTRALASIAN WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/04/88 U U ZHANG
Distance: 5472 km Direction: 359 degs. Time elapsed: 0 yrs 0 mths 0 days

061-69592 BEACHES CRAB CK RD ROEBUCK BAY BROOME WA 18d 0mS 122d22mE 23/03/88 +2 U AUSTRALASIAN WADER STUDY GROUP
67 03 CHONGMING ISLAND SHANGHAI CHINA 31d27mN 121d53mE 00/04/88 U U ZHANG
Distance: 5472 km Direction: 359 degs. Time elapsed: 0 yrs 0 mths 0 days

The bulk of the recent reports from China, taking the total from nine to 24. Note that many controls were made several years previously. However, 061-69592 was caught within 30 days of banding. 061-38231 is the longest time elapsed for this species.

AUSTRALIAN WADER CATCH TOTALS 1/7/87 - 30/6/88

Bander/Group	A	B	C	D	E	F	G	H	I	J	K	TOTAL
Bush Thicknee		1										1
Pied Oystercatcher					27	35		8		161		231
Sooty Oystercatcher								4		1		5
Masked Lapwing		7	1	4	3	3						18
Grey Plover									2		13	15
Lesser Golden Plover		3		1				1		22	1	28
Hooded Plover							1	14				15
Mongolian Plover										1	58	59
Double-banded Plover			1							551		552
Large Sand Plover									1		570	571
Oriental Plover											1	1
Red-capped Plover	3	1	1				1	6	6	45	1	64
Black-winged Stilt				1						3	7	11
Banded Stilt											9	9
Red-necked Avocet				1						35	55	91
Ruddy Turnstone	1										140	141
Eastern Curlew										19		19
Whimbrel	2										4	6
Grey-tailed Tatler	19										579	598
Greenshank									2		6	8
Marsh Sandpiper											1	1
Terek Sandpiper	4	7		7						2	1003	1023
Latham's Snipe				6								6
Asiatic Doitcher											1	1
Black-tailed Godwit											3	3
Bar-tailed Godwit	5	2								55	955	1017
Red Knot									2	6	722	730
Great Knot	4								2	2	856	864
Sharp-tailed Sandpiper	9									735	3	747
Red-necked Stint	1				1				66	6274	371	7613
Curlew Sandpiper	2	3			1					1095	803	1904
Sanderling											2	2
Broad-billed Sandpiper										1	336	337
TOTALS	50	24	3	20	32	38	2	33	81	9008	6500	15791

Totals include retraps

A	Denis Watson	Moreton Bay, Brisbane
B	Bill Lane	Four sites on N.S.W. coast
C	Greg Clancy	Red Rock Estuary, N.S.W.
D	David Pepper-Edwards	Kooragang Is. and Richmond, N.S.W.
E	Shorebird Study Group	Hobart area, Tasmania
F	Mike Newman	Hobart area, Tasmania
G	David Paton	Coorong, S.A.
H	Allen Lashmar	Kangaroo Is., S.A.
I	Vic Smith	Albany, W.A.
J	Victorian Wader Study Group	Eight sites on Victorian coast
K	Australasian Wader Study Group	Broome, 80 Mile Beach and Port Hedland Saltworks, W.A.

The total of 15791 waders shown in the above table represents the best ever year for wader banding in Australia. To put it further in perspective it is equivalent to some 75% of the U.K. wader banding total for 1986 - in a banding scheme which overall marks eight times as many birds annually as Australia. Wader banders thus contribute proportionately much more highly to the total Australian banding effort.

Whilst the highly successful 1988 N.W. Australia Expedition was a major contributor to unusually large totals for 13 different species, the huge Victorian Wader Study Group tally of 9008 contained only 5 species with major totals (dominated by 6274 Red necked Stints!). The VWSG total also reflected particular projects, including the continuing monitoring of Double-banded Plovers (551) and the commencement of a long term study of Pied Oystercatchers (161).

Pied Oystercatcher studies - already in their eighth year - were the main reason for good totals of this species in Tasmania (Mike Newman and Shorebird Study Group).

It was good to see useful totals of waders caught by individuals in all states (except Northern Territory) ranging from Moreton Bay, Queensland (Denis Watson) to Albany, Western Australia (Vic Smith). Denis had a particularly good total of Grey-tailed Tatler (19). Allen Lashmar continued his most successful study of Hooded Plovers on Kangaroo Island with a further 14 caught. A noticeable gap was only 6 Latham's Snipe (David Pepper-Edwards) - more effort on this species would be worthwhile in view of its possibly declining numbers and the corresponding need for data to assist in conservation measures.

