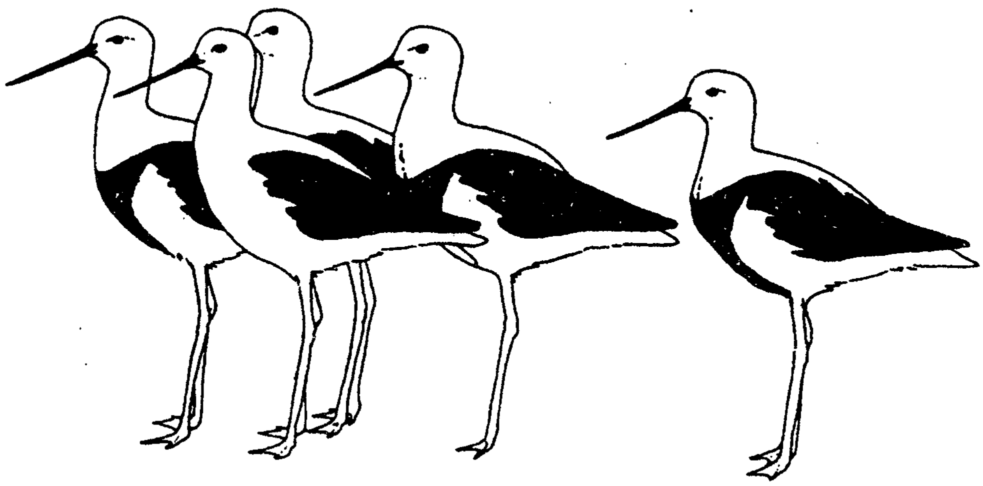
The Stilt



ISSN 0726-1888

BULLETIN OF THE AUSTRALASIAN WADER STUDIES GROUP

OF THE

ROYAL AUSTRALASIAN ORNITHOLOGISTS UNION

Number 19 OCTOBER 1991

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.

Subscriptions for 1991:

Australasia	AUS $15
Overseas	AUS $20
Libraries	AUS $25

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

EDITORIAL

Astute readers will notice some minor changes in the style and format in this edition of *The Stilt*. These changes, in particular those to the form of reference presentation, have been made in order to keep the layout of *The Stilt* in line with that of the *Emu*, the journal of our parent body The Royal Australasian Ornithologists Union, to which similar alterations have recently been made, mainly for reasons of simplicity.

The AWSG Committee is currently working on the preparation of instructions to authors for *The Stilt*, something which has not formally been done in the past. These instructions will, like those of *Emu*, not be regarded as rigid rules for the preparation of material but rather as general guidelines to assist prospective authors.

In a similar vein I would be pleased to see more short notes being submitted for *The Stilt*. I am sure that many of us have interesting pieces of information on waders hidden away in note books - information which should be published and *The Stilt* could be just the place to publish it.

This edition of *The Stilt* contains a number of interesting papers from all parts of the world. I am particularly pleased to see two papers from New Zealand, items from that country have been rather scarce in recent issues. The author of one of these papers noted in correspondence that *The Stilt* has "a fairly strong Australian bias", although this may well have been the case it is only so because material from other countries in the region has not been forthcoming.

Jeff Campbell

RECENT LITERATURE

The following is a selection of articles dealing with waders from recent publications.

ANDERSON, G.J. 1991. The breeding biology of the Bush Thick-knee *Burhinus magnirostris* and notes on its distribution in the Brisbane area. Sunbird 21, 33-61.

COX, J.B. (Ed.) 1990. Interesting wader records from the Interior. South Australian Ornithologist 31, 76-77.

DISHER, P. 1990. A Wilson's Phalarope at Tullakool, new for New South wales. Australian Birds 24, 38-39.

LLOYD, R.I. & H.J. 1990. An Oriental Pratincole at the Dry Creek Saltfields. South Australian Ornithologist 31, 74.

ELECTION OF OFFICE BEARERS

The term of office of the current Committee expires on May 31, 1992.

In accordance with Rule 7 of the Rules of the Australasian Wader Studies Group of the Royal Australasian Ornithologists Union, written nominations for committee positions, seconded by a member of the Group, shall be sent to the Chairperson by January 31 of the year of an election. The new Committee shall take office on June 1 1992, and shall have a term of two years.

The position and names of the current office bearers are listed below:

Chairperson	- Mark Barter
Administrative Secretary	- Brenda Murlis
Treasurer	- David Henderson
Research Co-ordinator	- Brett Lane
Liaison Officer	- Peter Haward
Editor	- Jeff Campbell
Committee Members	- Clive Minton
	- Mick Murlis
	-Hugo Phillipps

Should an election be necessary, ballot papers will be included in the April 1992 edition of The Stilt.

Brenda Murlis

HELP REQUIRED BY THE HANZAB ARTIST

Jeff Davies, the artist of the Handbook of Australian, New Zealand and Antarctic Birds, has asked for assistance in obtaining photographs and/or slides of the following:

Australian Pratincole - juvenile and immature - **IMPORTANT!!**

Underwings of:

White-rumped Sandpiper	Baird's Sandpiper
Marsh Sandpiper	Wood Sandpiper
Little Ringed Plover	Kentish Plover
Oriental Plover	Red-capped Plover
Ruff	Little Curlew
Lesser Yellowlegs	
Phalaropes (all three species)	

If you can help Jeff please contact him directly at:

26 Dresden Street (03) 458 2472
Heidelberg Heights
VIC 3081 Australia

AUSTRALASIAN WADER STUDIES GROUP EXPEDITION TO THE XUAN THUY RESERVE, RED RIVER DELTA, VIETNAM

20 MARCH-10 APRIL 1991

A team of three people visited the Xuan Thuy Reserve in order to study the northward migration of waders through the area.

The study methods involved regular counts, mist-netting and discussions with the local people, ecologists and hunters.

The largest single count totalled 6627 waders, with the most abundant species being Black-tailed Godwit, Curlew Sandpiper, Redshank, Large Sand Plover, Dunlin, Red-necked Stint and Kentish Plover. These species accounted for 77% of those seen. Rare species encountered included Spoon-billed Sandpiper and Nordmann's Greenshank.

A total of 227 waders were banded, with the most common being Curlew Sandpiper, Large Sand Plover, Red-necked Stint and Kentish Plover. Bands recovered from hunters included two placed on Red-necked Stints in Australia, one on a Black-tailed Godwit in Hong Kong and one of an as yet unknown species banded in the USSR.

Useful information was obtained on past hunting practices in the Reserve and its socio-economic importance. Hunting still occurs outside the Reserve boundary.

A report is being prepared for the Asian Wetland Bureau which will contain recommendations for future research activities.

Brett Lane

A CORRECTION

In the "AWSG Expeditions" Accounts published in the last *Stilt*, it was recorded that a payment of $2000 was made to Wayne Lawler. These funds were in fact used to part-finance the Java training expedition and were not a personal payment.

Mark Barter

SIGHTINGS OF ORANGE LEG-FLAGGED WADERS

Since January 1990, orange PVC leg-flags have been put on many of the palearctic waders caught in Victoria. The principal purpose is to increase the number of sightings of such birds on migration through Asia.

Almost 4000 waders have now been marked in this way, with the flag on the tibia rather than the tarsus on most birds (so that it is visible when the bird is standing in shallow water). Curlew Sandpipers and Red-necked Stints have so far formed the bulk of the birds marked, but in due course most species will be covered.

Numbers of birds orange leg-flagged to date (July 1991) are:

Red-necked Stint *Calidris ruficollis*	1635
Curlew Sandpiper *C. ferruginea*	964
Oriental Pratincole *Glareola maldivarum*	602
Sanderling *C. alba*	208
Red Knot *C. canutus*	158
Ruddy Turnstone *Arenaria interpres*	140
Bar-tailed Godwit *Limosa lapponica*	94
Common Tern *Sterna hirundo*	69
Pacific Golden Plover *Pluvialis fulva*	25
Sharp-tailed Sandpiper *C. acuminata*	11

NB. Oriental Pratincoles were leg-flagged in West Java, Indonesia.

Because the orange leg-flag is not specific to a particular banding site in Victoria, or to a particular date, it is only possible to define the banding details of birds sighted elsewhere as "banded Victoria, January 1990 or subsequently". However for all movements outside the state or overseas the general distance and direction of movement can be identified.

Some very interesting reports have already been received and they are detailed below.

Red-necked Stint

22.12.90 18.4.91	Lake Ellesmere, Christchurch, NEW ZEALAND	- Kathleen Harrison - Shelia Petch
10.3.91	St. Kilda, Adelaide, SA	- John Cox
30.3.91	Tullakool, near Moulamein, NSW	- Phil Maher
2.4.91	Pt Pinline, Kangaroo Is, SA	- Chris Lester
15.4.91	Eyre Bird Observatory, WA	- Gwen Goodreid
16.5.91	Mai Po, HONG KONG	- Wendy Young
26.5.91	Lake Eyre South, SA	- John Read

The report at Lake Ellesmere is the first recorded movement of a Red-necked Stint between Australia and New Zealand (where the species occurs in small numbers only).

The sightings at Adelaide, Kangaroo Island and Eyre Bird Observatory indicate a surprisingly strong westerly component in the initial stage of the "northward" migration back to the breeding grounds. In contrast the sighting at Lake Eyre South in late May was of a bird in non-breeding plumage - presumably a wandering first-year bird.

Within Victoria there have also been a number of sightings away from banding sites. These include two birds at Lake Murdeduke on 15 March 91 and one at Cundare Pool on 22 March (both seen by George Appleby).

Curlew Sandpiper

There were four sightings at Mai Po, HONG KONG, between 9 and 17 April 1990. The different positions recorded for the leg-flag (2 sightings on tibia and 2 on tarsus) indicate that at least two individuals were involved.

Sanderling

A bird observed by Martin Schulz on 19 May 1991 near Lake Mombiong, Discovery Bay, had been banded on 2 March 1991 at Killarney Beach. This represents a movement of 100 km WNW. The bird was in a small flock of presumed immature non-breeding birds.

This is the first recorded movement (albeit small) of a Sanderling banded in Australia.

Clive Minton

NEW MEMBERS

Arthur Rylah, Institute Library, PO Box 137, Heidelberg, VIC 3084.

Phil Battley, 8 Ayr Place, Palmerston North, New Zealand.

Ralph Cartar, 6-8 College Street, Sydney, NSW 2000.

Mike Crowley, PO Box 236, Moruya, NSW 2537.

Petrus Heyligers, 3/2 Sexton Street, Cook, ACT 2614.

Jin-Young Park, Dept. of Biology, Kyung He University, 1 Hoeki-Dong, Dongdaemoon-ku, Seoul 131, South Korea.

Barbara Jones, PO Box 180, Pambula, NSW 2549.

Tony Kirby, 14 Fourth Road, Armadale WA 6112.

Murray Lord, 8 Goodhart Place, Sandy Bay, TAS 7005.

Meme McDonald, 24 Molesworth Street, North Melbourne, VIC 3051

Lloyd Nielsen, PO Box 24, Canungra, QLD 4275

Donna O'Daniel, 216 W. Coral Drive, Payson, Arizona 85541, USA.

Shelley Quinn, PO Box 126, Chelsea, Vic 3196.

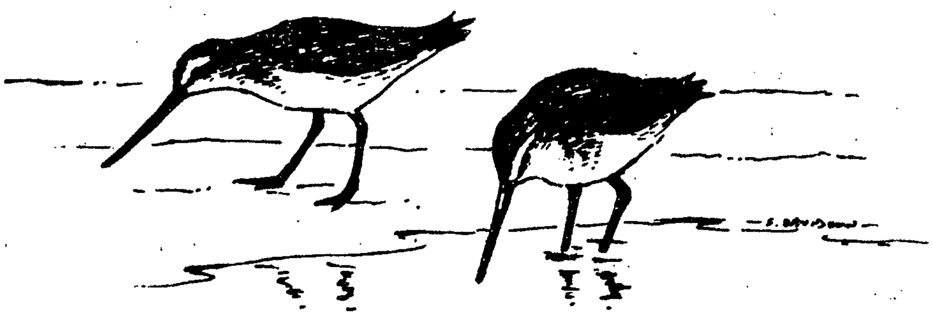
Brian Speechley, 9 Meehan Place, Kirrawee, NSW 2232.

Sue Taylor, 310 Commercial Road, Yarram, VIC 3971.

Shi Ming, Dept. of Environmental Science, East China Normal University, Shanghai 200062, China.

E.I. Gavrilov, Institute of Ornithology, 480032, Alma-Ata, USSR.

A.P. Savchenko, Krasnoyarsk University, Box 6047, 660113 Krasnoyarsk, USSR.



POSSIBLE CHANGES TO COMMON AND SCIENTIFIC NAMES OF AUSTRALIAN WADERS

An agreement was reached at the recent International Ornithological Congress in Christchurch, by the major ornithological bodies, to attempt to standardise bird names throughout the world. It was decided to use the most recent taxonomic work (Sibley and Monroe 1990) as the basis for discussion.

Listed below are the "Sibley and Monroe" names (common and scientific) for waders which occur in Australia. The names which differ from those given in "Recommended Names for Australian Birds" (Emu 1978) have been underlined. It should be noted that the systematic order is different to that in the Supplement, which follows Condon (1975).

The Taxonomic Advisory Committee of the RAOU is planning to issue a list of recommended names for Australian birds and those people who wish to make comments on wader names should write to the Chairman, TAC, 21 Gladstone Street, Moonee Ponds, VIC 3040, Australia.

Plains-wanderer	*Pedionomus torquatus*
Latham's Snipe	*Gallinago hardwickii*
Pintail Snipe	*Gallinago stenura* *
Swinhoe's Snipe	*Gallinago megala*
Black-tailed Godwit	*Limosa limosa*
Hudsonian Godwit	*Limosa haemastica* *
Bar-tailed Godwit	*Limosa lapponica*
Little Curlew	*Numenius minutus*
Whimbrel	*Numenius phaeopus*
Eurasian Curlew	*Numenius arquata*
Far Eastern Curlew	*Numenius madagascariensis*
Upland Sandpiper	*Bartramia longicauda*
Common Redshank	*Tringa totanus*
Marsh Sandpiper	*Tringa stagnatilis*
Common Greenshank	*Tringa nebularia*
Lesser Yellowlegs	*Tringa flavipes* *
Wood Sandpiper	*Tringa glareola*
Terek Sandpiper	*Tringa cinerea*
Common Sandpiper	*Tringa hypoleucos*
Grey-tailed Tattler	*Tringa brevipes*
Wandering Tattler	*Tringa incana*
Ruddy Turnstone	*Arenaria interpres*
Asian Dowitcher	*Limnodromus semipalmatus*
Great Knot	*Calidris tenuirostris*
Red Knot	*Calidris canutus*
Sanderling	*Calidris alba*
Western Sandpiper	*Calidris mauri*
Little Stint	*Calidris minuta*
Rufous-necked Stint	*Calidris ruficollis*
Long-toed Stint	*Calidris subminuta*
White-rumped Sandpiper	*Calidris fuscicollis* *
Baird's Sandpiper	*Calidris bairdii*
Pectoral Sandpiper	*Calidris melanotos*
Sharp-tailed Sandpiper	*Calidris acuminata*
Dunlin	*Calidris alpina*
Curlew Sandpiper	*Calidris ferruginea*
Stilt Sandpiper	*Micropalama himantopus* *
Buff-breasted Sandpiper	*Tryngites subruficollis*
Broad-billed Sandpiper	*Limicola falcinellus*
Ruff	*Philomachus pugnax*
Wilson's Phalarope	*Steganopus tricolor*
Red-necked Phalarope	*Phalaropus lobatus*
Red Phalarope	*Phalaropus fulicaria*
Greater Painted Snipe	*Rostratula benghalensis*
Comb-crested Jacana	*Irediparra gallinacea*
Pheasant-tailed Jacana	*Hydrophasianus chirurgus*
Bush Thick-knee	*Burhinus grallarius*
Beach Thick-knee	*Burhinus giganteus*
Pied Oystercatcher	*Haematopus longirostris*
Sooty Oystercatcher	*Haemotopus fuliginosus*
White-headed Stilt	*Himantopus leucocephalus*
Banded Stilt	*Cladorhynchus leucocephalus*
Red-necked Avocet	*Recurvirostra novaehollandiae*
Pacific Golden-plover	*Pluvialis fulva*
Grey Plover	*Pluvialis squatarola*
Common Ringed Plover	*Charadrius hiaticula*
Little Ringed Plover	*Charadrius dubius*
Red-capped Plover	*Charadrius ruficapillus*
Double-banded Plover	*Charadrius bicinctus*
Mongolian Plover	*Charadrius mongolus*
Greater Sand Plover	*Charadrius leschenaultii*
Caspian Plover	*Charadrius asiaticus*
Oriental Plover	*Charadrius veredus*
Hooded Plover	*Charadrius rubricollis*
Red-kneed Dotterel	*Erythrogonys cinctus*
Inland Dotterel	*Peltohyas australis*
Black-fronted Dotterel	*Elseyornis melanops*
Banded Lapwing	*Vanellus tricolor*
Masked Lapwing	*Vanellus miles*
Oriental Pratincole	*Glareola maldivarum*
Australian Pratincole	*Stiltia isabella*

* not in "Recommended names for Australian Birds" (Emu 1978)

REFERENCES

Condon, H.T. 1975. Checklist of the Birds of Australia, I. Non-passerines. RAOU, Melbourne.

Emu 1978. Recommended names for Australian Birds. Supplement to Emu 77 (May 1978).

Sibley, C.G. and Monroe, B.L. 1990. Distribution and Taxonomy of Birds of the World. Yale University Press, New Haven and London.

Mark Barter

ADDENDUM TO "SURVIVAL RATE OF DOUBLE-BANDED PLOVERS *Charadrius bicinctus bicinctus* SPENDING THE NON-BREEDING SEASON IN VICTORIA".

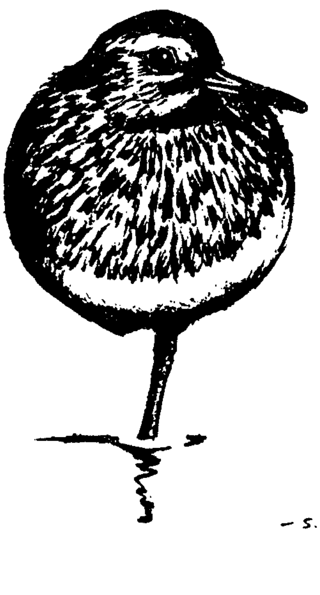
Mark Barter, 21 Chivalry Avenue, Glen Waverley, VIC 3150

The VWSG made further excellent catches of Double-banded Plovers at Queenscliff, Victoria, in July and August 1990, and this has allowed the previous survival rate estimates to be updated. There are some resulting minor changes for the earlier years (see Barter 1989 for comparison) and an estimate for the 1988/89 period (see Table).

Period/Method	Fisher-Ford	Jolly	Manly-Parr
1984/85	-	0.70	-
1985/86	-	0.83	0.67
1986/87	-	0.68	0.58
1987/88	-	0.95	0.94
1988/89	-	0.59	0.61
AVERAGE	0.77 (80/90)	0.75 (84/89)	0.71 (84/89)

Reference

Barter, M.A. 1989. Survival rate of Double-banded Plovers *Charadrius bicinctus bicinctus* spending the non-breeding season in Victoria. Stilt 15:34-36.



MONGOLIAN PLOVERS *Charadrius mongolus* IN AUSTRALIA - NEED FOR MORE BIOMETRIC AND BREEDING PLUMAGE INFORMATION.

Mark Barter, 21 Chivalry Avenue, Glen Waverley, VIC 3150
Jeff Davies, 26 Dresden Street, Heidelberg Heights, VIC 3081

1. Introduction

Detailed knowledge of breeding and non-breeding areas and the migration routes of waders is necessary in order to develop sound conservation and management plans. One species that poses a particularly interesting problem is the Mongolian Plover *Charadrius mongolus*, for which the occurrence and distribution of the various sub-species within Australia is not accurately known.

There are five sub-species of the Mongolian Plover and these fall into two separate groups - the *atrifrons* group, comprising *atrifrons, pamirensis* and *schaeferi*, and the *mongolus* group, consisting of *mongolus* and *stegmanni*.

Existing information indicates that the nominate sub-species *mongolus* occurs most commonly in Australia. However, there are published records of both *stegmanni* and also of birds from the *atrifrons* group (Lane 1986).

Biometric data and breeding plumage can generally be used to separate the *atrifrons* and *mongolus* groups, but distinction between the *stegmanni* and *mongolus* sub-species appears to be more difficult.

Wing:bill, wing:tarsus and bill-length:bill-depth ratios can be useful in separating the the *atrifrons* and *mongolus* groups; (Cramp and Simmons 1983, see Barter 1991 for a summary).

Analyses of available biometric data (Cramp and Simmons 1983, Prater *et al* 1977, C.S. Roselaar pers. comm.) indicate that wing, bill-lengths and bill-depths for *mongolus* and *stegmanni* are similar, but that the average tarsus-length of *stegmanni* is some 2mm shorter than that of *mongolus*. The shorter tarsus confirms Roselaar's comment (pers. comm.) that *stegmanni* is shorter-legged than *mongolus*. *Stegmanni* has a shorter bill-length:bill-depth ratio than *mongolus*. However, care needs to be taken in making any firm conclusions from the available data as the *stegmanni* sample size is very small.

Schaeferi, on average, has a shorter wing, but longer bill and tarsus, than either *mongolus* or *stegmanni* (Cramp and Simmons 1983) and can be separated in breeding plumage from the *mongolus* group by the presence of a black, or almost fully black, forehead compared to the white "headlights" of the *mongolus* group (Marchant *et al* 1986). Roselaar (pers. comm.) comments that *stegmanni* has "a relatively broad rufous breast- band", whilst *mongolus* "are generally paler but not very uniform".

2. Discussion

Examination of photographs taken of Mongolian Plovers in eastern Australia indicates that some of these may be of the *stegmanni* sub-species. This opinion is based on photographs of birds in the hand which show the head in profile. In particular, an individual caught by the Victorian Wader Studies Group at Queenscliff on 4 January 1986 clearly demonstrates the bill-length:bill-depth ratio of *stegmanni* (pers. obs).

Banding data confirms that birds occurring in both north-western and south-eastern Australia are generally from the *mongolus* group. There is also some indication from bill-length:bill-depth ratios that some Mongolian Plovers in south-eastern Australia are from the *stegmanni* sub-species, whilst those in north-western Australia are mainly *mongolus* (Barter 1991).

Further evidence supporting the possibility that *stegmanni* may occur in eastern Australia is the fact that this sub-species breeds further east (Commander Islands) than *mongolus* (Kamchatka Peninsula, westward to Lake Baikal)(Cramp and Simmons 1983, C.S. Roselaar pers. comm.) and, thus, could be expected to have a more easterly non-breeding range.

Of the other sub-species, *schaeferi* occurs in Sumatra and Java and is, thus, likely to reach north-western Australia.

There is clearly a need to obtain further biometric data and plumage descriptions in order to determine whether there are any geographical differences between Mongolian Plovers in Australia and, if so, which sub-species are occurring and where. It is particularly important that standardised methods be used as this is the only way that the evidently minor differences between *mongolus* and *stegmanni* can be detected.

It is suggested that all those catching Mongolian Plovers should measure wing, bill and tarsus lengths, and bill-depths, using the techniques described in Lowe (1989). If birds are caught or observed in breeding plumage, the full plumage description should be recorded on Plumage Description sheets as supplied by the Australian Bird Banding Scheme.

The resulting information should be sent to the Australian Bird Banding Scheme in Canberra for collation and future analysis.

3. References

Barter, M.A. 1991. Biometrics and moult of Mongolian Plovers *Charadrius mongolus* spending the non-breeding season in Australia. Stilt 18:15-20.

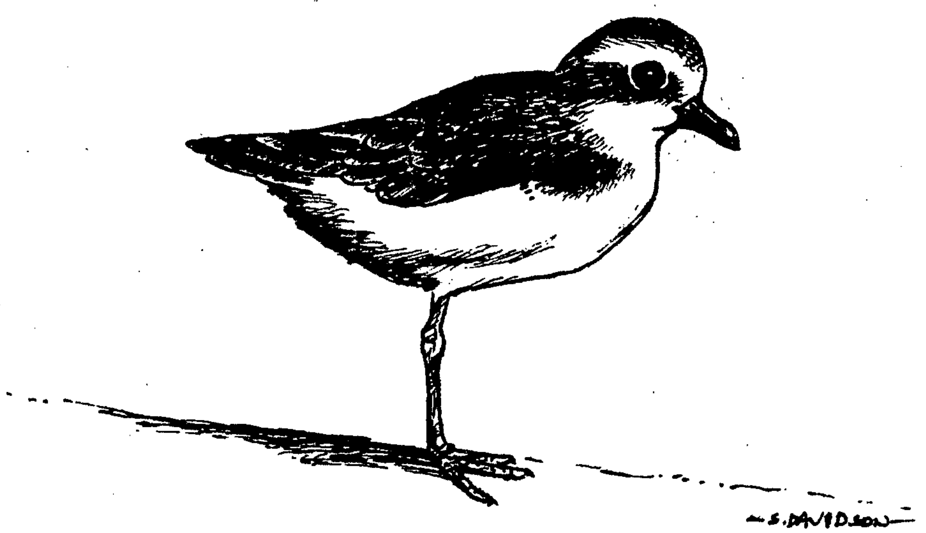
Cramp, S. and Simmons, K.E. (eds). 1983. The Birds of the Western Palearctic. Vol.3. Oxford University Press.

Hayman, P., Marchant, J. and Prater, T. 1986. Shorebirds. Croom Helm, London

Lane, B.A. 1986. Shorebirds in Australia. Nelson, Melbourne.

Lowe, K.W. 1989. The Australian Bird Bander's Manual. Australian National Parks and Wildlife Service, Canberra.

Prater, A.J., Marchant, J. and Vuorinen, J. 1977. Identification and ageing of Holarctic waders. BTO Guide 17, Tring, Herts.



SURVEY OF VICTORIAN BEACHES FOR HOODED PLOVERS - OCTOBER 1990

Brett A Lane, 12/262 Barkly Street, North Fitzroy, Vic. 3068.

Every two years, a survey of Victorian ocean beaches is organised to count Hooded Plovers *Charadrius rubricollis*. The aim of the survey is to monitor the population and distribution of this species in the state. The survey is conducted by volunteers in October when the population of this species is dispersed for breeding. This brief paper reports the results of the 1990 survey and compares them with previous years' results. Possible reasons for changes are discussed.

The survey was conducted between 10 and 21 October 1990. A total of 506 kilometres of ocean beach was walked by volunteer observers and staff from the Victorian Department of Conservation and Environment. This represents just over 65% of all suitable ocean beaches (777 km.) in the state. This is similar to coverage obtained in surveys in 1982, 1984 and 1986. In 1980 and 1988, complete coverage of all ocean beaches in Victoria was achieved. A full report of the results from 1988 is provided by Murlis (1989).

Table 1 provides a summary of the results of the survey by coastal sector, comparing these with previous years.

Table 1: Summary of Hooded Plover survey results in Victoria, 1980-1990. (* = incomplete coverage; - = no coverage)

Area	1990	1988	1986	1984	1982	1980
Nelson - Warrnambool	179	234	192	183*	208	197
Warrnambool - Cape Otway	-	7*	-	0	-	0
Cape Otway - Queenscliff	16	26	-	24	9	17
Point Nepean - Point Leo	5*	26	27	15	36	5
Phillip Island	23	28	8*	20	27	14
San Remo - Darby Beach	56	66	86	105	105	77
Wilson's Promontory	0*	0*	7*	19	-	18
Snake Island - McLoughlin's Beach	-	35	22	4*	-	14
Ninety Mile Beach - Marlo (incl. Gippsland Lakes)	22	43*	6*	0*	5*	23
Marlo - Point Hicks	-	30*	-	-	-	43
Point Hicks - NSW Border	33*	43*	18*	34	30*	34
Total	334	538	351	394	420	474

In terms of distribution, the 1990 results are consistent with those from previous years. The largest numbers and highest densities of Hooded Plovers occured on the beaches in the western part of the state, between the S.A. border and Warrnambool. Very low densities were once again recorded on Ninety Mile Beach in eastern Victoria.

Table 2 provides a comparison between 1988 and 1990. On the beaches surveyed in both years, total numbers in 1990 were more than 25 percent lower than in 1988. In the western part of the state (S.A. border to Warrnambool), total numbers were down by 23.5 percent (range: -8 to -50 percent). In central Victoria (Cape Otway - Wilson's Promontory), they were 33.8% percent lower (range: +17.9 to -100 percent). In eastern Victoria (Wilson's Promontory), total numbers were 12.7% lower (range: +26.9 to -62% on beaches showing a decline).

Table 2: Detailed comparison of coastal sectors counted in 1988 and 1990. (Figure in brackets is the count a week later, see text)

Area	1990	1988	No. km.	% change
Discovery Bay	55	41	51	- 25.4
Bridgewater Bay	2	4	16	- 50.0
Portland Bay	64	70	40.5	- 8.6
The Crags - Port Fairy	25	44	7	- 43.2
Port Fairy - Killarney	24	28	6	- 14.3
Killarney - Warrnambool	23	33	12	- 30.3
TOTAL WESTERN VICTORIA	179	234	132.5	- 23.5
Cape Otway - Torquay	2	8	29	- 75.0
Torquay - Queenscliff	14	18	24	- 22.2
Point Nepean-Cape Schank	5(23)	24	19	- 79.2(-4.2)
Phillip Island	23	28	24	- 17.9
San Remo - Cape Patterson	17	21	25	- 19.0
Venus Bay	33	28	35	+ 17.9
Waratah Bay	0	5	8	-100.0
Darby Beach	6	19	18	- 68.4
TOTAL CENTRAL VICTORIA	100	151	182	- 33.8
McLoughlin's Beach - Lakes Entrance	8	21	112.5	- 61.5
Lakes Entrance-Lake Bunga	6	6	9	0.00
Lake Tyers - Marlo	8	10	47	- 20.0
Mallacoota - NSW border	33	26	22	+ 26.9
TOTAL EASTERN VICTORIA	55	63	190.5	- 12.7
TOTAL	**334**	**448**	**505**	**- 25.4**

The decline in numbers counted in 1990 was so widespread that some systematic factor was indicated. A decline due to human disturbance would have been more patchy, with declines occurring mostly in areas subject to such disturbance. This was not the case. The reason for the lower numbers may have been related to the heavy storms which pounded the Victorian coast in the week preceding the survey. Many observers noted that beaches along which they walked had been considerably eroded by these storms.

Hewish (1989), describing her experiences on Discovery Bay in western Victoria in 1988, found the highest densities of Hooded Plovers along a flat, broad section of that beach. In eastern Victoria and south-eastern New South Wales, Schulz (1988) found Hooded Plovers nesting on broad, flat beaches or in dunes behind beaches. Furthermore, the greatest declines (in percentage terms) occurred on steeper beaches (e.g. McLoughlin's Beach - Lakes Entrance, Darby Beach, Cape Schank - Point Nepean, Bridgewater Bay) or those not backed by very extensive dunes (e.g. Cape Otway - Torquay, Port Fairy - The Crags)

It is possible that in 1990 some of these broader areas of beach preferred by Hooded Plovers had been washed away during the storms and that many birds were sheltering or attending nests in the dunes at the time of the survey. It is also possible that some had moved to stretches of beach not covered during the survey or lakes near the coast (also not covered).

Circumstantial evidence to support movement away from the beach comes from a count of the Point Nepean - Cape Schank coastline a week after the survey. In 1988, 24 birds were counted there. On the survey weekend, 5 birds were counted and in the following week, 23 birds were seen, similar to 1988. Many birds may have moved from the dunes back to the beach in the intervening week as calmer weather and associated constructional wave patter "repaired the damage" of the earlier storms.

The next Hooded Plover survey will be held in October 1992.

Acknowledgements

I would like to thank all participants for their efforts during the 1990 survey, Margaret Cameron for organising coverage of Victoria from Queenscliff to the S.A. border, staff of the Victorian Department of Conservation and Environment for covering the areas from Point Nepean to Cape Schank and from McLoughlin's Beach to Lakes Entrance, and members of the Gippsland BOC for covering the area from Lakes Entrance to Marlo.

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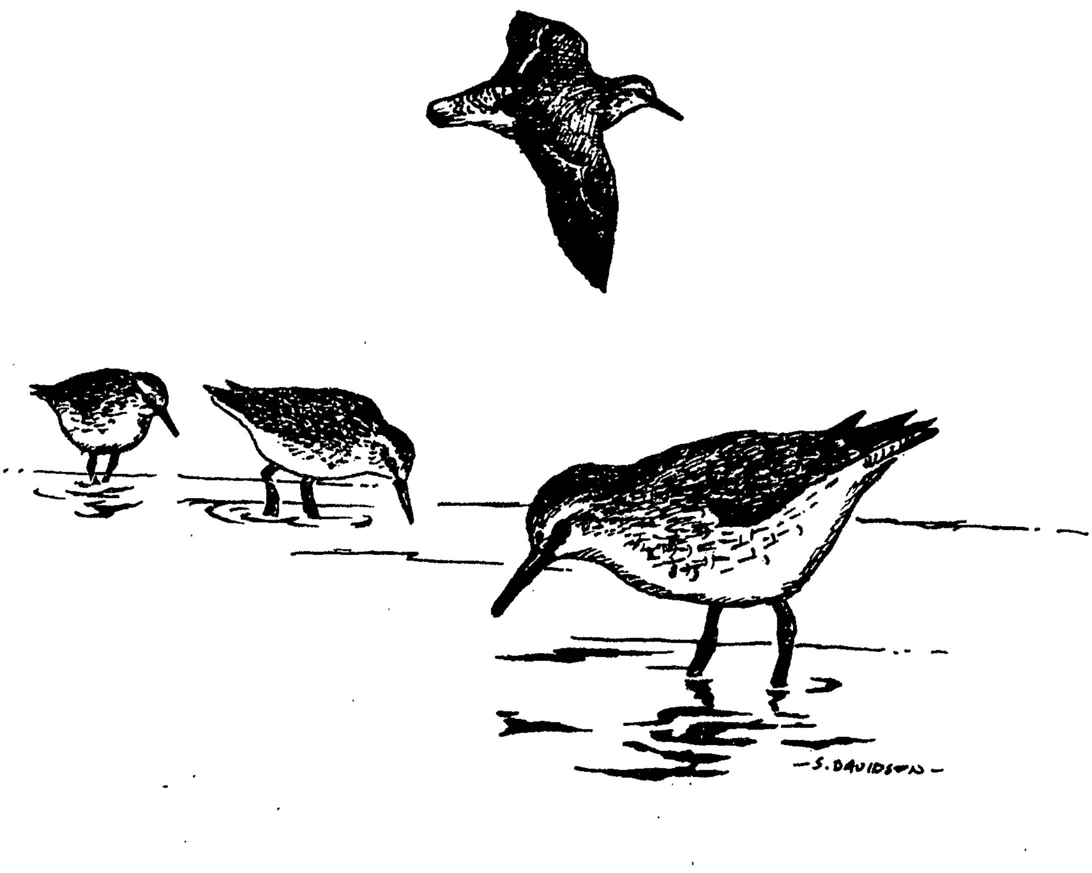

1990 SPRING HOODED PLOVER SURVEY, SOUTH AUSTRALIA

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The third Spring Hooded Plover survey was conducted by the Beach User Group on the weekends of 27-29 October and 4 November. The area surveyed was from the Victorian/South Australian border to the Murray Mouth.

A total of 147 adults, 2 juveniles and 5 runners (chicks) were sighted. Also 220 Pied Oystercatchers were counted (Table 1).

Some points to come out of the survey were:

- A pair of Hooded Plovers were sighted on the edge of a nearly dry swamp, one kilometre from the beach in the Green Point area east of Port Macdonnell.
- The surveyors counting the Cape Douglas/Carpenter Rocks area reported large amounts of seaweed on the beach and felt they may have easily missed seeing some birds due to this.

The beach has changed dramatically in many areas between Carpenter Rocks and Southend with the sea washing away parts of the foredune. In the Little Rocks area it may breach the foredune. The beaches are very heavy to traverse along the area of the survey.

Some surveyors felt that some plover sightings occurred in the same places as previous surveys (this being easy to note when they are near to known rock outcrops).

There were some areas that were not surveyed. These being the Finger Point area, rocky outcrops and an area from Wrights Bay to Boatswain Point due to seaweed covering the beach.

Again this year all surveyors reported numerous fox tracks on the beach and some cat prints also.

Since the survey was completed some of the surveyors have reported seeing chicks with adults which were not seen on the survey weekend.

In the 1988 survey a pair of Hooded Plovers were found nesting in the sand dunes approximately 600 metres from the sea. In the Cullen's Bay area near Southend, this sighting was confirmed by the resident N.P.W.S. ranger at Southend.

On October 14, 1990 I observed one adult and one very small runner in the same area.

On October 16 I returned to the area to photograph the birds but could only find the two adult Hooded Plovers. No sign of the runner could be seen. The weather conditions between the two observations were gale force winds from the N.W. and S.W.

The area where the birds were seen was observed on 14 and 26 October - two adults being sighted and what looked like a nesting scrape was noted (no eggs). 29 October - two adults observed in the area. 6 November - approached the area where the birds were. A scrape with four eggs was noted. 11 November - bird observed on nest. No sign of other adult.

I did not get to the area again until 7 December. No sign of any plovers or the nest were seen. I did not expect to find any birds in the area, as I felt the eggs would have hatched and the birds would have left the area to go to a beach to feed. It is interesting to note that on searching the nearest beach at Sweep Rock, 1 km. from the nest site, a pair of adults and three small runners were seen.

Another pair were observed on a number of occasions over several months on a lake near Salt Creek. The last observation was on 4 November. No surveyors have been

Table 1. 1990 Beach User Group - Hooded Plover & Pied Oystercatcher Survey

Area (Date of 1990 Survey)	Approx. Kms Surveyed	Pied Oyster-catcher	Adult Hooded Plover	Juv. Hooded Plover	Runner (chicks) H.Plover	Hooded Plover Spring 1988	Hooded Plover Spring 1989	Bransbury Survey Spring 1982	Bransbury Survey Spring 1987
Vic. Border-Cape Douglas (28/10)	30	9	12		3	8	8		
Cape Douglas-Carp. Rocks (28/10)	22	1	2	1		11	7	6	4
Carp. Rocks - Southend (27/10)	48	6	37			21	26	41	22
Southend - Robe (29/10)	57	11	36		2	35	41	38	30
Robe - Kingston SE (28/10)	45	5	10			27	7	19	13
Kingston SE-42 Mile (27/10)	62	16	29	1		21	24	27	13
42 Mile - Murray Mouth (4/11)	110	182	21			47	24	27	8
TOTALS	374	220	147	2	5	170	137	158	90

NOTE: Rocky areas, Finger Point sewage, Wrights Bay to Boatswain Point not surveyed.
Survey conditions: 27/10 - Good; 28/10 - Fair - tide rather high; 28/10 - Fair - tide rather high; 4/11 - Fair

back to this lake to see if they nested in the area but one would suspect that they may have after spending so much time in the area.

Some surveyors have revisited areas and have seen more birds than were seen on the survey day.

The surveyors were:

Victorian border to Cape Douglas -
Bob & Dulcie Schleter (4WD vehicle)

Cape Douglas to Carpenter Rocks -
Graham & Liz Hughes (4WD vehicle)

Carpenter Rocks to Southend -
Allan Gurney (motor bike)

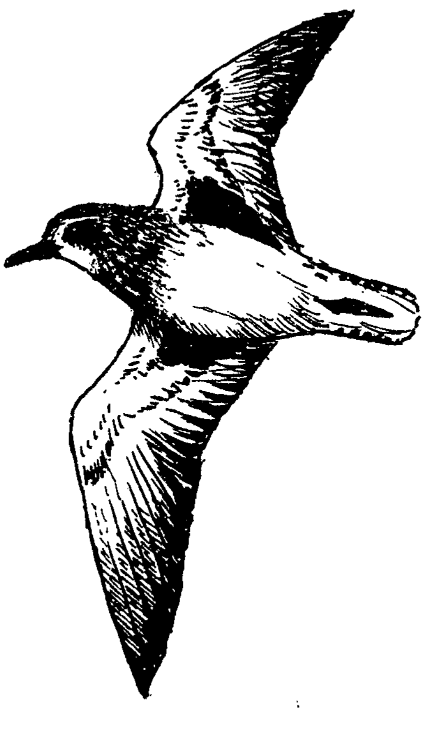
Southend to Robe -
Iain Stewart (motor bike)

Robe to Kingston SE -
Robert & Patsy Holme (4WD vehicle)

Kingston SE to 42 Mile -
Gary Schaeffer & Vicki Natt (4WD vehicle)

42 Mile to Murray Mouth -
Bob Coxon and Ren DeGaris with assistance from Dennis Cowling & John McRostie (4WD vehicle)

My thanks to the surveyors for their assistance.