Thank you to those who responded so promptly to requests for figures at short notice. Hopefully next year we will circulate requests a little earlier. Good wader banding in 1988-89.

Clive Minton.

AUSTRALASIAN WADER STUDIES GROUP

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ROYAL AUSTRALASIAN ORNITHOLOGISTS' UNION

NUMBER THIRTEEN OCTOBER 1988

AWSG ITEMS

ASIAN SECTION

NEW ZEALAND

OPEN NOTEBOOK

BANDING ROUND-UP

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NEWSLETTERS AND SUBSCRIPTIONS

INTERWADER (East Asia/Pacific Shorebird Study Programme), under the umbrella of the Asian Wetland Bureau, produces a bi-annual newsletter in June and December. In future, the old style INTERWADER newsletter will be incorporated into the broader-based "Asian Wetland News" as a special section focussed on shorebird studies in Asia. The "Asian Wetland News" will be distributed to all relevant agencies and biologists within the Region and also available to subscribers outside Asia.

INTERWADER/Asian Wetland Bureau is an independent, non-profit non-governmental research organisation and as such relies on grants and donations to fund its activities. The production of the bi-annual newsletters is reliant on subscription from overseas, all subscribers will receive the newsletters as well as other information on shorebird study in Asia. A special agreement between AWB and AWSG enables you now to pay your subscription in A$ direct to the Administrative Secretary of AWSG, c/o 34 Centre Road, Vermont, Victoria, Australia, on the subscription form below.

INTERWADER SUBSCRIPTION FORM FOR 1988/1989.

Rates in Australia for the bi-annual newsletter are:

	AIR	SURFACE
AWSG Members	$11.50	$8.00
Non members	12.50	9.00
Institutions	25.00	18.00

NAME (Prof/DR/MR/MRS/MS): .....

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..... TEL: .....

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Please forward completed form and remittance to:

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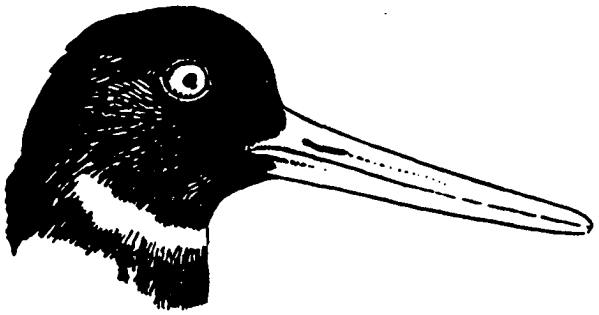


UNITED KINGDOM/EUROPEAN

WADER STUDY GROUP

INFORMATION FOR A.W.S.G. MEMBERS

The WADER STUDY GROUP (WSG) is an association of amateurs and professionals from all parts of the world interested in the Charadrii (waders or shorebirds). Membership of the WSG is currently over 500 people, approximately half of which live in Britain (where the group was formed in 1970) with others in Europe, the Americas, Asia, Africa and Australia. The interests of the Group have diversified from the original concentration on migration-related studies to embrace all aspects of wader biology.

The aims of the WSG are:

- to maintain contact between amateurs and professionals studying waders - to help organise co-operative studies - to provide a vehicle for exchange of information.

The main means of achieving these aims is by the publication of the Wader Study Group bulletin. WSG maintains contacts with many regional, national and international bodies interested in bird research and conservation, notably the International Waterfowl Research Bureau and the British Trust for Ornithology, and often works alongside them in co-operative studies. The Group has been involved also in the organisation of expeditions to remote areas to fill gaps in our knowledge of waders. Projects co-ordinated by WSG currently on-going include: studies of the spring migration of waders on the East Atlantic flyway, a large-scale investigation of spring migration through the Americas, a long-term monitoring of the usage of inland migration sites in Europe and a breeding wader monitoring scheme in Britain. Recently completed co-operative projects include an intensive study of breeding wader distribution and densities in the Outer Hebrides of Scotland, where rapid changes in agricultural practice are being made, an entire survey of the non-estuarine shores of the United Kingdom for wintering waders and an investigation into the effects of severe winter weather on waders. WSG also co-ordinates (on behalf of several national authorities) the colour-marking of waders, and attempts to forward sightings of these.