BIOMETRICS AND MOULT OF GREY-TAILED TATTLERS *Tringa brevipes* IN AUSTRALIA.

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1. Summary

Data obtained from 1237 Grey-tailed Tattlers caught in Australia have been analysed for bill, total-head, tarsus-plus-toe and wing lengths, and primary moult and breeding plumage. In north-western Australia (NWA), the average adult bill length is 38.2mm, whilst the total-head length is 68.6mm. Both measurements are marginally shorter in Victoria. Adult wings, with new outer primaries, average 167.7mm in NWA. Juvenile wings are shorter on arrival, ie. 164.6mm in October/November, and wear quickly to be 155.8mm in the March/April period. Wing lengths are generally longer in Victoria than in NWA. Weight gains of more than 40% are normal prior to migration, and birds of this weight should be capable of flying non-stop to The Philippines, which is on the migration route for this species. In NWA, adult primary moult commences soon after arrival in late August/early September, has reached a median primary moult score (MPMS) of 19 by late October/early November, and is complete by mid-March, probably earlier. Victorian adult moult appears to occur later than in NWA. Moult in NWA second-year birds is well advanced when adults are arriving (MPMS=22). Eighty to ninety percent of NWA first-year birds are in active outer primary moult in the March/April period, with moult commencing in the centre wing. Moult into breeding plumage is well advanced in March/April, with many birds being in full nuptial plumage.

2. Introduction

The Grey-tailed Tattler *Tringa brevipes* breeds along river and stream banks, generally above the tree line, on mountains in north-eastern Siberia. Adults arrive in late May and nest from mid-June to mid-July. Fledging occurs in early August and numbers have diminished considerably by mid-August, as birds leave for the non-breeding areas. The main migration routes, to and from the breeding grounds, are along the east Asian coastline (Neufeldt *et al* 1961).

The non-breeding range extends from the south-east Asian mainland coast southwards, through The Philippines and Indonesia, to Australia (Lane 1987). The estimated Australian non-breeding population is 36,000 (Watkins, in prep.).

Up to late 1990, nine Grey-tailed Tattlers banded in NWA had been recovered or controlled overseas, ie. in Taiwan (3), China (3), Japan (2) and USSR (1), and three Japanese-banded birds had been recovered or controlled in Queensland and one Taiwanese bird controlled in NWA.

Few data are available on the biometrics and moult of this little-studied species. Published information on bill, wing and tarsus lengths is given in Table 1.

Table 1. Bill, wing and tarsus lengths (mm) for museum specimens (Prater *et al* 1977).

Metric	Age	Sex	n	x	Range
Bill	3+/2+	-	58	37.7	34-42
	1	-	48	37.3	35-42
Wing	3+/2+	M	18	163.9	158-170
		F.	16	168.4	160-175
	1	M	10	161.6	154-167
		F	19	162.5	154-169
Tarsus	3+/2+	-	63	31.8	29-34
	1	-	51	31.4	29-34

Key for Tables 1 to 6 and Table 9:
n = sample size
x = mean
sd= standard deviation

Prater and Marchant (1975) found no difference between the moult of the Grey-tailed and its close relative the Wandering Tattler *T. incana*. They determined that adults commence moulting primaries descendantly in late September and early October. Some birds have completed moult by early February, most by March and all by April. They observed that 25% of adults were in suspended moult in November/December, with the point of suspension varying from primary three to seven. All first year birds examined, which had been collected after December, were undergoing, or had undergone, descendant partial outer primary moult with completion dates ranging from mid-March to mid-August. Numbers of feathers replaced varied from four to seven, with the most common being five. A third of this age group had also moulted at least one of their inner primaries, indicating that active moult may occur at two centres.

This paper contains the results and discussion of analyses of data obtained from 1237 birds caught in north-western Australia (NWA) and Victoria between 1981 and 1988.

3. Methods

All birds were caught in cannon-nets. Catches in NWA were made during expeditions covering arrival and departure periods in August/September and March/April, respectively, and in October/November. Catch details by period are;

August/September	183
October/November	94
March/April	926

Thirty four birds have been caught in Victoria, mostly in January.

Bill, total-head, wing and tarsus-plus-toe lengths were measured, and primary moult scored, according to methods described in Lowe (1989).

Birds were aged according to the Australian Bird Banding Scheme code, viz:

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

It is generally possible to separate 3+ and second-year birds during the August to November period. However, this cannot be done following moult of the tenth primary in either age group and both are then aged as 2+. Three+ and 2+ birds are often referred to as adults and first-years as juveniles.

4. Results And Discussion

Bill, total-head, wing, tarsus-plus-toe lengths and weights are given in Tables 2 to 6, respectively. Primary moult and breeding plumage data is provided in Tables 7 to 9.

Average bill lengths of adults (38.1, 38.2mm) are longer than those of juveniles (36.3, 37.1mm) in both Victoria and NWA, respectively, probably reflecting incomplete growth in first-year birds. Second-year birds in NWA have identical average bill lengths to those of adults (38.2mm). Bills of live adult birds are longer than those of specimens (37.7mm), probably due to shrinkage in the latter group.

Table 2. Average bill lengths in Victoria and north-western Australia (mm).

Place	Age	n	x	sd
Victoria	2+/3+	29	38.1	1.95
	1	2	36.3	0.28
NWA	2+/3+	150	38.2	1.62
	2	60	38.2	1.43
	1	21	37.1	1.45

Average total-head lengths of adults are similar in Victoria and NWA (68.3 vs. 68.6mm, respectively). All age groups, ie. 3+/2+, second and first-year birds, have similar head-lengths.

Table 3. Average total-head lengths in Victoria and north-western Australia (mm).

Place	Age	n	x	sd
Victoria	2+/3+	26	68.3	1.80
	1	2	66.3	0.64
NWA	2+/3+	157	68.6	2.12
	2	52	68.7	2.40
	1	47	68.4	1.87

Adult mean wing lengths in NWA show the effect of feather wear and primary replacement through the three catching periods, ie. 166.7mm, in August/September, wearing to 164.7mm in October/November and increasing to 167.7mm in March/April, when the outer primary has been replaced. Average adult wing lengths seem to be longer in Victoria than in NWA. First-year bird wings in NWA are shorter than those of adults upon arrival and wear quickly, ie. 164.6mm, in October/November, wearing to 155.8mm in March/April. NWA second-year birds in August/September have shorter wings than those of adults at the same time (162.5 vs. 166.7mm), but longer than those of first-year birds in March/April (ie. 162.5 vs. 155.8mm), indicating that many of the first-years replace their outer primaries (see below).

Wing lengths in both Victoria and NWA are consistent with those given for museum specimens (Table 1).

Table 4. Average wing lengths in Victoria and north-western Australia (mm).

Place	Age	Date	n	x	sd
Victoria	2+	Jan	24	165.3	3.15
		Apr	3	171.0	6.38
	1	Jan	2	167.0	2.00
		Jun	3	162.7	1.25
NWA	2+/3+	Aug/Sep	43	166.7	3.42
		Oct/Nov	68	164.7	3.98
		Mar/Apr	176	167.7	4.41
	2	Aug/Sep	118	162.5	3.64
	1	Oct/Nov	7	164.6	2.81
		Mar/Apr	43	155.8	3.65

Tarsus-plus-toe lengths of NWA birds are similar, on average, for the two age groups (ie. 2+ - 64.8mm; 1 - 65.3mm).

Table 5. Average tarsus-plus-toe lengths in north-western Australia (mm).

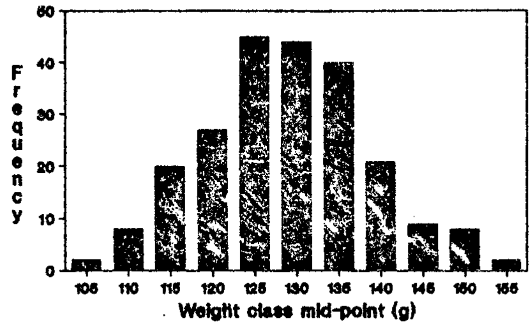
Age	n	x	sd
2+	48	64.8	2.00
1	26	65.3	2.03

Average adult weights are approximately 99g in the October/November period, increasing to around 127g in early April. The heaviest birds at this time weighed 155g, with 13% weighing greater than 140g, ie. 40%, or more, heavier than the average October/November weight (see Fig 1). Use of the Davidson (1984) flight range equation indicates that birds weighing more than 140g are capable of flying non-stop to The Philippines, a country in which Grey-tailed Tattlers occur during the migration period.

Table 6. Weights of the different age groups in north-western Australia (g).

Period/Age	3+/2+			2			1		
	n	x	sd	n	x	sd	n	x	sd
Late Aug	13	96.4	6.78	33	97.2	4.66	-	-	-
Early Sep	42	98.7	9.03	92	100.2	7.08	-	-	-
Oct/Nov	74	98.7	6.48	12	99.6	8.15	7	85.2	5.91
Late Mar	287	115.1	11.82	-	-	-	71	87.2	7.88
Early Apr	348	127.1	10.61	-	-	-	124	92.1	6.31
Mid Apr	43	122.2	11.66	-	-	-	28	84.1	6.52

Fig 1. Adult weights in NWA 1st to 4th April 1988



Adult primary moult in NWA appears to commence shortly after arrival with 9% of birds being in active moult during the late August/early September period. The median primary moult score (MPMS) has reached 19 by late October/November and all birds have completed moult by mid-March. The single adequate sample of Victorian adults caught in early January had a MPMS of 34, indicating that Victorian birds are moulting later than their NWA counterparts. This latter observation is similar to that for other species occurring in both these regions of Australia (Barter 1988).

Most second-year birds are in active moult when adults are returning from the breeding grounds, with the MPMS of 22 being similar to that of adults some two months later. This difference in timing is similar to that for other species in NWA (Barter 1988).

Some 80-90% of NWA first-year birds are in active primary moult in late March/early April. Moult generally commences at the fifth, sixth or seventh primary, with up to three feathers having been replaced by this time. A few birds had commenced moulting at the innermost primary, with some close to completing a full moult. Three first-years caught in Victoria at the end of June were in suspended moult, having changed three, five and seven feathers.

The primary moult strategies of NWA birds are generally consistent with those observed by Prater and Marchant (1975). However, NWA adult moult commences earlier than they observed (ie. late August/early September vs. late September or October) and suspension in adults has not been observed in Australia. Partial outer primary moult in first-year birds was onfirmed. c

Table 7. Primary moult data in north-western Australia.

Period	Age	n	%NS	%M	%C	MPMS
Aug/Sept	3+/2+	54	91	9	0	0
	2	97	1	97	2	22
Oct/Nov	3+/2+	61	0	100	0	19
Mar/Apr	1	226	16	83	1	8

Key: %NS = percent not started
%M = percent moulting
%C = percent completed
MPMS= median primary moult score

Table 8. Primary moult data in Victoria.

Period	Age	n	%NS	%M	%C	MPMS
Early Jan	2+	26	0	100	0	34
Late Jun	1	3	0	100	0	25

Breeding plumage is well developed by end March/early April with catch averages ranging from 80-90% and many birds having attained full nuptial plumage.

Table 9. Breeding plumage in north-western Australia.

Date	n	x	sd
24-25 Mar	54	0.74	0.26
29-31 Mar	87	0.80	0.25
4 Apr	70	0.90	0.18

NB.Breeding plumage was assessed subjectively using a range of 0 to 1 for each bird.

5. Acknowledgements

We would like to thank both the Australasian Wader Studies Group and the Victorian Wader Study Group for making their data available. Bands were supplied by the Australian Bird Banding Scheme.

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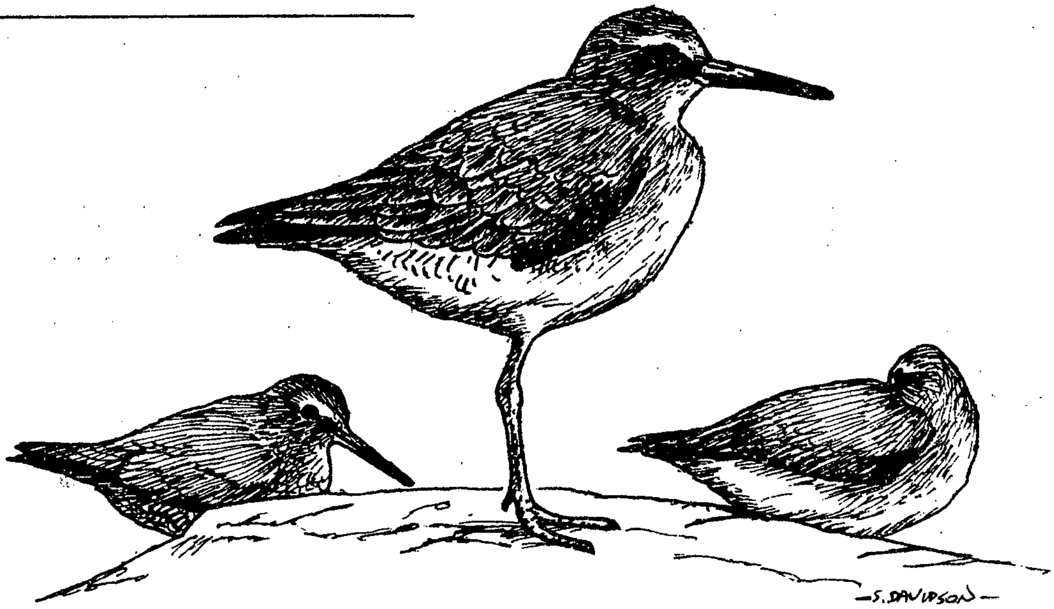

BIOMETRICS AND MOULT OF ORIENTAL PRATINCOLES *Glareola maldivarum* IN THE INDRAMAYU-CIREBON REGION, WEST JAVA, INDONESIA

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1. Summary

Data obtained from 609 Oriental Pratincoles, caught between mid-October and mid-November 1990, have been analyzed for bill, total-head, tarsus, tarsus-plus-toe, tail-fork and wing lengths, bill-depth, weight and primary, secondary and tail moult. No significant sexual dimorphism was found in any of the measurements. The available evidence, ie. weight and lack of sightings of leg-flagged birds, indicates that there was continual turnover during the study period. Primary and tail moult strategies were broadly similar to those recorded for similar species, although the Oriental Pratincole was more advanced in wing moult. The great majority of birds were in suspended moult indicating that they were still on migration. The ability to age juveniles on the basis of buff-tipped secondaries may not be possible later in the non-breeding season, as more than a quarter of juveniles were in the latter half of secondary moult.

2. Introduction

There is little published biometric data on the Oriental Pratincole, although much more is available for two similar species, the Collared Pratincole *G. pratincola* and Black-winged Pratincole *G. nordmanni*. The Black-winged and Oriental Pratincoles have sometimes been included as subspecies of the Collared Pratincole but have been treated as separate by Cramp and Simmons (1983) and Prater et al (1977), on the basis of the mainly separate breeding ranges and different plumages. The Black-winged Pratincole is the largest of the three and the Collared is the smallest, with the Oriental being intermediate in size, although it does have the shortest tail fork.

Published data for bill, tarsus and wing lengths, and tail-fork depth are given in Tables 1 to 4. Data obtained from a March sample of 84 birds (Barter 1990) caught in north-western Australia (NWA) is also included. Additional biometric information obtained from the NWA sample is given in Table 5. Cramp and Simmons (1983) state that the Oriental Pratincole has an average bill-depth of 6.4mm compared to the Collared's 6.7mm and Black-winged's 6.0mm.

No published data is available on the moult of primary, secondary and tail feathers in the Oriental Pratincole. Cramp and Simmons (1983) consider moults in the primary and tail feather tracts to be identical for the Collared and Black-winged Pratincoles.

This paper contains the results of analysis of biometric and moult data obtained from 609 Oriental Pratincoles caught during a visit to the Indramayu-Cirebon region of West Java, Indonesia, by a two man Australasian Wader Studies Group team. The major purpose of the visit was to train Indonesian biologists in obtaining and analysing population, migration and hunting data on a variety of waterbird species. The Oriental Pratincole was chosen as the principal study species because of the heavy hunting pressure to which it is subjected in the region (Milton and Marhadi 1989).

3. Methods And Materials

A total of 735 birds was caught in mist-nets, some by the study team (280) or hunters (79), specifically for banding purposes, others by hunters (376), initially for food but sold later to the team. Additionally, seven birds were retrapped that had been previously banded by the team. Those caught for food were bought from wholesalers and had been kept overnight before banding and measurement; many were in poor physical condition and mortality was high.

A total of 733 birds was banded and comprehensive biometric information was obtained from 609 of these. Orange leg flags were attached to 602 birds. Data obtained comprised measurements of bill (exposed culmen), total-head, tarsus, tarsus-plus-toe, longest and shortest tail feather and wing lengths, and bill-depth and weight (see Lowe 1989 for techniques). Tail and wings were measured to the nearest whole mm, weight to the nearest gram and the remainder to the nearest 0.1mm. Primary, secondary and tail moult scores were obtained. Records were kept of the source of the bird, ie. caught by the team or a hunter, or obtained from a wholesaler.

Adults and juveniles were separated by the absence or presence of the distinctive buff-tipped juvenile secondaries. In most cases the age could be confirmed by the presence of adult or juvenile contour feathers or by the primary moult status. On this basis 449 birds were aged as adults, 156 as juveniles and four remained unaged.

The ageing convention used followed that of the Australian Bird and Bat Banding Schemes, viz:

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

Two+ birds are often referred to as adults and first-year birds as juveniles.

Table 1. Published data for bill-length (mm)

Age	n	x	sd	Range	Source
2+	12	14.2	-	13/15	Prater
2+	67	14.0	0.77	12.5/16.1	NWA
1	12	13.2	-	12/14	Prater
1	16	13.9	0.93	12.9/16.2	NWA

KEY: n = sample size; x = mean; sd = standard deviation; Prater = Prater et al 1977; NWA = Barter 1990

Table 2. Published data for tarsus-length (mm)

Age	n	x	sd	Range	Source
2+	13	33.5	-	32/37	Prater
1	11	33.5	-	30/35	Prater

Table 3. Published data for tail-fork depth (mm)

Age	Sex	n	x	sd	Range	Source
2+	M	17	26.4	-	22/33	Prater
2+	F	9	24.4	-	17/30	Prater
1	M	6	19.8	-	14/25	Prater
1	F	5	14.4	-	8/19	Prater

Table 4. Published data for wing-length (mm)

Age	Sex	n	x	sd	Range	Source
2+	M	18	190.8	-	182/200	Prater
2+	F	9	190.0	-	185/199	Prater
2+	-	65	188.3	6.65	169/205	NWA
1	-	16	184.6	-	170/197	Prater
1	-	16	186.7	7.56	177/202	NWA

Table 5. Additional data obtained from north-west Australian sample (mm and g).

Measure	Age	n	x	sd	Range
Total head-length	2+	66	46.4	1.21	43.6/48.7
	1	16	46.2	1.49	42.5/48.4
Tarsus-plus-toe	2+	66	33.5	1.75	30.1/37.8
	1	16	32.6	1.58	30.2/34.7
Outer tail feather	2+	35	78.3	3.55	71/78
	1	15	77.9	3.63	71/86
Weight	2+	66	76.8	7.39	61/94
	1	17	74.6	6.76	59/84

4. Results And Discussion

The bill length averages for the age groups (2+ - 13.9mm, 1 - 13.8mm; Table 6) are similar, and to those of the NWA live birds (2+ - 14.0, 1 - 13.9mm; see Table 1). Agreement with adult museum material (14.2mm) is reasonable, but not with juvenile material (13.2mm). The juvenile specimens may have been collected at an early stage in life when bills were still growing.

Table 6. Bill-length data (mm)

Age	n	x	sd	Range
2+	446	13.9	0.92	11.1/16.6
1	157	13.8	0.90	11.3/16.1

The average bill-depths (2+ - 6.5mm, 1 - 6.4mm; Table 7) are consistent with the 6.4mm given for this species by Cramp and Simmons 1983.

Table 7. Bill-depth data (mm)

Age	n	x	sd	Range
2+	446	6.5	0.36	5.3/7.9
1	157	6.4	0.36	5.4/7.5

Average total head-lengths are similar for adults and juveniles (2+ - 46.1mm, 1 - 45.9mm; Table 8). Adult and juvenile total head-lengths are shorter than those of NWA birds (2+ - 46.1 vs. 46.4mm; 1 - 45.9 vs. 46.2mm; Table 5), but these differences are probably due to measuring artefacts.

Table 8. Total-head length data (mm)

Age	n	x	sd	Range
2+	446	46.1	1.25	41.0/49.4
1	155	45.9	1.21	43.1/49.1

Average tarsus-lengths are identical for the two age groups (30.9mm; Table 9). The tarsus-lengths are considerably shorter than in published data (2+ and 1 - 33.5mm; Table 2). The reason for this difference is not known.

Table 9. Tarsus-length data (mm)

Age	n	x	sd	Range
2+	447	30.9	1.68	26.2/39.1
1	156	30.9	1.91	25.8/38.4

Average tarsus-plus-toe lengths are the same for both age groups (33.8mm; Table 10). Adult measurements are similar to those obtained in NWA (33.8 vs. 33.5mm; Table 5), whilst juvenile average tarsus-plus-toe lengths are longer (33.8 vs. 32.6mm).

Table 10. Tarsus-plus-toe length data (mm)

Age	n	x	sd	Range
2+	447	33.8	1.54	29.6/38.5
1	156	33.8	1.64	28.4/38.4

Adult outer tail feathers average 5.5mm longer than those of juveniles (76.8 vs. 71.3mm) for birds with old outer tail feathers, whilst the difference for central feathers is less at 1.4mm (55.6 vs. 54.2mm). As a result adult tail fork-depth averages 4.2mm more than for juveniles (21.2 vs. 17.0mm; Table 11).

Table 11. Tail-fork depth data (mm)

Age	n	x	sd	Range
2+	436	21.2	3.95	7.6/32.6
1	154	17.0	6.01	0.6/29.6

NWA outer tail feathers are longer than in Javan birds (2+ - 78.3 vs. 76.8mm; 1 - 77.9 vs. 71.3mm; Table 5), presumably due to the presence of new outer feathers in the NWA birds. Few adults (n=7) and juveniles (n=2) in Java had new outer tail feathers.

Average Javan adult tail-fork depths are considerably less than quoted for museum specimens (21.2 vs. c.25.4mm; Table 3), whilst juvenile measurements are similar (17.0 vs. c.17.1mm). It seems likely that the adult museum specimens have new outer tail feathers.

Adults with new outer primaries have longer wings, on average, than those with old primaries (184.6 vs. 183.2mm). Average length juvenile wings, with the original primaries, are some 6mm shorter than those of adults (177.0 vs. 183.2mm), but are similar in length when the outer primary has been replaced in both age groups (183.9 vs. 184.6mm) (Table 12).

Table 12. Wing-length data (mm)

Age	n	x	sd	Range
Primary moult score < 50				
2+	62	183.2	6.11	169/199
1	138	177.0	7.23	159/193
Primary moult score = 50				
2+	380	184.6	5.36	171/200
1	19	183.9	4.84	176/192

Interestingly, Javan adult average wing-lengths are considerably shorter than those given for museum specimens (190.4mm) and for NWA birds (188.3mm)(Table 4).

Attempts to establish sexing criteria were unsuccessful due to the lack of dimorphism in any of the measurements taken. Frequency histogram data for adult bill, total-head, tarsus-plus-toe and wing lengths are given in Fig 1.

Fig 1a. ADULT BILL LENGTH

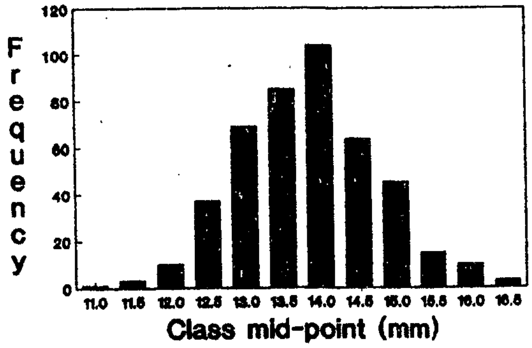


Fig 1b. ADULT TOTAL-HEAD LENGTH

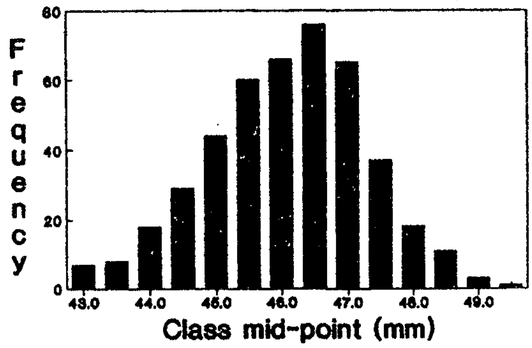


Fig 1c. ADULT TARSUS-PLUS-TOE LENGTH

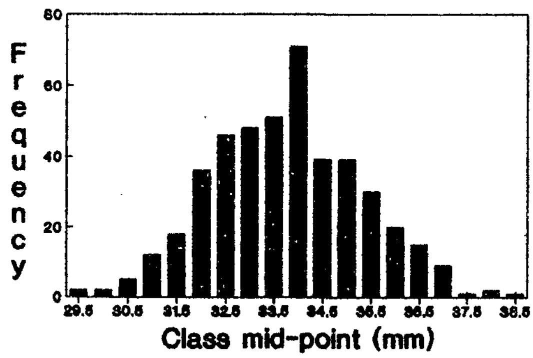
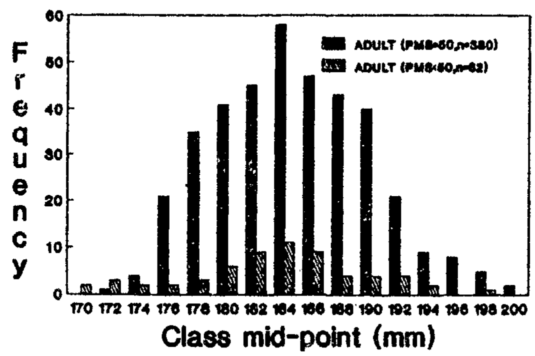
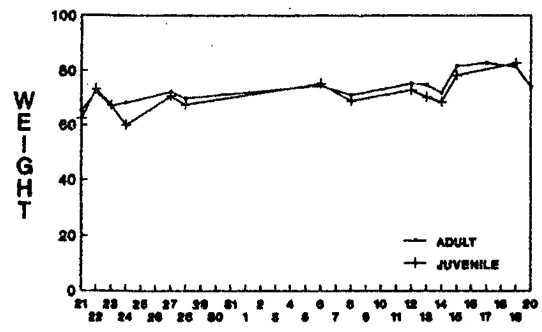


Fig 1d. ADULT WING LENGTH



Weights were quite variable during the catching period, even on successive days, and there was an apparent general increase in weight during this period (Fig. 2). The weight variability is caused by two factors - the source of the bird and whether birds were caught whilst actively feeding.

Fig. 2 ADULT AND JUVENILE WEIGHTS (g)



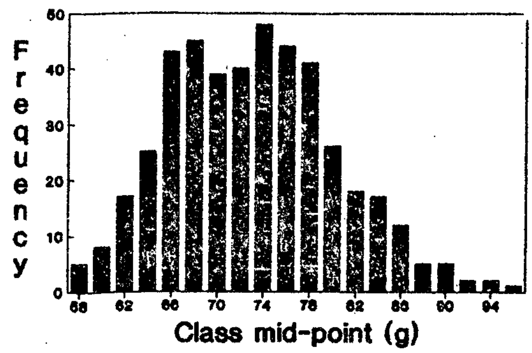
It can be seen from Table 13 that the average weights of the birds caught by the team (ie. weighed with little delay) were 75.2g for adults and 73.5g for juveniles, whilst birds obtained from wholesalers (kept overnight) were some five to six grams lighter, on average, and those supplied directly by hunters (a few kept overnight) averaged less than two grams lighter. The difference in weight between those birds obtained from wholesalers and those caught by the team is shown clearly in the frequency histogram in Fig 3.

Table 13. Weight data (mm)

Age	Source	n	x	sd	Range
2+	W	172	69.3	6.34	57/90
	H	61	73.8	7.86	58/93
	T	211	75.2	6.64	59/95
1	W	73	67.2	6.24	52/83
	H	19	71.6	9.33	56/96
	T	69	73.5	7.05	60/94

Key: W = Wholesalers
H = Hunters
T = Team

Fig. 3 ADULT WEIGHT



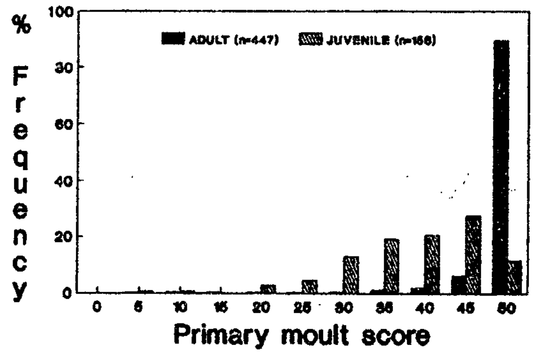
Catches of heavy birds made on 15 and 19 November (2+ - 81.6, 81.5g; 1 - 78.2, 82.8g, respectively) occurred whilst they were feeding and had noticeably full crops.

The apparent increase in weight through the catching period is due to the greater proportion of birds being caught by the team towards the end of the expedition and more actively feeding birds being captured at that stage as well.

The apparently stable average catch weight during the catching period may be explained by the continual departure of heavier birds as they attain a weight which allows them to leave on the next migration stage. The suggestion of a continual turnover is supported by the low number of retraps, ie. six out of 741 birds caught and the fact that no leg-flagged birds were seen after release.

No adults were in active primary moult and about 89% had completed moult. Juveniles were not as advanced as adults with 11% having completed moult, although almost all were in the second half of moult (Fig. 4a). Six percent of juveniles caught were in active moult.

Fig. 4a ADULT/JUVENILE PRIMARY MOULT



Less than two percent of adults were in active secondary moult with 78% having completed moult. Ninety four percent of adults had moult scores of 25 or more. On the other hand, 28% of juveniles had not commenced secondary moult and none had completed, whilst 27% had a moult score of 25 or more (Fig. 4b). Two percent of juveniles were in active moult.

The fact that 27% of juveniles were in the latter half of secondary moult throws some doubt on the feasibility of continuing to use buff-tipped secondaries for ageing purposes throughout the first year of life, as it seems that the remaining juvenile feathers could well be replaced, at least in some of the birds, whilst they are on the non-breeding grounds. If all the secondaries are renewed this would be in contrast to the statement of Prater *et al* (1977) that juvenile inner secondaries are distinctive throughout the non-breeding season and into the first northern summer.

Forty one percent of adults had not commenced tail moult, whilst only six percent had completed; two percent were in active moult. Juveniles were not as advanced as adults with 66% yet to start and only one bird having completed out of 150 (Fig. 4c). Five percent of juveniles were in active moult.

Fig. 4b ADULT/JUVENILE SECONDARY MOULT

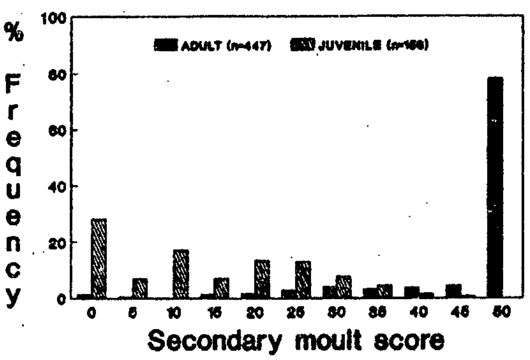
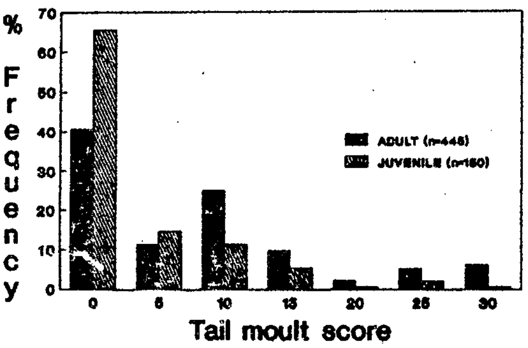


Fig. 4c ADULT/JUVENILE TAIL MOULT



On average, primary moult in each age group is more advanced than that of secondary moult, which in turn is ahead of tail moult. Adults on average have more new feathers in each of the feather tracts than do juveniles.

These results are broadly similar to those given for the Collared and Black-winged Pratincoles (Cramp and Simmons 1983). Adults of these two species replace up to seven primary and four tail feathers near the breeding grounds, suspend during migration and complete moult at the non-breeding sites. The majority of Javan adult pratincoles have, in fact, completed both primary and secondary moult, although the tail moult status is similar to that of the other two pratincole species. Cramp and Simmons (1983) state that post-juvenile moult is often slower and later than that of adults with up to five new primaries and only one new tail feather, on average, being grown before migration commences. As with adults, Javan juveniles are ahead of the same age group in the Collared and Black-winged Pratincoles for primary moult, and at a similar stage for tail moult.

In the NWA catch (30/3/90), only one adult out of 65 had not completed primary moult, whilst 14 out of 18 birds aged as first-years were in suspended moult, with from four to seven new outer feathers. The other four birds had not commenced moult.

The fact that very few adults and juveniles are in active moult in Java indicates that they are waiting until they reach their migration destination before completing or commencing moult. The status of those in active moult is unclear, but experience with other long distance migrants indicates that this group may remain in Java during the non-breeding season (see, for example, Barter *et al* 1988).

The primary moult status of NWA first-years is consistent with that found for Javan juveniles which, when finally completing moult, would be expected to have feathers of two age groups - older inner primaries, replaced prior to migration, and new outer feathers grown in the non-breeding areas. Similarly, NWA adults have scores which are consistent with those of Javan birds.

5. Acknowledgements

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MIXED BREEDING OF WADERS AT BENDIGO SEWAGE FARM, VICTORIA

with some notes on breeding behaviour of in particular Red-necked Avocet *Recurvirostra novaehollandiae.*

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Summary

During the 1988 breeding season, four species of wader bred, and a fifth species copulated, on a number of very small islands in a 2 hectare sewage lagoon in Bendigo, Vic. The lagoon was being drained at the time. Breeding attempts of all four species were followed. Additional notes were made on the breeding behaviour of Black-winged Stilt *Himantopus himantopus*, Black-fronted Plover *Charadrius melanops*, Masked Lapwing *Vanellus miles*, and, in most detail, of Red-necked Avocet *Recurvirostra novaehollandiae*. At the same time Silver Gulls *Larus novaehollandiae* also started breeding in the lagoon. Most of the breeding failed once the lagoon had dried out sufficiently to allow overland access by predators/human beings.

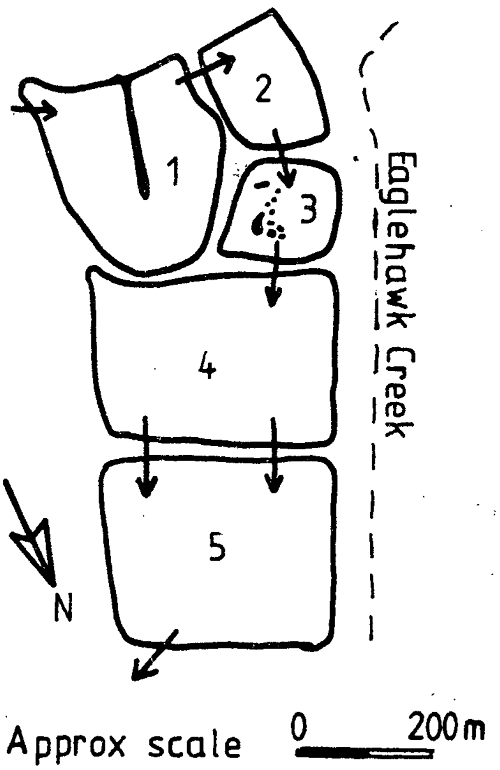


Fig. 1. Lagoons at Bendigo Sewage Farm, with approximate position of islands in lagoon 3.

Introduction

During the winter and spring of 1988, preparations were being made for renovation and extension of the sewage purification system at the Bendigo (Vic.) Sewage Farm, which is managed by the Bendigo Water Board. The Sewage Farm occupies an area of about 200 ha; it included a purification plant, six purification lagoons up to 25 ha in size, a number of irrigation bays, and a wetland to purify overflow from the last lagoon before discharge into the Bendigo Creek. The preparations for upgrading of the treatment system included removal of nutrient-rich sludge from the swamp, and drainage of lagoons 2 and 3, the two smallest (2 ha each) of the six lagoons (see Fig. 1).

As these two lagoons fell dry, they became very attractive to waders: at first mostly for feeding - on the mud along the edges - later also for breeding - on the sandy islets that emerged in lagoon 3. I had been making monthly visits to the sewage farm for some months, and followed breeding of various species on the islets in lagoon 3 during visits of up to three hours on 9 July, 13 August, 15 and 28 September, and 3, 6 and 21 October.

Breeding chronology

The numbers of wader species counted during each visit are shown in Table 1; the development of most of the nests is shown in Table 2.

9 July - Lagoon 3 had 5% of its area as mud, mostly along its edges. Two small islands had appeared in the lagoon, the largest (see Fig. 2) at this time approximately 12 m long and 1-3 m wide. Some tree stumps were also emerging as the water level fell due to seepage and evaporation.

Masked Lapwing *Vanellus miles*. There was a pair with three downy young on the largest island: there were 13 on the rest of the farm, plus a nest with three eggs on the mud flat of lagoon 2.

Black-fronted Plover *Charadrius melanops*. There were 17 on the largest island in lagoon 3, and 28 along its edges; I counted 129 on the rest of the farm.

Black-winged Stilt *Himantopus himantopus*. The only one on the whole farm was on lagoon 3.

Red-necked Avocet *Recurvirostra novaehollandiae*. None.

Table 1 Numbers of waders at lagoon 3 and May Swamp, and total for Bendigo Sewage Farm, winter-spring 1988

	Masked Lapwing	Black-fr. Plover	Black-w. Stilt	Red-necked Avocet	Red-kneed Dotterel
8 April					
Lagoon 3	12	12	15	0	0
May Swamp	0	0	0	0	0
Farm Total	61	57*	15	0	1
16 May					
Lagoon 3	2	0	22	0	0
May Swamp	0	0	0	0	0
Farm Total	30	92*	27	0	0
15 June					
Lagoon 3	6	54	0	0	0
May Swamp	0	65	0	0	0
Farm Total	12	138	0	0	0
9 July					
Lagoon 3	5	45	1	0	0
May Swamp	2	34	0	0	0
Farm Total	18	164*	1	0	0
13 August					
Lagoon 3	2	6	0	0	0
May Swamp	5+	34	2	2	0
Farm Total	19+	49	2	2	0
15 September					
Lagoon 3	3	1	2	23	0
May Swamp	7	9	2	4	0
Farm Total	24	10	4	28	0
28 September					
Lagoon 3	0	0	8	29	2
May Swamp	-	-	-	-	-
Farm Total	-	-	-	-	-
3 October					
Lagoon 3	2	3	11	62	7-8
May Swamp	-	-	-	-	-
Farm Total	-	-	-	-	-
6 October					
Lagoon 3	6	3	3	8	2
May Swamp	25-30	14	1	17-23	0
Farm Total	-	-	-	-	-
21 October					
Lagoon 3	0	3	0	0	0
May Swamp	7	7	12	100	0
Farm Total	-	-	-	-	-

* mostly at Lagoon 2, which was also being drained.

9 July cont...

Red-kneed Dotterel *Erythrogonys cinctus.* None.

Silver Gull *Larus novaehollandiae.* 50 on lagoon 3, 210 on the rest of the farm.

Table 2 - Nests on islands in Lagoon 3, Spring 1988.

e = eggs — B.f.Pl. = Black-fronted Plover
y = young — Stilt = Black-winged Stilt
x = on nest — Avocet = Red-necked Avocet
S. Gull - Silver Gull.

For Masked Lapwing see Text 9/7, 13/8 and 15/9.

	15 Sept	28 Sept	3 Oct.	6 Oct.
B.f.Pl.1	x			
Stilt 1	x	2 y	2 y	
S2		x	x	
S3			x	
Avocet 1	2e	2 e		
A2		2 e		
A3		2+ e	x	
A4			x	x
A5	3 e	3 e	x	
A6		x		
A7	2 e	x	x	
A8		x	x	
A9	x	x	x	2 e
A10		x	x	
A11	2 e	x	x	
A12		2 e	x	
A13	2 e	3 e	2 e, 1 y	
A14		2 e, 2 y		
A15	x	x	x +2 and 3y loose	
S. Gull 1	x	x		
S.G.	x			

13 August - Lagoon 3 had somewhat less than 15% mud, mostly along its southern and south-eastern edges. Its islands were much as in July, if somewhat larger.