Membership of the WSG is open to all individuals or groups interested in waders. Applicants wishing to pay in Australian dollars should complete the form overleaf and return it together with payment to: Brenda Murlis, 34 Centre Road, Vermont, 3133, Australia. All cheques should be made payable to "AUSTRALASIAN WADER STUDIES GROUP (WSG)". Members recieve Wader Study Group bulletin three times per year posted from the UK.

The bulletin provides a forum for news, notices, ringing recoveries, recent publications, new catching and study methods, articles and preliminary or interim publication of results from all parts of the world. The editors try to maintain a balance of material ranging from newsletter, informal descriptions of research activities, meetings and expeditions to formal presentation of results on preliminary analyses.

The bulletin appears in April, August and December. The deadlines for inclusion of notices are 1 February, 1 June and 1 October respectively. Articles however, must be received well before these dates. Articles, notes, papers, notices, obituaries, requests for information, books for review, reprints of papers and other items should be sent to the Editor: Dr. N.C. Davidson, c/o NCC, Northminster House, Peterborough, PE1 1UA, UK. Material relating to the New World may be sent to the Editors of the New World Section whose addresses appear within the front cover of the bulletin. Matters relating to the circulation of the bulletin should be sent to the UK Membership Secretary: Jeff Kirby, PO Box 247, Tring, Herts., HP23 5SN, UK.

WADER STUDY GROUP - SUBSCRIPTION RATES AND MEMBERSHIP FORM

*** AUSTRALASIA ***

	Surface mail delivery	Airmail delivery
Individual members:	$ 24.50	$ 31.85
Institutions and Subsciption agencies:	$ 61.25	$ 68.60

Joining the WSG is easy! Subscriptions in Australian dollars can be made by cheque made payable to "AUSTRALASIAN WADER STUDIES GROUP (WSG)" and sent along with a completed application form to: Brenda Murlis, 34 Centre Road, Vermont, 3133, Australia.

APPLICATION FOR WADER STUDY GROUP MEMBERSHIP WSG/APP/88

Name (surname in capitals).....

Full address.....

.....

Telephone No. (if any).....

I wish to apply for membership of the Wader Study Group for the year..... (subscriptions cover one calender year from January to December). I enclose payment of $ ..... to cover my subscription with Bulletins posted surface mail/airmail (delete as appropriate) and..... Car Sticker(s) at $ 1.80 each.

..... Signature.

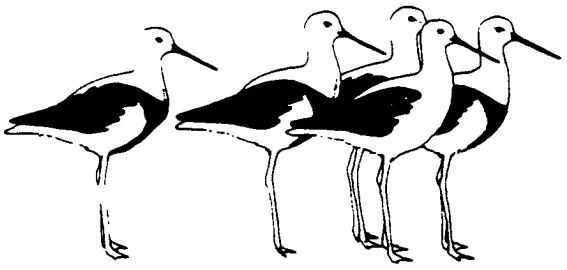
All cheques should be made payable to "AUSTRALASIAN WADER STUDIES GROUP (WSG)" and returned with this form to: Brenda Murlis, 34 Centre Road, Vermont, 3133, Australia.

BACK BULLETINS

All back issues of the WSG Bulletin are available at the following price: Issues 1-5 combined ($8.00), 6-10 combined ($8.00), 11-15 combined ($8.00), 16-20 combined ($8.00), 21-22 combined ($8.00) and 23 to the present issue ($8.00) each. Please send details of your order and payment to Brenda Murlis.

UK DATA PROTECTION ACT 1984

Please note that the WSG holds membership details for each member on computer disc. Also, it is WSG policy to print the names and addresses of new members in the Bulletin, as well as changes of address and, at regular intervals, a full membership list. Your signature on this form will be taken as your consent for your membership information to be treated in this way.



Australasian Wader Studies Group

MEMBERSHIP RENEWAL

1st January to 31st December 1989

Please tick appropriate box and complete information.

AUSTRALIA/NEW ZEALAND	$15	☐
OVERSEAS	$20	☐
LIBRARIES/AGENCIES	$25	☐
DONATION TO "RAOU RESEARCH FUND (AWSG)" $2 and over are tax deductible		☐

NAME .....

ADDRESS .....

..... POSTCODE .....

TELEPHONE NUMBER (including STD prefix) .....

SIGNATURE .....

CHANGE OF ADDRESS - Please notify Administrative Secretary of any change of address during the coming year.

Completed form should be returned to:

Administrative Secretary, AWSG,
c/- 34 Centre Road,
Vermont, 3133
Victoria,
Australia.