Masked Lapwing. Two adults at lagoon 3, but no sign of the chicks; 17+ on the rest of the farm, including a pair with three young a few weeks old at lagoon 2.

Black-fronted Plover. Six at lagoon 3; 43 on the rest of the farm.

Black-winged Stilt. None at lagoon 3, two on the rest of the farm.

Red-necked Avocet. None at lagoon 3, two on the rest of the farm.

Red-kneed Dotterel. None.

Silver Gull. Two at lagoon 3, 25 on the rest of the farm.

15 September Less than 5% mud along the edges of lagoon 3: due to rain?

Masked Lapwing. Three juveniles which could fly at lagoon 3; 19 adults and two young on the rest of the farm.

Black-fronted Plover. One on nest on largest island in lagoon 3 (see Fig. 2); nine on rest of farm.

Black-winged Stilt. Two at lagoon 3, of which one on nest; two on rest of farm.

Red-necked Avocet. 23 on or near island in lagoon 3, seven nests: four with two eggs each, one with three eggs, two with adult on (see Table 1 and Fig. 1). Five adults elsewhere on farm.

Red-kneed Dotterel. None.

Silver Gull. 15 at lagoon 3, of which three appeared to be on nests on tree stumps which had emerged in the lagoon; three on rest of farm.

28 September. Water level lagoon 3 lower than on 15 September. I did not thoroughly check the waders on the rest of the farm.

Masked Lapwing. None at lagoon 3.

Black-fronted Plover. None at lagoon 3.

Black-winged Stilt. Eight at lagoon 3: three sets of two, plus two downy young walking around near Avocet nest 7 (see note below for description).

Red-necked Avocet. 27 adults at lagoon 3 and two downy young; 14 nests, seven with an adult brooding, three with two eggs, one with two or more eggs, two with three eggs, and one with two young, two eggs and both parents attending (see note below, Table 2 and Fig. 2.)

Red-kneed Dotterel. Two at lagoon 3.

Silver Gull. One on nest on tree stump in lagoon 3.

3 October. There was a dredge in the north-eastern corner of lagoon 3, pumping water into lagoon 1. The water level in lagoon 3 had already dropped an estimated 10 cm, causing the island to join partially.

Masked Lapwing. Two adults at lagoon 3.

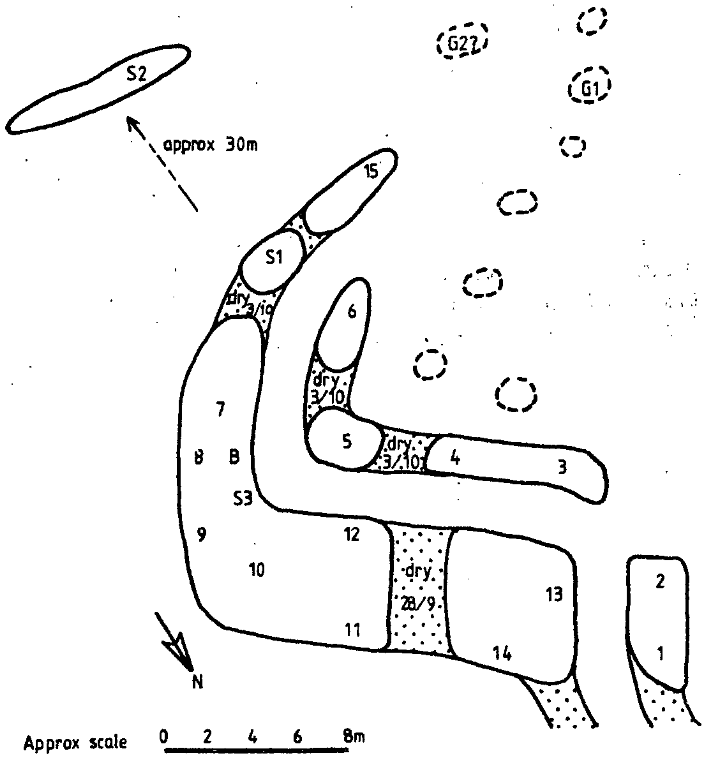
Black-fronted Plover. Three at lagoon 3, one on nest.

Black-winged Stilt. Nine adults and two juveniles at lagoon 3: four (one on nest) on southern island, five (one on nest) on largest island, and two juveniles walking about together. Two of the adults flew over the largest island at 1545, making alarm calls.

Red-necked Avocet. 62 at lagoon 3: 14 feeding at southern edge, 28 feeding in centre (west of islands), 10 roosting on extended largest island, and 10 on nest; one other nest had two eggs and one young, and there were two groups of two and three young respectively, each accompanied by two adults.

Red-kneed Dotterel. Seven or eight at lagoon 3, of which two copulating.

Fig. 2. Position of wader nests in islands in lagoon 3, Bendigo Sewage Farm, Epsom, Spring 1988.



Position of wader nests on islands in Lagoon 3, Bendigo Sewage farm, Epsom. Spring 1988

5 = Avocet nest 5

B1 = Black-fronted Plover nest 1

S3 = Black-winged Stilt nest 3

G1 = Silver Gull nest 1

Tree stump

two sandbanks with connecting shallows

Silver Gull. None at lagoon 3, nest possibly already abandoned.

6 October Lagoon 3 had been pumped out, its water level had dropped 0.8-1.0 m since three days earlier: one could on this day walk along the sand ridges, the tops of which formerly formed the islands. Attempts to suspend the pumping had failed, due to contractual obligations of various parties involved in the pumping. As expert advice had suggested that relocation of any nests would be useless, the following was the sorry state of affairs at lagoon 3; many of the waders having gone to the overflow swamp (May Swamp) at the north-eastern corner of the farm, which had by then recovered somewhat from its drainage and removal of its sludge.

Masked Lapwing. Six at lagoon 3, 25-30 at May Swamp, approximately 10 elsewhere on the farm.

Black-fronted Plover. Three at lagoon 3, four at May Swamp.

Black-winged Stilt. Three at lagoon 3, giving alarm calls; no young to be found. One or two at May Swamp.

Red-necked Avocet. Eight at lagoon 3, giving alarm calls. 17-23 at May Swamp. Walking among the abandoned nests, I found one egg pecked open on its side and emptied. Nest 9 still had two eggs.

Red-kneed Dotterel. Two at lagoon 3, none on rest of farm.

Silver Gull. One still on nest?

21 October All the water and most of the sludge had been taken out of lagoon 3,, which was 2-3 m deep at its deepest. I collected one of the Avocet nests. May Swamp obviously provided an alternative to lagoon 3 for feeding, but not for nesting.

Masked Lapwing. None at lagoon 3, 10 at May Swamp.

Black-fronted Plover. Three at lagoon 3, seven at May Swamp.

Black-winged Stilt. None at lagoon 3, 12 at May Swamp.

Red-Necked Avocet. None at lagoon 3, approximately 100 at May Swamp.

Red-kneed Dotterel. None

Silver Gull. None.

Notes on breeding behaviour of various species

Masked Lapwing 9/7 One of two adults accompanying three downy young almost constantly chased the closest of the 17 Black-fronted Plovers present on the same small (15 x 1-3 m) island; the plovers were slightly larger than the young. The young themselves were unperturbed. The Silver Gulls, which kept more distance, were not bothered by the adult Masked Lapwing.

Black-fronted Plover 15/9 Nest was 1.5-2 m away from nearest Red-necked Avocet and Black-winged Stilt nests (A9 and S3), which were occupied at the same time as the Plover nest.

3/10 Nest-relief observed.

Black-winged Stilt 15/9 Brooding bird relieved by partner at about 1400. Nest relief in this species is also reported in Cramp and Simmons (1983).

28/9 The two downy young were pale yellowish-grey, with a small dark pattern on the wing area, a long straight stoutish apparently black bill, and long pinkish legs. They were rather like the young Red-necked Avocets, as mentioned in Cramp and Simmons (1983), except for their legs.

6/10 Nest mound of S3 composed mainly of gravel, 20 cm external diameter, approximately 4 cm high. In Cramp and Simmons (1983) and Urban *et al.* (1986) mention is made only of vegetation as a nesting material: aquatic vegetation did not seem to be readily available at the Sewage Farm. The external diameter was slightly larger than that mentioned by Cramp and Simmons (20 vs, 16-18 cm), possibly due to the approximately 10% slope this nest was on. Nest S3 was 1.5 m away from the nearest Red-necked Avocet nest (no. 9) and a similar distance from the Black-fronted Plover nest: all three nests were occupied at the same time. Johnsgard (1981) in Urban *et al.* (1986) mentions a minimum distance of 30 cm between two nests both of Black-winged Stilts, but no mention is made there, nor in Blakers *et al.* (1984), of distances from nests of other species. Cramp and Simmons (1983) do mention breeding of the Avocet *Recurvirostra avosetta* intermingled with Black-winged Stilts and small *Larus* gulls, but give no distances. Stilt nest S2 at Bendigo was about 20 m from Silver Gull nest G1, which was out on a tree stump surrounded by water and occupied at the same time.

Red-necked Avocet 28/9 Nest 14: One parent was on nest and rose when I approached, approximately 60 m away, along the bank. This exposed two young and two eggs. The young also left the nest, followed their parent to the water near nests 9 and 10, waded, swam, and sheltered under the belly of their parent standing in the water. The young were possibly newly hatched as there were still two eggs in the nest. The young were pale yellowish-grey with a small dark pattern on their wing area, a long black apparently straight bill and what appeared to be grey legs.

3/10 Nest 13: Incubation time may be 18-21 days: In this nest there were two eggs on 15/9, three on 28/9, and two eggs and one young on 3/10. On 3/10 at around 1500 an adult with less-curved bill stood up from nest, other adult with more-curved bill came closer and picked up what looked to be a bit of egg shell (thin, white one side, dark the other, perhaps a few cm across). It ran around with this in its bill on the island for a minute or so, at first chased by the first adult. It then dropped the bit of shell in the water near the shore and appeared to immediately go on to feed, pecking here and there in the water. Approximately 10 minutes later the adult with the less -curved bill got off the nest, and an adult with a more-curved bill (which also had the darkest chestnut chest) made as if to get onto the nest but did not.

Because of its richer colour, I thought the bird with the more-curved bill was a male, the other one a female. Sexual differences in bill shape are mentioned in Cramp and Simmons (1983) for *R.americana* (Hamilton 1975) and are supposed by them for *R.avosetta*. Rogers (1990) gave an exhaustive review of sexual dimorphism in bill shape in avocets, including possible changes in bill shape over time after collection. He concluded that it is likely that, analogous to the situation for *R.americana*, Red-necked Avocets with long flat bills are males. In the incident I described, the fact that the avocet with the more deeply curved bill was also richer in colour may be due to age - rather than sex-differences: it provides little ground for either confirming or contesting Roger's tentative conclusion regarding bill shape and sex in Red-necked Avocets.

Nest-relief is mentioned for *R.avosetta* in Cramp and Simmons (1983). Cramp and Simmons (1983) and Urban *et al* (1986) mention removal of eggshell by *R.avosetta* parents after hatching (immediately after hatching).

6/10 After the nests had been abandoned following the drop in waterlevel, I walked to the former islands to inspect them. Some of the avocet nests were scrapes in the sand, up to 8 cm in diameter, with a ring around them of gravel (up to 2 cm in size, but mostly much smaller) and of small bits of twig (<5 cm long, < 5 mm diameter). This gave the impression of small mounds several cm's high, and 15-20 cm in diameter, with a scrape in the centre. Kalas (1974 in Cramp and Simmons 1983) mentions an average diameter of the scrape of *R.avosetta* of 11-13.5 cm, but does not mention mound diameter. Gravel is mentioned as mound material for *R.avosetta* as "occasionally little or no material, or a few small stones or shells" (Cramp and Simmons 1983): rather a contrast with the use of gravel by the Red-necked Avocets at Bendigo. Cramp and Simmons also mention that the nesting material may be brought from some metres away. The inferred incubation time of between 18 and 21 days by and large agrees with the incubation time mentioned by Cramp and Simmons (1983) of 23-25 (20-28) days for *R.avosetta*. Cramp and Simmons (1983) also mention the young of *R.avosetta* are nudifugous, as observed for the Red-necked Avocets at Bendigo.

Minimum distance between two avocet nests was 1.6 m (between centres, nests 7 and 8), between an avocet nest and a stilt nest 1.5 m (nests 9 and S3), and between an avocet nest and a Black-fronted Plover nest (nests 9 and B1) also about 1.5 m. Cramp and Simmons (1983) do mention breeding of the Avocet *Recurvirostra avosetta* intermingled with Black-winged Stilts and small *Larus* gulls, but give no distances. Avocet nest no.15 was about 8m from Silver Gull nest G1 and occupied at the same time (see Table 2). None of the intra and inter-specific aggressive behaviour mentioned by eg. Makkink (1936 in Cramp and Simmons 1983) for *R. avosetta* was observed for the Red-necked Avocets on the Bendigo Sewage Farm.

Where the slope of the sand was greater, the mounds of gravel and bits of twig were larger, so as to make a flat spot for a scrape, and the scrapes were actually in the mounds themselves, rather than in the underlying sand. Nest 6 was on the steepest slope (10-13%) and was 35 cm across, with a maximum height difference between the lowest and highest parts of the mound of 4-5 cm. On 21 October I collected this mound. It proved to contain 2.01 kg of gravel (mostly quartz and some bits of gravel-sized glass) and bits of twig and bark. I sampled and counted the mound material as follows.

gravel >2 mm: 300 pieces = 65 g, or 46 pieces per 10 g.

small gravel and bark: 300 pieces = 10 g.

large pieces of gravel: 115 pieces = 65 g, or 18 pieces per 10 g.

gravel >3-4 mm: 190 pieces = 65 g, 250 pieces = 95 g: 27-29 pieces per 10 g.

In all 1155 pieces of gravel and bark were counted, weighing a total of only 290 grams. If the sample of gravel >2 mm gave a good average for the whole mound, there would have been about 9250 pieces in the 2.01 kg of mound material, with an average weight of 0.271 g. Assuming all these pieces were quartz with a relative density of 2.65 (and many were much lighter pieces of twig and bark), the pieces would have averaged approximately 4x4x5 mm in size. From inspecting the mound material, this calculated average size seemed to me to be larger, if anything, than the actual average size. It therefore seems safe to say that this mound was made up of more than 10,000 pieces of gravel, twig and bark. Given that most of the pieces must have been collected outside the pecking distance of a brooding Avocet, many perhaps even off the island, the Avocets have gone to a lot of trouble to build their nest mound!

Acknowledgements

I would like to thank the Bendigo Water Board for permission to visit their property. The Bird Observers Group of Bendigo Field Naturalists Club was always a source of inspiration, even if I could spend much less time with them than I would have liked. The friendship of many members of the AWSG and VWSG during my times in Australia is also much appreciated. Richard Loyn gave advice on possible relocation of nests. Rosemary Stern kindly and expertly draughted the figures.

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HOT NEWS FROM A HOT PLACE: FEEDING ECOLOGY STUDIES ON KNOTS AND OTHER WADERS IN BROOME, NORTHWEST AUSTRALIA, SPRING 1991

by Ingrid Tulp & Petra de Goeij

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Introduction

Imagine being a wader and having your annual urge to wander north for thousands of kilometers to breed. What would determine your travel scheme? Where would you go to buy your food supplies on the way north? Would you prefer a shop nearby with expensive food or one further away with lots of bargains? And how about the temperature, do you like an airconditioned shop or don't you care? Is 38°C and a humidity of nearly a 100% no big deal for you? Such are the questions that waders face. The more we thought about these problems, the more we became interested to find out ourselves about how waders solve them.

Almost half a million waders were counted in Northwest Australia during wader expeditions mounted by the Royal Australasian Ornithologist Union (RAOU) in the non-breeding seasons 1981-85, and subsequent hard work has shown the area to be of critical importance as a fuelling and refuelling site for even larger numbers of southward and northward bound waders. The area harbours over half the entire wintering population of Great Knot *Calidris tenuirostris*, a species until recently considered endangered since it was rarely seen (it winters at so few sites!). The wader-catching expeditions have recently led to the proof that several species of wader cover the 5500 km between Northwest Australia and the delta of the Yellow River near Shanghai, China, in one flight. This distance must be the longest direct flight of waders now firmly established, and leads one to wonder why all these birds don't stop and use the intertidal areas available in the South-east Asian archipelago en route? The use of only a few staging sites in spring also implies that those areas are especially critical for the survival of the birds.

The outstanding importance of the Roebuck Bay (Broome) and Eighty Mile Beach areas, the relative scarcity of information about the birds and the habitats, and the realisation that the formulation of how to protect chains of unique but fragile wetlands ultimately depend on sound biological insights, have led the RAOU to establish the Broome Bird Observatory. BBO is reasonably facilitated and located right on the spot, in a climate which is otherwise not exactly easy for humans (and waders?) to work in, but thereby of considerable biological interest. As such, the observatory is uniquely situated for studies on the ecology of coastal wetlands and migrating waders in an extreme, tropical, environment.

That is why we wanted to go to Broome and start to reveal some of the ecological links between Roebuck Bay's intertidal resources and the migratory wader populations, thereby working on the outlined migratory mysteries at large. In view of our own experience in The Netherlands, and the existence of an important body of comparative knowledge from elsewhere, we concentrated our efforts on the two knot species, the Red Knot *Calidris canutus rogersi* and the Great Knot. We also did some work on Bar-tailed Godwits *Limosa lapponica*, Whimbrels *Numenius phaeopus* and Eastern Curlews *Numenius madagascariensis*. The project was carried out in close cooperation with the AWSG and the RAOU and was supervised by Theunis Piersma from the Netherlands Institute for Sea Research (NIOZ) and Prof. J. Mike Cullen from Monash University, Victoria.

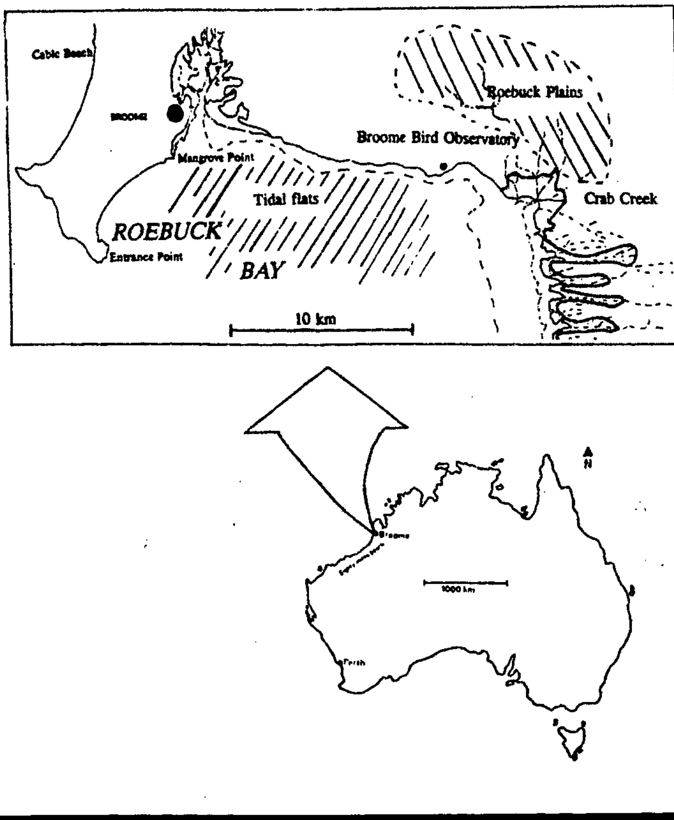
The Broome Bird Observatory, situated so close to the area of field-work in Roebuck Bay, offered an ideal working base. The study area comprised a 10 km stretch of beach and the adjacent tidal flats (Figure 1). We were based at BBO between 27 February and 13 May 1991, thus covering the entire period of spring migration.

Preliminary Results

Changes in numbers and roost-site use

Waders in Roebuck Bay were counted every fortnight, during high water. In a restricted area of tidal mudflat, low water counts were also done. We kept records of all migratory departures of flocks of waders. Simultaneously, Steve McChessney documented the aerial migration tracts of waders by the weather radar at the meteorological station in Broome.

Figure 1. Locality map to indicate the study area near the Broome Bird Observatory in Roebuck Bay, Northwest Australia.



On 6 March, the total number of waders counted during high tide on the beaches of Roebuck Bay was 9700. On 22 March it was 5000, and on 4 April 3000. On 5 May we counted only 1000 waders. Most abundant in March were Bar-tailed Godwits (max: 3730), Great Knots (3635), Red Knots (503) and Large Sand Plovers *Charadrius leschenaultii* (660). The decline in numbers corresponded with the visible departures of waders during the period 29 March- 20 April. Largest numbers of waders were observed to leave northwards on 9 April, when 1600 birds took off in six flocks. On the radar screen these flocks didn't show up since they departed over land, whereas the radar screen only covers the area over open sea.

During very high tides, roosting waders tended to leave the beach, flying to the saltmarshes on the Roebuck plains. In spring 1991 the plains were very wet because of abundant rainfall. However, many times during lower high tides, the birds flew to the plains as well. We have strong evidence that this is caused by disturbance on the beach by fishermen and sunbathers. Obviously, such disturbances strongly affect the results of high tide counts. On 4 April during high tide, we counted only one Great Knot and 13 Red Knots in the whole of whole Roebuck Bay. One day later during low tide, 100 Great Knots and 640 Red Knots were seen. These, and observations on waders flying to the plains after being disturbed from the beach, made clear that the high tide counts usually yield underestimates of the total number of waders using the tidal flats in Roebuck Bay.

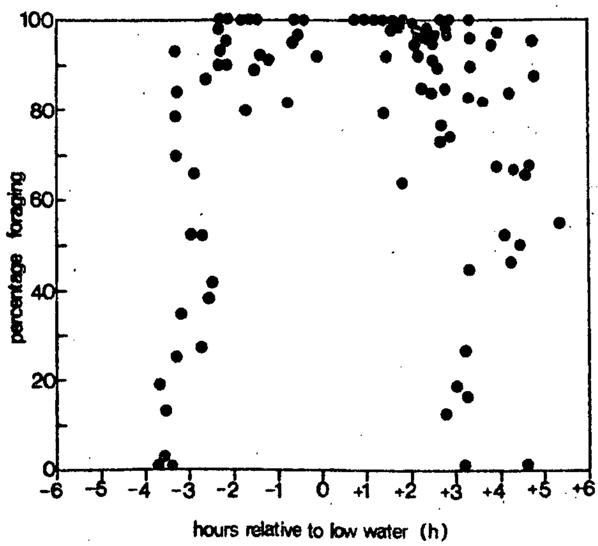
Time budgets

When observing the behaviour of feeding and roosting waders we used telescopes and tally counters. The birds were approached as closely as possible on foot. Records of the birds' behaviour involved different types of observation: activity scans and continuous observations. Activity scans on groups of birds were used to determine changes in foraging activity in the course of the day and the tidal cycle. During entire low water periods, groups of waders were scanned every 15 minutes and the activity (forage, rest, preen) of each bird scored. Figure 2 shows the results of our activity scans of Great Knots in March 1991. Great Knots (and Red Knots as well) started foraging as soon as the water retreated. Great Knots were actively foraging during the entire low water period. Sometimes, during neap-tides, birds continued to feed during the whole day, resting around noon.

Diets

Continuous observations were used to record the behaviour of an individual bird as accurately as possible. Such protocols included: - a record of the number of prey items eaten per unit time (if possible differentiated per prey species), - an estimate of the size of prey items captured, and - a record of the time spend foraging. After a group of knots had been observed and had moved elsewhere, droppings were collected and dried for further examination (see elsewhere in this issue of *Stilt*).

Figure 2. Tidal changes in foraging activity of Great Knots on the intertidal flats of Roebuck Bay in March 1991. Each data point is based on a scan of at least 50 individuals.



At home in the Dutch Wadden Sea, Red Knots mainly subsist on bivalves. In Roebuck Bay, we saw Red Knots eating bivalves only occasionally. They mostly ate very small, and hence rather unidentifiable, prey items. Great Knots ate different kinds of prey. Their diet includes bivalves, small crabs, but also small and unidentifiable prey-items (probably worms).

Benthic prey availability

Benthic macrofauna-samples were taken with a core and sieved through an 0.5 mm sieve. The sample locations were spread over the feeding- as well as the non-feeding areas. Sieving was done on the spot by digging a hole in the mud, which then filled up with water, to get rid of the wet sediment in the sieve. Sorted samples were dried in an oven for two days at 60°C, and have been taken to NIOZ to be incinerated and the ash-free dry masses thus to be determined.

Sampling was quite exhausting. Friends who helped during this part of the fieldwork will not easily forget the soft and sticky mud! The density of bivalves appeared to be low (usually less than 100 ind./m^2), but some interesting bivalve species (from the knots' perspective) were encountered. Three species with very thin and breakable shells are good candidates as knot-food, because knots swallow the whole shell and have to break the shell in their stomachs. Our measurements of the depth of living of these animals suggests that they are in fact more tractable for the long-billed Great Knots than the relatively short-billed Red Knots. Additional potential prey were small sea-cucumbers living close to the surface, and polychaete worms.

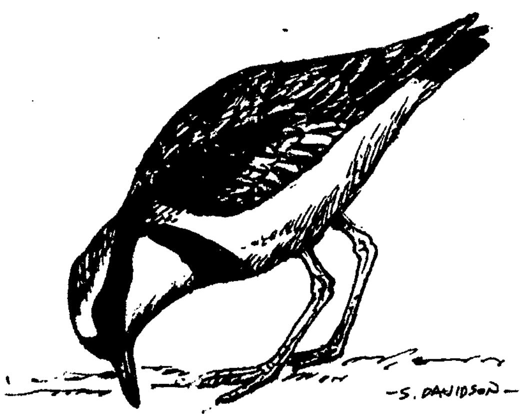
Discussion

So shortly after our Australian research experience, and before the hard work of getting things out of the lab, into computers, analysed, digested and provisionally written up, there is little hard data to report yet. However, we have been strongly strengthened in our belief that BBO provides a unique site and facility to learn about the ecological adaptations of waders preparing for a very long-distance migration in a hot and humid environment. It was interesting to discover the differences in diet between Red Knots in Europe (and in New Zealand, see Piersma, this issue) and in North-west Australia. Are such dietary differences due to differences in prey availability or due to foraging decisions taken by the predator? Is the feeding on bivalves by Great Knots facilitated by its longer bill compared to Red Knots? One thing became clear to us: since the mud in Roebuck Bay is very soft and extremely difficult to walk on (in), it was impossible to follow the knots all the way to the waters edge. Observations from a boat could bring practical progress in future studies.

We very much hope that our bit of work can help the ecological research on migrant wader populations at the Broome Bird Observatory to be developed further. BBO is perfectly located at a strategic hot spot on the wader flyway map!

Acknowledgements.

Of course we start with Theunis Piersma, who really wanted to have this research done, and helped us to get to Broome in every way he could. Next we want to thank the NIOZ-management, who made it finally and financially possible for us to go. Without the help of many other people the work couldn't have been done. The physical or psychological support of the Wardens of BBO, Gail & Brice Wells and Kira & Stuart Jackson, was essential during the hot and mosquito-rich days and evenings. We would also like to thank Steve McChessney, Ann & Alastair Cuthbert, David & Alle Penteloo, Danny Rogers and Nick Dunlop for their help and hospitality. We thank Shirley Slacksmith for her advice about the bivalves and for identifying bivalve species, and Stuart Halse and Grant Pearson for help in Perth. Finally we should not forget Doug Watkins and Mark Barter, who helped so much at the start and finish of our Australian stages. Apart from NIOZ, we are being financially supported by funds in The Netherlands and England. These will be listed at a later stage.



LONGEVITY, BREEDING SUCCESS, AND FAITHFULNESS TO WINTERING SITES OF WRYBILL - AS SUGGESTED BY BANDING DATA

Stephen Davies on behalf of Miranda Banders

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The Wrybill *Anarhynchus frontalis* is a wader endemic to New Zealand with a population of about 5,000. The birds breed on braided rivers in Canterbury and North Otago (South Island), mainly between September and January. The wintering areas lie mainly 600-800 kilometres to the north, on the Kaipara and Manukau Harbours and at the Firth of Thames (North Island). The largest concentration, a flock of 2,000 or more birds, is found in the Miranda area on the Firth of Thames. The first migrants head south in late July and north in late December. Only very small numbers remain on the wintering grounds during the breeding period.

Nineteen Wrybill were banded at Jordan's Farm (Kaipara Harbour) in February 1981. More recently, at the same site, Miranda Banders has had catches of 4 (on 31/01/87), 190 (on 19/02/88), 11 (on 03/02/91) and 43 (on 17/03/91). The wintering flock at Jordan's Farm typically contains 100-200 birds. In addition, on 20/04/91, 5 birds were captured near Miranda, where fourteen hundred had been banded in 1979-81.

Generalising from the data obtained from catches can be dangerous, both because the birds captured may not be representative of those at the site and because the birds at the site may not be representative of the wider population. Note, however, that about 66% of the birds present at Jordan's Farm in 1988 and in 1991 were captured and that Hay (1984) concluded both that the age structure at the different wintering sites was uniform and that birds from all breeding areas dispersed to all wintering sites. The data obtained from the recent catches suggests (A) that the birds may be long-lived; (B) that recruitment of young birds to the population may be low; and (C) that the birds may be faithful to their winter site.

(A) One bird, banded as an adult at Jordan's Farm on 08/02/81, was retrapped both in February 1988 and March 1991, so it was not less than **11.5** years old. A further four birds banded on the same date were retrapped in February 1988. Three of these were banded as adults and retrapped at not less than **8.5** years of age; the other, banded as a juvenile, was retrapped at **7.5** years of age. That is, more than one quarter of the birds banded at Jordan's Farm in 1981 were alive seven years after banding and at least one of these birds survived a further three years. All (four) birds captured in January 1987 and aged as adults were retrapped one year later and one of these was also recaptured in March 1991 at age of not less than **5.5** years. 19 of the birds banded in February 1988 were recaptured in 1991. All were banded as adults and retrapped at an age of not less that **4.5** years. A further four birds captured in March 1991 were banded either in February

1981, late January 1987, or February 1988. In these cases abrasion had obliterated at least one band number, so the individual could not be identified with certainty.

Two birds banded in the South Island were captured during the period. One, banded breeding on the Lower Rakaia River in September 1986, was captured on 19/02/88. The other, banded breeding at Lake Tekapo in October 1986, was captured in both 1988 and 1991. It is agreed in the literature that first-year birds do not breed. Johnsgard (1981), quoting Hay, suggests that breeding may not take place until the bird's third year. So the first bird was controlled at an age of not less than 3.5 years and the second at an age of not less than 6.5 years.

Hay (1984) calculated that adult birds have a mean expectation of further life of more than five years. The retrap data provided confirms that many adults attain an age of five years or more, with some birds living beyond ten years. About 5% of the wintering flock at Miranda wear bands. Probably many of these birds first were banded in 1980-81, so ages of more than ten years may not be exceptional in the species. One bird, banded as an adult at Miranda on 07/06/80 was retrapped there on 20/04/91 at an age of not less than 12.5 years. For a small plover, the Wrybill appears to be unusually long-lived.

(B) Wrybill adults complete a post-nuptial, full moult on the wintering grounds, but first year birds do not (Hay 1985). Most adults do not complete the moult until late April. This, along with feather abrasion, provides the most reliable ageing criterion. The suggestion in Hayman, *et al* (1986) that first-year birds may retain white fringes to inner coverts through the first year is not supported by the birds we have caught.

Only 13 of the 179 unbanded birds caught in 1988 were aged as first-year. Of the 54 birds trapped three years later, only 24 were unbanded. Of these 24, only three were aged as first-year. The five birds captured in April 1991 were all adults. These figures suggest a low rate of recruitment to the population. Perhaps this should not be surprising - the clutch size is two, though two successful nests can be produced each season.

(C) Hay (1984) found that adults were faithful to their wintering sites, while juveniles were (perhaps) more inclined to transience. Our recapture data supports the claim that there is a high degree of fidelity to wintering areas. None of the Wrybill retrapped at Jordan's Farm had been banded at other wintering sites. A majority of the small flock at Jordan's has been observed to wear bands since the catch of 1988. Jordan's Farm lies about 100 km by direct flight from Miranda where the large wintering flock is found. As indicated above, this flock contains many banded birds. The single bird retrapped near Miranda in April 1991 had been banded there in 1980.

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MARSH SANDPIPERS IN NEW ZEALAND

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While the Marsh Sandpiper *Tringa stagnatalis* is a common migrant to Australia (Lane 1987) it was not until 1959 that the species was discovered in New Zealand (Sibson 1959). Since then there has been a steady trickle of sightings in New Zealand (Appendix 1), with an increase in records in the 1980's. For instance, there were 10 records involving 13 birds from 1959 to 1972 (after which an eight year absence followed), but 18 records involving 24 birds from 1980 to 1988. 22 records were from the North Island and six from the South Island. Most sightings were of single birds, three were of pairs, and two were of groups of four birds. Overwintering had been confirmed on at least five occasions.

It became obvious then, that the 1988-1989 summer was quite an exceptional one, with sightings coming from nine localities, and numbers building up to a group of four birds in the Kaipara Harbour, Auckland (Appendix 2). However, in a country the size of New Zealand, it was possible that movement by the birds could lead to an over-estimate of total numbers present. This paper attempts to determine (as far as is possible) how many Marsh Sandpipers were in New Zealand in 1988-1989.

Table 1 records the monthly distribution of Marsh Sandpipers in the 1988-1989 season. The Firth of Thames bird was a long-staying bird and was assumed to have been present over March to May, although there were no sightings. The Bay of Plenty site was not visited over January and February and the bird was assumed to be present over that period. The maximum monthly count of seven birds occurred in January spread between seven localities. However, the plumage characteristics of birds present in the April to June period produces a higher minimum count.

The four birds present at the Kaipara harbour in April showed no signs of breeding plumage (BP) and hence were first year birds. The bird seen there in May and June could not have been one of those four as to be in breeding plumage in May it would have needed to have commenced moult into BP by April (M. Barter, pers. comm.). Five birds, then, occurred there from April to June. Likewise the Whangarei Harbour bird was also in breeding plumage and so could not have been one of the Kaipara four for the same reason. The Manukau Harbour June bird was in fuller BP than the Kaipara bird so was another individual (pers. obs.).

The total for the April to June period came to nine birds. While there may have been more present, this is the smallest definite number we can account for. It would be tempting to postulate some possible hypotheses about the movements of birds within the country over the summer but without any individual recognition of birds this would be purely speculation.

In Australia birds depart for the breeding grounds in March and April, leaving Port Hedland in mid-April (Lane 1987). They pass through Hong Kong in late March and April (Lane 1987), reaching their breeding grounds in eastern USSR in early to mid-May (Demente'ev & Gladkov 1969). The birds present in New Zealand from April to June, then, were probably first year birds not ready to breed, although the Firth of Thames bird had been present since February 1987 and so would have been at least nearly three years old in June. Prolonged stays by waders are well known in New Zealand, with similarly long stays recorded by Grey-tailed Tattler (Falla *et al.* 1978), Black-tailed Godwit (Heather & Brathwaite 1985) and Greenshank (nine years) (Latham 1986). The latter two even assumed southern hemisphere moult cycles. Perhaps the absence of conspecifics affects their motivational urge to migrate and breed.

To summarise, at least nine Marsh Sandpipers were present in New Zealand over the summer of 1988-1989, being seen at nine main localities. This brings the New Zealand total (1959 to 1989) to 37 sightings of 46 birds. We can only hope that the increase in records over the past decade will continue and the Marsh Sandpiper will become a more regular element of New Zealand's wader fauna.

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Table 1: Monthly Distribution of Marsh Sandpipers, 1988/89 (BP - Breeding Plumage)

	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Maximum	Max Apr-Jun
Northland												1		1	1
Kaipara	1	1	1	1	1	1	1	1	3	3	4	1(BP)	1	5	5
Manukau							1	1	1				1(BP)	1(2?)	1
Firth of Thames	1	1	1	1	1	1	1	1	1(BP)	(?)	(?)	(?)	1(BP)	1	1
Bay of Plenty					1	1	1	(?)	(?)	1				1	-
Lk. Wairarapa								1						1	-
Farewell Spit												1		1	1
Lk. Grassmere								1						1	-
Lk. Ellesmere						1	1	1						1	-
TOTAL	2	2	2	2	3	4	5	7	6	5	5	4	3		9

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Appendix 1

MARSH SANDPIPERS IN NEW ZEALAND 1959-1988

Manukau Harbour-1 March - May 1959.

Firth of Thames-1 on 28/4/63 -
1 September and December 1963

Hawera, Taranaki-1 on 1/11/63

Gisborne-1 "in 1964"

Crowaiti Lagoon, Westport-1 on 5/5/68

Manukau Harbour, Mangere Sewage Ponds-
1 from 11/2/69 to 18/9/69

Kaituna, Bay of Plenty-4 on 5/4/69 -
4 from 25/1/70 to 15/3/70

Gisborne, Whakaki Lagoon-1 on 20/1/70

Napier-1 from 22/1/72 to 12/2/72

Firth of Thames-1 wintered 1980 and 1981

Lake Ellesmere, Canterbury-4 birds 1981-1982

Marfells Beach-1 in February 1983

Westshore Lagoons, Napier-1 from 17/2/83 to 16/4/83
-1 on 12/11/83

Manukau Harbour, Karaka-1 from 29/1/84 to 17/4/84 (pale) -1 from 28/10/84 to 11/4/85

Southland: Awarau Bay-1 on 2/12/84
Waituna Lagoon-1 on 3/1/85 (same bird)

Hawkesbury Lagoon-1 from 6/2/85 to March 1985

Westshore Lagoons-1 from 19/2/85 to 24/2/85

Lake Wairarapa-2 in November 1985

Parengarenga Harbour-2, November/December 1986

Waimango, Karikari Bay, Northland-1 on 29/12/86 and 1/2/87

Lake Half, Northland-1 from 15/11/87 to 4/1/88

Kaituna Cut-2 from 18/3 to 4/4/88 (1 entering breeding plumage), 1 on 9/4/88

Firth of Thames-1 from 1/2/87 to at least 25/6/89

Lake Grassmere, Marlborough-1 Jan-March 1988.

Appendix 2

MARSH SANDPIPERS IN NEW ZEALAND SUMMER 1988/1989

WHANGAREI HARBOUR (NORTHLAND):
-1 bird 10/5/89 (M.P. Kearns)

KAIPARA HARBOUR:
-1 bird 19/11/88 onwards (A.C. Reigan)
-3 birds 18/2/89, 23/3/89 (P.F. Battley)
-4 birds 12/4/89 (no signs of breeding plumage) (P.F. Battley)
-1 bird in breeding plumage 13/5/89, 21/6/89 (R.J. Pierce; P.F. Battley)

MANUKAU HARBOUR:
- Mangere Sewage Ponds, 1 bird 26/12/88 to 15/2/89 (various OSNZ)
- Karaka Shellbanks, 1 bird in extremely good breeding plumage on 6/6/89 (P.F. Battley, A.C. Crossland, P. Schofield)

FIRTH OF THAMES:
-1 bird present since 1987, seen on 27/2/89 (entering breeding plumage), then not again until 25/6/89 (P.F. Battley *et al.*)

BAY OF PLENTY:
- Kaituna Cut, Maketu, 1 from 30/10/88 to 27/3/89 (P.C.M. Latham, DDM)

LAKE WAIRARAPA:
-1 bird 2/1/89 (B.D. Heather)

FAREWELL SPIT:
-1 bird in non-breeding plumage on 5 & 6/6/89 (W.F. Cash)

LAKE GRASSMERE:
-1 bird on 21/1/89 (C.M. Miskelly)

LAKE ELLESMERE:
-1 bird from 19/11/88 to 24/1/90 (A.C. Crossland *et al.*)

RED KNOTS IN NEW ZEALAND EAT MOLLUSCS TOO: PRELIMINARY DIET OBSERVATIONS AT MIRANDA, FIRTH OF THAMES AND FAREWELL SPIT IN NOVEMBER 1990

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Abstract

In November 1990, Red Knots *Calidris canutus rogersi* were studied for a couple of tides at Miranda, Firth of Thames, North Island, and at Farewell Spit, South Island, New Zealand. At both sites they foraged in flocks of 20-100 birds with nearest neighbour distances of 7-10 bird lengths. Both study areas harboured abundant bivalve communities with high densities of suitable prey available in the upper layer of the sediment. An analysis of 50 droppings showed that Knots fed mainly on a few thin-shelled bivalve species (*Myadora*, *Tellina* and *Nucula*) ranging in length from 3-15 mm. A common but thicker-shelled species (*Chione*) was less frequently preyed upon. At Farewell Spit, trochid gastropods were also taken. A possible selection for relatively small prey is discussed.

Introduction

Red Knots *Calidris canutus* breed on high arctic tundra around the Arctic Ocean and spend the northern winter at a variety of latitudes on all continents. This global distribution does not imply that Red Knots can be found anywhere. In contrast, they are only found in well defined habitats. When not breeding, their world is one of spacious intertidal sandy flats, and sometimes of extensive intertidal rocky shores, on which they forage during low tide. During high tide they retreat to roost on sand bars, rocky outcrops or, if nothing else remains available, wide open patches in salt marsh or mangrove. Their non-breeding diet, collected on the intertidal flats, is well known to consist usually of small bivalves and gastropods (Cramp & Simmons 1983), although in at least one tropical wintering area in West Africa they commonly feed on other small prey as well (Zwarts *et al.* 1990). However, studies of the diet of Knots are rather biased to one subspecies (*C.c.islandica*) and to northwest Europe (Prater 1972, Goss-Custard *et al.* 1977, Evans *et al.* 1979, Boere & Smit 1980, Warnes 1981, Summers & Smith 1983, Davidson & Evans 1986, Piersma *et al.* 1991a, Zwarts & Blomert MS). With a geographically biased but extensive comparative database available, it is therefore of interest to find out whether the prey choice of Knots wintering in the southern hemisphere would be similar. I have grasped the opportunity during a tour through the North and South Islands of New Zealand in advance of the XXth IOC in Christchurch, in November 1990.

Study sites and methods

The 50 000 or so Red Knots of the subspecies *rogersi* spending the northern winter in New Zealand, are mainly found in the following six estuarine areas: Parengarenga, Whangarai, Kaipara, Manukau and Firth of Thames on the North Island and Farewell Spit on the South Island (Parish *et al.* 1987, Sagar 1987, 1989, Barter 1991; P.M.Sagar pers.comm.). That the distribution of Knots along the New Zealand coastline is much more restricted than that of the other common high arctic migrant, the Bar-tailed Godwit *Limosa lapponica*, probably reflects the limited extent and abundance of suitable sandy habitats (P.M.Sagar pers.comm.; pers.obs.).

Knots were studied at two sites. On 9 and 10 November 1990, I visited the Firth of Thames coast near Miranda (175°20'E, 37°13'S), and surveyed the coastal stretch between Wharekawa and Pukorokoro Creek. Detailed observations on Knots and sediment samples containing the available prey were collected during the morning low water period (0630-1000) of 10 November on the sandflats 1000-1500 m eastward of the seawall, at a point 2 km south of Kaiaua. On 24 November 1990 I visited the base of Farewell Spit (172°44'E, 40°05'S). Between 1100 and 1300, a few hrs before high tide, observations on Knots were made 700 m offshore from Puponga Farm.

At both sites I walked up to the feeding flocks of Knots (approachable to 150-200 m) and tried to observe (with 10 x 40 binoculars) any ingested prey. After a flock had moved, I visited their previous feeding area and collected droppings. Near Miranda I managed to collect 30 droppings and at Farewell Spit 20. At both localities I dug extensively by hand in the sediment to locate available benthic species. Some of these were collected. In addition, at the Firth of Thames, I took 20 circular sediment samples to a depth of 6 cm with an opened and empty tomato-can covering 1/226 (0.0044) m^2. These sediment samples were then sieved through a mesh of c. 1 mm^2. Back at the camp site, the droppings and the collected benthic animals were slowly dried in a frying pan and stored in an airtight plastic container.

A month later in The Netherlands, the well-preserved and apparently dry material was dried at 50°C for a day. The benthic animals were sorted as to size and species (the delightful book by Morton & Miller 1973 providing much help), and subsequently weighed and incinerated at 550°C to determine ash masses, and, by subtraction from dry mass, ash-free dry masses (AFDM). I determined ash mass in addition to AFDM, since their ratio is the relevant parameter to estimate ingested biomass from faeces-related parameters (see below). The dried droppings were analysed according to the methods outlined by Dekinga & Piersma (MS). Briefly, the dry mass fraction retained on a 0.3 mm sieve was weighed and the fragments sorted to species. Recognizable hinges of bivalves were measured and the ingested shell lengths reconstructed. The composition of the faeces retained on the sieve in terms of ash and AFDM was determined by incinerating a sample from each site at 550°C.

Results

General observations

Miranda - Starting from the shell beach 2 km south of Kaiaua, the first 100 m of intertidal flat consisted of undulating 5-10 cm deep soft mud, but further offshore the substrate was hard. For the first 1 km offshore the sediment contained a lot of shell-material. Further on east, where I encountered the Knots, the sediment was more like pure sand. There was no seagrass cover. The c. 800 Knots which were within seeing distance moved around in (small) flocks of 20 to 100 individuals. Such flocks also contained Bar-tailed Godwits and the Knots foraged rather far apart, with nearest neighbour distances of 8-10 bird lengths. The Knots fed intensively and no birds were observed preening, bathing or roosting. They were continuously sewing the upper layer of sediment and paced at rather low rates; both these features indicate that they were locating their prey by touch. The Knot flocks could be approached to 150-200 m before they flew up, which equals the flight distances for single calmly moving observers in the Dutch Wadden Sea (pers.obs.). With the available equipment it was impossible to observe prey being ingested.

Farewell Spit - East of Puponga Farm the flats were rather sandy with a light cover (5-25%) of the seagrass *Zostera nana* (Latin name after Morton & Miller 1973). At first only flocks of Bar-tailed Godwits were spotted, but one mixed flock of 50 Bar-tailed Godwits and 150 Knots was encountered. Nearest neighbour distances averaged c. 7 bird lengths, and all were feeding intensively in a similar manner as at Miranda. Although the sediment contained empty shell remains, there was less than at the inshore zone at Miranda.

Benthic prey

Miranda - The sediment sampling carried out 1.5 km offshore indicated a density of 2610 ind./m^2 of the small asymmetrically shelled bivalve *Myadora boltoni*. Additionally, another small bivalve, *Nucula hartvigiana*, occurred in estimated densities of c. 500 ind./m^2. The larger bivalve *Tellina liliana* occurred in the same mudflat at even lower densities. On the surface the carrion eating and carnivorous snail *Cominella glandiformes* was abundant. In the sandy "*Myadora*"-area, sand dollars *Arachnoides zelandiae*, with diameters between 3 and 7 cm, were abundant just under the surface. They covered perhaps 10% of the sediment area, which was thus unavailable to probing Knots and Bar-tailed Godwits.

Farewell Spit - Close to the shore, the "cockle" *Chione stutchburyi* dominated the benthic fauna in high densities, estimated at 2000+ ind./m^2. Further offshore where the Knots fed, the tellinid bivalve *Tellina liliana* was dominant and very abundant, with a large range of sizes (5-20 mm shell length) occurring close to the surface of the sediment (within 5 cm). *Cominella* was regularly observed and the beautiful slender gastropod *Maoricolpus roseus* (Turritellidae) spotted a few times.

Biomass - The relationships between maximal shell length and ash or AFDM in *Myadora, Tellina* and *Chione* are documented in Figures 1-3. *Myadora* and *Tellina* are both thin-shelled and flat, and have pretty much the same length-dependent composition in terms of AFDM and ash (the latter an indicator of relative shell mass). Together they contrast with *Chione*, which is much rounder. It also contains much more ash (calcimass) at the same shell length. Working from the size distribution of *Myadora* encountered at Miranda (Figure 6), the AFDM-size relationship given in Figure 1 and the average density of 2610 individuals/m^2 given above, the biomass of *Myadora* works out at 7.28 g AFDM/m^2. Since they probably all occur in the upper 3 cm of the sediment (pers.obs.) and are thus pretty well available for Knots with a bill length of 3.3 cm (Barter *et al.* 1988), this equals the minimum (no *Nucula* incorporated) available biomass at this site.

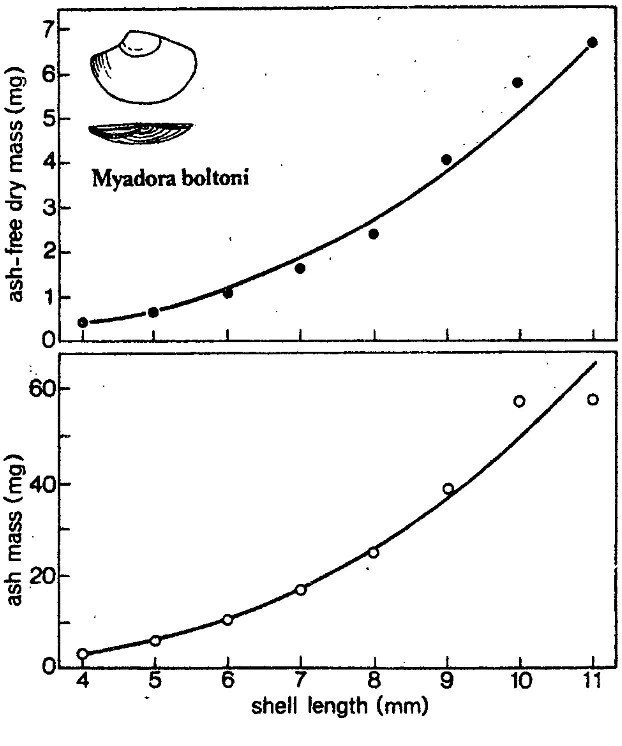


Figure 1. Mass-size relationships in *Myadora boltoni* from Miranda. The relationship between ash-free dry mass (AFDM, mg) and shell length (SL, mm) is best described by AFDM=0.00666·SL$^{2.873}$ (r^2=0.99, based on 193 specimens in 8 length classes) and indicated by the line in the top panel. The relationship between ash mass (ASH, mg) and shell length is best described by ASH=0.06081·SL$^{2.906}$ (r^2=0.99), and given by the line in the lower panel. The upper drawing is of the outside of the concave valve, the lower one gives a sideview.

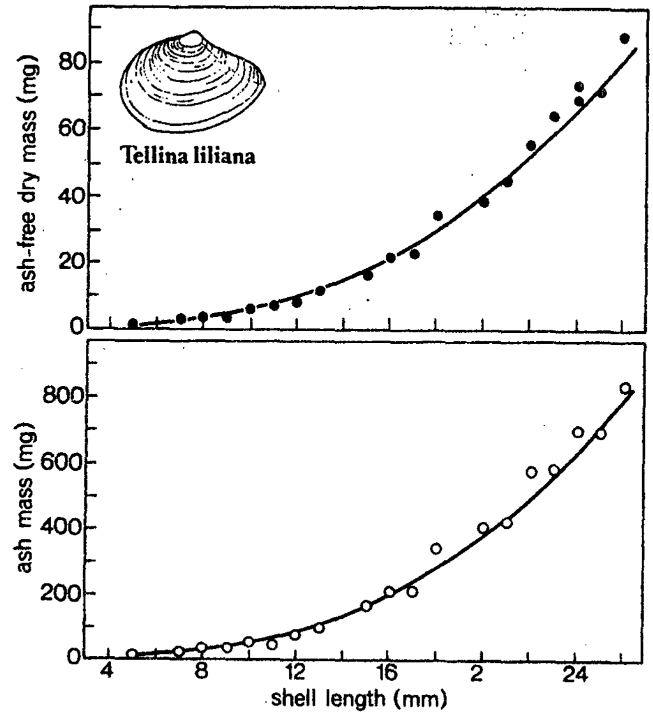


Figure 2. Mass-size relationships in *Tellina liliana* from Farewell Spit. The relationship between AFDM (mg) and shell length (SL, mm) is best described by AFDM=0.01074· $SL^{2.741}$ (r^2=0.99, based on 55 specimens in 19 length classes) and indicated by the line in the top panel. The relationship between ash mass (mg) and shell length is best described by ASH=0.07876· $SL^{2.831}$ (r^2=0.99), and is given by the line in the lower panel.

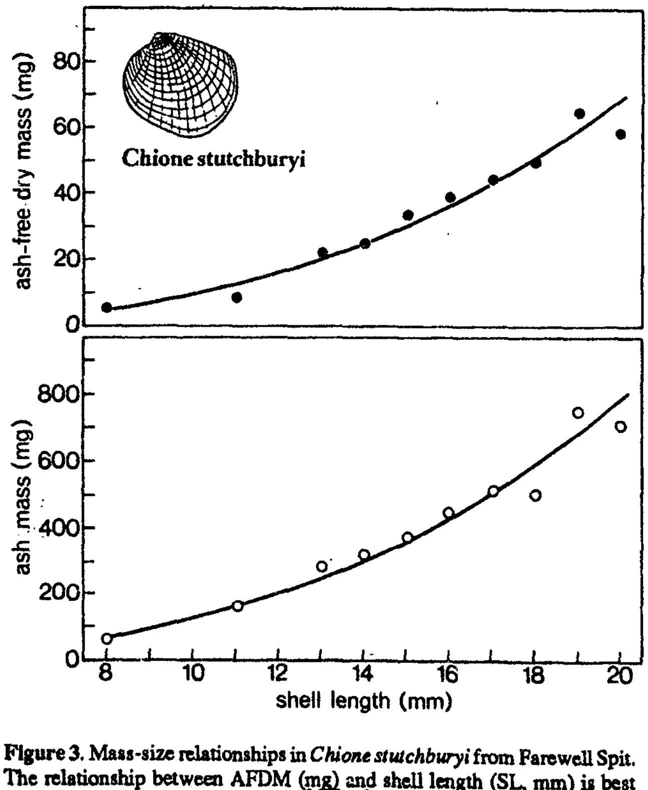


Figure 3. Mass-size relationships in *Chione stutchburyi* from Farewell Spit. The relationship between AFDM (mg) and shell length (SL, mm) is best described by AFDM=0.01304· $SL^{2.860}$ (r^2=0.96, based on 19 specimens from 10 length classes) and indicated by the line in the top panel. The relationship between ash mass (mg) and shell length is best described by ASH=0.25239· $SL^{2.685}$ (r^2=0.98), and is given by the line in the lower panel.

Analysis of droppings

The droppings of Knots consisted almost entirely of ash (Table 1), most of which must have been shell remains. At both study sites the diet appeared to consist entirely of molluscs, with no remains of other taxonomic groups encountered (Table 1). At Miranda, *Myadora* dominated as strongly in the diet of Knots as it did in the local benthic bivalve community. At Farewell Spit the bivalve *Nucula* and one or two species of trochid gastropods were eaten. *Tellina* featured in the diet at both sites. In spite of their abundance, very little of *Chione* was found in the droppings from Farewell Spit.

Table 1. Results of an analysis of droppings of Red Knots collected at two sites in New Zealand in November 1990. The 'gastropods' refer to two species of Trochidae: *Micreleuchus tenebrosus* and *Diloma subrostrata*. See text for methodological explanations.

Variable		Miranda	Farewell Spit
number of droppings		30	20
dry (shell) mass retained on 0.3 mm sieve		4.57 g	1.76 g
ash content of this shell mass		96.8 %	96.3 %
shell mass composition:	*Myadora*	90 %	0 %
	Nucula	5 %	35 %
	Tellina	5 %	15 %
	Chione	0 %	15 %
	gastropods	0 %	35 %
estimated ingested ash mass		4.46 g	1.72 g
estimated ingested AFDM		0.46 g	0.17 g
AFDM/dropping		15.3 mg	8.3 mg

Building on a large series of experiments with captive Knots fed different types of mollusc prey, Dekinga & Piersma (MS) showed that, to estimate the amount of ingested ash mass, the mass-fraction of dry faeces retained on a 0.3 mm sieve has to be multiplied by a factor of 0.977. To estimate the biomass-equivalent of the analysed droppings, we must multiply the estimated ash mass by the ratio of AFDM and ash mass. These ratios are 0.103 for *Myadora*, 0.108 for *Tellina* and 0.084 for *Chione* (overall averages computed from data presented in Figures 1-3 and summarised in Figure 8). Since at Miranda almost only *Myadora* was taken, we used a ratio of 0.103 to arrive at a total of 0.46 g AFDM in 30 droppings collected there, or 15.3 mg AFDM per dropping. Assuming that the molluscs preyed upon at Farewell Spit had a slightly lower AFDM/ash-ratio than at Miranda, we used a ratio of 0.1 to arrive at an ingested biomass of 0.17 g AFDM, or 8.3 mg AFDM per dropping. These biomass equivalents of droppings are much lower than those in the Wadden Sea in the period August-October, when monthly averages vary between 32.5 and 37.2 mg AFDM/dropping with the Knots feeding on a tellinid bivalve, *Macoma balthica*, and a small gastropod, *Hydrobia ulvae* (Dekinga & Piersma MS). The data presented by Zwarts & Blomert (MS) for Knots feeding on *Macoma* in August, allow a biomass equivalent of 37.6 mg AFDM/dropping to be estimated. Since the sieved shell masses per dropping (152.3 mg at Miranda and 88.0 mg at Farewell Spit; computed from Table 1) are in the same range as for the Wadden Sea (100-250 mg; Dekinga & Piersma MS) the low biomass equivalents in New Zealand may therefore be due to a relatively low meat content in the local prey of Knots and not to a less complete collection of droppings. Alternatively, Knots in New Zealand just produce smaller droppings.

For both *Myadora* and *Tellina*, there was a high correlation between hinge height (measurable in the shell remains of the droppings) and shell length (Figures 4 and 5). A careful search under a binocular microscope through the faeces-fractions retained on the 0.3 mm sieve revealed 64 measurable hinges of *Myadora* and 14 of *Tellina*. In the case of *Myadora* from Miranda, it was possible to compare the size distribution of apparently ingested bivalves with that of those collected on the feeding grounds (Figure 6). Knots do not eat the smallest or the largest available *Myadora*. (Note that only a part of the top, the actual hinge, is measured, and that therefore even hinges of the smallest *Myadora* should have remained on the 0.3 mm sieve. Note also that in similar prey types of Knots in Europe there is no size dependent hinge loss in the digestive tract, Dekinga & Piersma MS.) Knots ate *Tellina* with lengths between 5 and 15 mm, average 9.6 mm (Figure 7).

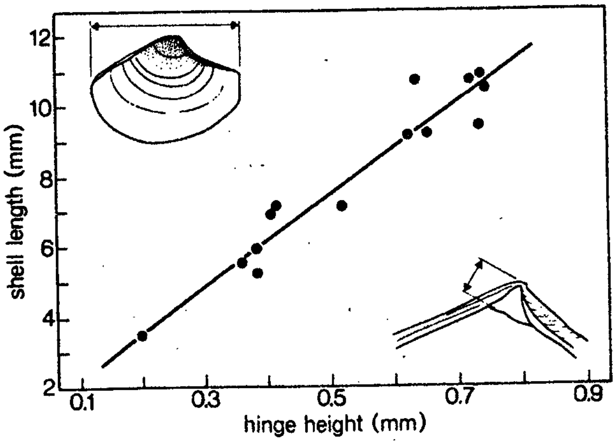


Figure 4. The estimation of shell length (SL, mm) on the basis of hinge height (HH, mm) of the concave valve of *Myadora boltoni* from Miranda. The linear regression line is given by SL=13.167• HH +0.920 (r^2=0.93, n=15).

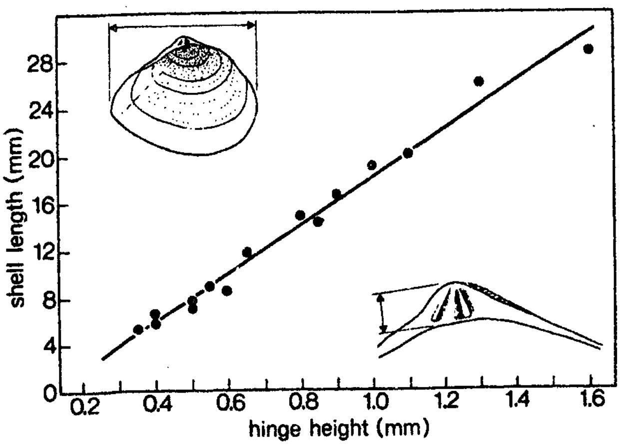


Figure 5. The estimation of shell length (SL, mm) on the basis of hinge height (HH, mm) in *Tellina liliana* from Farewell Spit and Miranda. The linear regression line is given by SL=20.145• HH -2.138 (r^2=0.98, n=15).

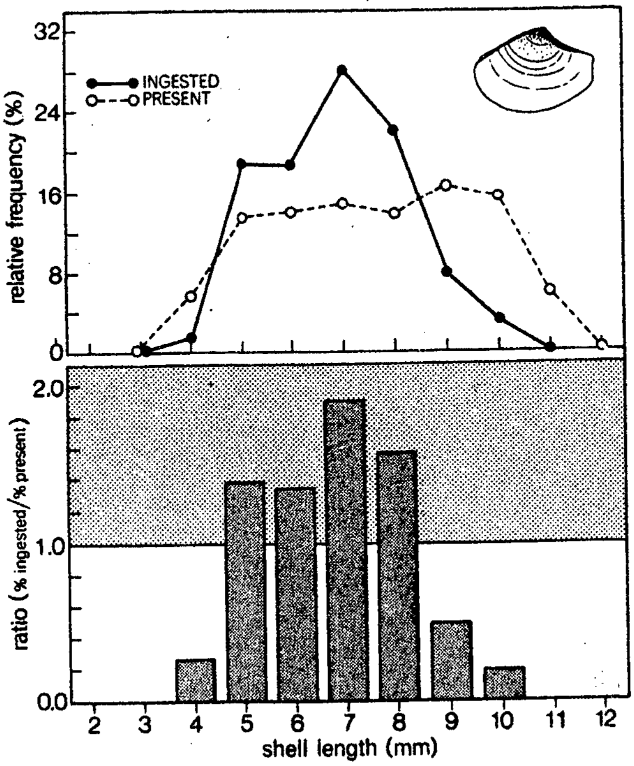


Figure 6. Relative abundance of *Myadora boltoni* of different lengths in the sediment at Miranda and in the droppings of Knots feeding on the same spot (top) and the resulting evidence for selection of 5-8 mm long *Myadora* (below). The length distribution of *Myadora* in the sediment was based on 231 measured specimens collected in 20 sieved samples of 1/226 m^2 to a depth of 5 cm. The length distribution of *Myadora* in the droppings is based on 64 measured hinges collected traced from 30 Knot-droppings.

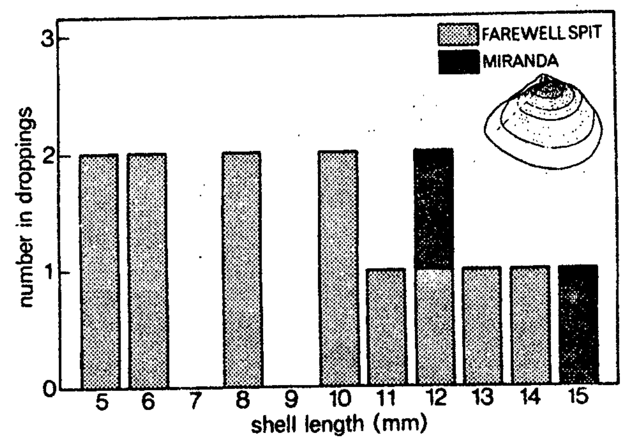
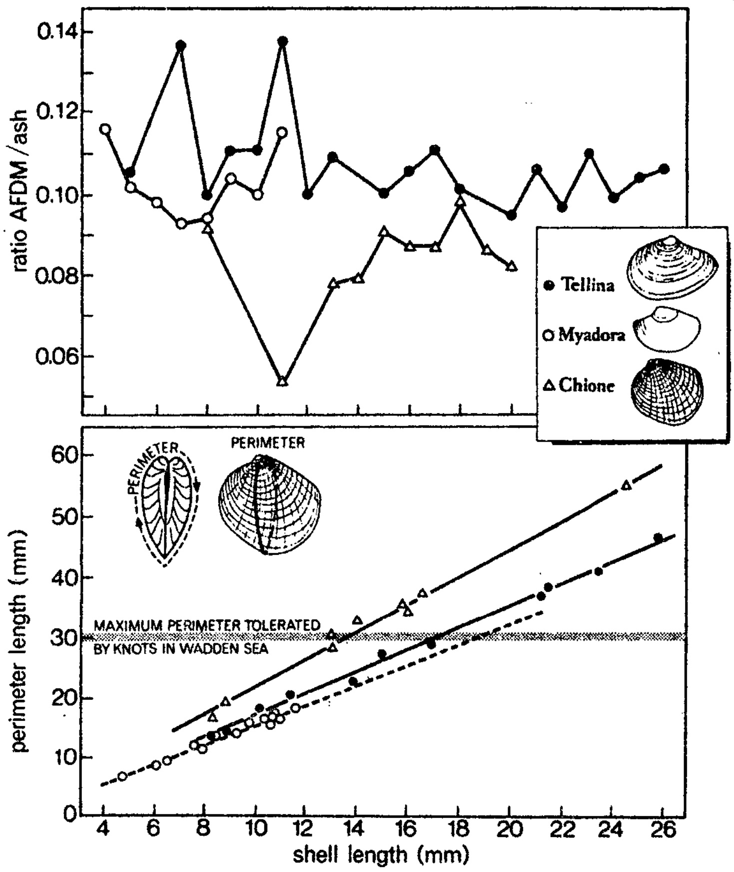


Figure 7. Reconstructed length distribution of *Tellina liliana* on the basis of hinges found in Knot-droppings from Farewell Spit and Miranda.

Discussion

Three points suggest themselves on the basis of this preliminary field study: 1) molluscs are the major component of the diet of Knots "wintering" in New Zealand, 2) Knots take the flatter, thinner-shelled and 'meatier' (see Figure 8 top) of the small sized bivalves available in the upper layer of the sediment (they hardly take *Chione*), and 3) at one site where they feed on such a thin-shelled bivalve species (*Myadora*), they select specimens of average size, not taking the largest individuals present.

Figure 8. Comparison of the length-dependent prey characteristics, relevant for foraging Red Knots, of three bivalves from New Zealand. The upper panel presents the ratio of ash-free dry mass (AFDM) to ash mass, a measure of the 'meat quality' of the prey, for *Tellina*, *Myadora* and *Chione*; the data points are based the data presented in Figures 1-3. The lower panel presents the perimeter (P), or minimum circumference, values in relation to shell length (SL) in the three prey species. The horizontal bar indicates the maximum perimeter of bivalve prey accepted by Knots in August in the Dutch Wadden Sea according to Zwarts & Blomert (MS). Individual data points are given. For *Tellina* P=1.822 • SL-1.337 (r^2=0.99, n=11), for *Myadora* P=1.683• SL-1.447 (r^2=0.98, n=14) and for *Chione* P=2.293• SL-1.247 (r^2=0.99, n=9).



Could the latter be because such individuals are too voluminous to be swallowed? Zwarts & Blomert (MS) conclude that, whatever the bivalve prey species, individual prey with a minimum perimeter longer than 30 mm are no longer ingested by Knots. Figure 8 shows that all available *Myadora* have perimeters much smaller than this upper threshold. Incidentally, the perimeter value of 30 mm does pretty well predict the maximum length of ingested *Tellina*: 17 mm, which is only two mm longer than the largest retrieved from the droppings (Figure 7).

The first two tentative conclusions fit the results of research on the diet and feeding of Knots in Europe. Here they also live on mollusc prey (Cramp & Simmons 1983) and appear to select thin-shelled bivalves of high biomass such as the locally abundant tellinid *Macoma balthica* (Zwarts & Blomert MS). However, I was surprised that the Knots at Miranda did not prey upon the largest and apparently (Figure 8) easily ingestible specimens of *Myadora* available. If large *Myadora* live at slightly greater depths than smaller individuals (I only roughly noted that specimens of all sizes occurred in the upper 4 cm of the sediment), the smaller individuals would be still discovered (touched) first by a probing bird and could henceforth be passively selected by Knots (see Hulscher 1982 for an extensive discussion of the process of passive selection).

Alternatively, Knots at the subtropical site of Miranda may actively select smaller sized prey than they do elsewhere. In April 1988, on the tropical Banc d'Arguin (Mauritania, West Africa), I was surprised to see that actively feeding Knots rejected thin-shelled bivalves retrieved from the sediment which were larger than c. 10 mm, and were swallowing almost invisibly-small prey only (unpubl.obs.); 10 mm is much below their preferred size of this type of bivalve prey in the Wadden Sea (Zwarts & Blomert MS, Piersma *et al.* 1191b). The common environmental factor at both the Firth of Thames (Miranda) and the Banc d'Arguin is the warm climate, leading to low thermostatic costs (Piersma *et al.* 1991b). Swennen & Duiven (1991) experimentally documented a preference for small and relatively unprofitable prey in a fish-eating bird under relaxed thermostatic and feeding conditions. Thid leads me to hypothesise that when daily energetic demands are low and when prey is sufficiently abundant, Knots prefer smaller and probably less profitable prey over larger prey. This may be to reduce the risk of not being able to successfully swallow or stomach-crack the prey taken. It is up to future research to see whether Knots in congenial environments are really "prudent"!

Acknowledgements

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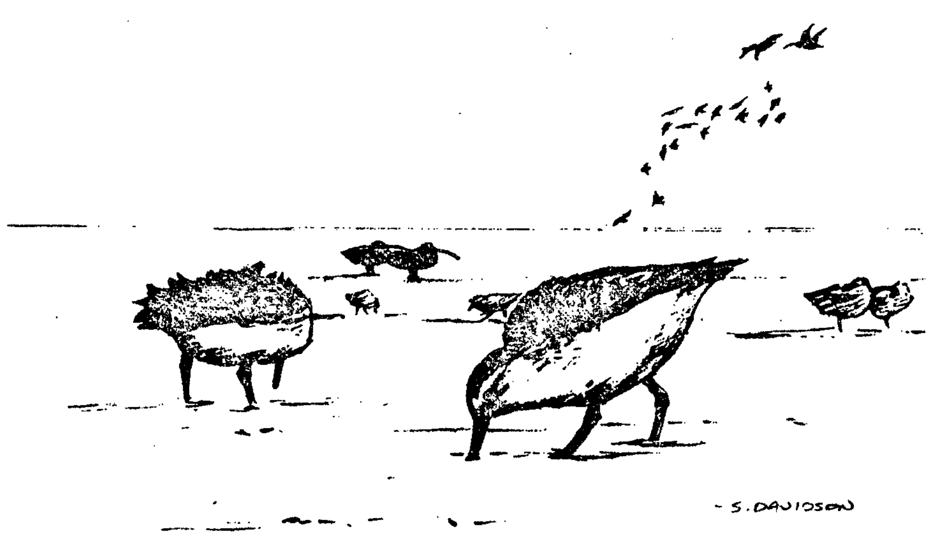

WADER CATCHING CASUALTIES FOR BODY CONDITION ANALYSES: RATIONALE AND FIRST RESULTS FOR GREAT KNOTS

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Introduction

For many of us the excitement of studying waders has much to do with their habit of travelling the globe. Hard field work is required to get enough birds banded to tell us when and where they went. Having the birds in the hand allows us to measure them and hence to collect data on body size and body mass. This information could help us to understand how waders are able to make their journeys fuel-wise (Davidson 1984, Thomas 1987). A considerable body of morphometrics data of many species of long-distance migrant waders spending the non-breeding season on Australian territory, has now accumulated in the pages of Stilt. The longest non-stop flight of waders (5500 km) for which there is now solid evidence (Barter & Wang Tian Hou 1990), is a result of the work in northwest Australia. But there are limitations to the data. Since fat yields about eight times as much energy per unit mass as muscle tissue, birds rely on fat to fuel their impressive flights (Blem 1980). If one could equate changes in body mass with changes in fat load, body mass loss during a flight would give us estimates of the amount of energy becoming available. Yet, recent studies of body composition changes before migration have repeatedly shown that not all deposited mass is necessarily fat; protein-rich tissue is additionally being stored in various parts of the body (Piersma & Jukema 1990, Lindström & Piersma MS). Why birds would bother to store low-energy-yield protein-tissue before take off is currently a matter of debate (Piersma & Jukema 1990, Piersma 1990), but could relate to the fact that a non-stop flight of 2-3 days is rather like an intensive starvation, during which protein must be used up to repair the working body (Cherel *et al.* 1988) (As a matter of fact, living things always show continuous protein turnover with a net loss; but this loss cannot be balanced without food intake.) The fact that there is much interindividual variation in structural size among waders of a kind (reflected in wing length, bill length, total head length or other linear measures) adds to the complications in estimating body composition in migrant waders (Piersma & van Brederode 1990, Piersma & Davidson 1991).

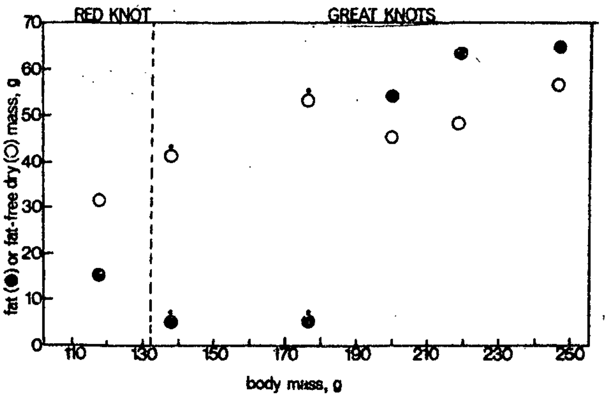
In order to advance our understanding about how waders are able to make it between the non-breeding areas in Australia and the central and eastern Siberian breeding sites, and to understand their differential use of refuelling sites en route over southeast Asia, we thus have to carry out a certain amount of fairly boring laboratory work to document compositional changes in variable body masses. Usually there is no great need to kill birds for the purpose. Careful collection and storage of catching casualties can help us a great deal in describing fat and protein storage before migration (e.g. Piersma & van Brederode 1990), although the need to establish random time series in order to properly describe such changes, creates a complication here (Lindström & Piersma MS). Recently we started a collaborative research project between two Dutch institutions experienced in these sorts of things, and the AWSG, to look at body condition in Australasian waders. A number of Red-necked Stints *Calidris ruficollis*, from Victoria, and a few Great Knots *C.tenuirostris* and one Red Knot *C.canutus* from Broome, were flown on dry ice from Melbourne to Amsterdam, and have since been analysed at the Netherlands Institute for Sea Research at Texel, using exactly the same methods as used previously and concurrently on wader samples from the East Atlantic Flyway. Below we present some preliminary findings. You will also find a request for help with supply of wader casualties in the East Asian-Australasian Flyway.

Some results to wetten the appetite

The two published studies on the morphometrics of Great Knots (Barter 1986, 1987), have assumed that the fat-free body mass of Great Knots is about 139 g. The five analysed Great Knots (with an average body mass of 195.9 g) gave a measured average fat-free mass of 157.4 g (SD=19.6), but with a massive variation among individuals (range= 133-182 g). Two 2nd calendar year birds which evidently were not storing fuel for departure (average mass 157.2 g), both contained about 5 g of fat (Figure 1). Three adult birds, also from late March 1990, which evidently did store fuel (average mass= 221.7 g), had an average fat load of 60.1 g (range 54.1-64.6 g; Figure 1). To look at mass related protein content, we also plotted fat-free dry mass on body mass (Figure 1), yielding a trend of higher fat-free dry masses with increasing body mass. The large variation in fat-free (dry or wet) mass is thus partially explained by variation in the total amount of stored fuel (fat) and may also be due to variation in structural size, since the lightest bird also had the shortest bill (42.8 mm) but not the shortest wing (197 mm). The Red Knot, an adult in almost full summer dress, was of a low mass (117 g) but carried surprisingly much fat (15.4 g). Birds from the *islandica* subspecies from northwest Europe have usually depleted their fat-reserves to 1-2 g when reaching a mass of 115-120 g (Piersma unpubl.)!

Great Knots can depart with body masses as high as 260 g (Barter & Wang Tian Hou 1990), so even our sample of adult birds is limited to individuals much below departure mass. What happens in birds storing an extra 70 g: would this all be fat or also partly protein? When carrying out the analyses, the adult Great Knots appeared rather fat (thick subcutaneous fat layers) but with rather lean fat-free bodies (small muscles and organs). The relatively small size of the muscles and organs is borne out in the comparison with a northerly-living congeneric, the Purple Sandpiper *C.maritima*, presented in Table 1. Perhaps not surprisingly the contour feather masses of Purple Sandpipers contribute more to fat-free dry mass than those of the Australian knots, since

Figure 1. Relationship between body mass on the x-axis and total fat mass and fat-free dry mass on the y-axis in five Great Knots (the two 2nd calendar year birds are indicated with a dot above the symbol) and one Red Knot from Broome, northwest Australia, late March 1990



the Purps are the northernmost wintering waders, whereas the knots come from pretty much the hottest wader area on earth. All muscle components and organs contribute much less to fat-free mass in the knots than in the Purple Sandpipers, suggesting a relatively small 'machinery'. A comparison between the non-migrant juvenile Great Knots and the migrant adults shows relatively larger breast muscles in the pre-migrants, but larger belly organs in the juveniles. Although we have found evidence of stomach atrophy before departure in waders (Piersma *et al.* MS), the other organs usually seem to increase in size before departure in wader species from western Europe (unpubl.). The small 'machinery' of the reasonably fat pre-migrant Great Knots is thus very puzzling. Would they only put on the relatively 'cheap to build' (in terms of energy; they feed on protein rich food) machinery just before departure, in order to save on metabolic costs for keeping this machinery going (and hence metabolic heat production) during the period of fattening? This would be consistent with ideas about the relationship between metabolism and organ size in waders (Kersten & Piersma 1987) and the metabolic repercussions of wintering down south (Piersma *et al.* 1991). Or would, for some reason, they not store protein-rich tissue at all, thereby nicely conflicting with all current trains of thought?

A plea for help

In order to solve some of the developing mysteries, and to add to the comparative database available for waders from the East Atlantic Flyway, we would much like to receive and analyse frozen corpses of waders collected from East Asian-Australasian Flyway sites. In view of the availability of comparative material and potentially developing logistical/financial constraints, we are currently concentrating on three long-distance migrants: Red Knot, Great Knot and Bar-tailed Godwit *Limosa lapponica*. Any catching casualties of these species should immediately be stored frozen in an airtight plastic bag (to avoid dehydration after death) after having been weighed and measured. Transport to Australia or The Netherlands can usually be arranged via scheduled planes. Alternatively, material can be carried by travelling friends and colleagues. Contact one of us if you have material available.

Table 1. Distribution of fat-free dry matter over different parts of the body of two 2nd calendar year Great Knots (body mass=157.2g, sd=27.2; wing=198.0mm, sd=1.0; bill=44.0mm, sd=1.2), three adult Great Knots (body mass=221.7g, sd=23.5; wing=192.7mm, sd=1.9; bill=43.9mm, sd=0.5) and one Red Knot (body mass=117.5g; wing=159mm; bill=31.3mm). All birds are catching casualties of cannon-nettings at Roebuck Bay, Broome, in the last week of March 1990. For comparison the the relative distribution of fat-free matter in Purple Sandpipers (total fat-free dry mass=19.1g) is also presented (from Summers *et al* in press).

Part	**juvenile Great Knot (n=2)**			**adult Great Knot (n=3)**			**Red Knot (n=1)**		**Purple Sandpiper**
	average mass (g)	*sd*	*%*	*average mass(g)*	*sd*	*%*	*mass (g)*	*%*	*%*
Flight feathers	1.94	0.13	4.11	2.05	0.15	4.10	1.01	3.19	3.35
Contour feathers	*5.16*	*0.15*	*10.96*	*5.94*	*0.54*	*11.90*	*3.51*	*11.10*	*15.55*
Skin	6.75	1.50	14.32	7.31	0.49	14.65	4.78	15.11	9.40
Breast muscles	*7.71*	*0.80*	*16.37*	*9.22*	*1.00*	*18.48*	*6.09*	*19.25*	*20.03*
Leg Muscles	1.27	0.15	2.69	1.18	0.13	2.37	0.83	2.62	3.94
Stomach	*2.96*	*1.00*	*6.29*	*1.85*	*1.20*	*3.71*	*1.61*	*5.09*	*6.10*
Intestines	1.94	0.24	4.12	1.49	0.18	2.99	0.88	2.78	5.45
Heart	*0.51*	*0.02*	*1.07*	*0.50*	*0.07*	*1.00*	*0.38*	*1.20*	*1.73*
Lungs	0.42	0.07	0.89	0.58	0.06	1.16	0.25	0.79	1.57
Liver	*1.57*	*0.16*	*3.32*	*1.37*	*0.52*	*2.75*	*0.70*	*2.21*	*5.40*
Kidneys	0.61	0.12	1.30	0.47	0.06	0.94	0.27	0.85	1.67
Brain	*0.21*	*0.01*	*0.45*	*0.21*	*0.03*	*0.41*	*0.15*	*0.47*	*0.76*
Rest of carcass	16.07	1.55	34.12	17.74	1.20	35.56	11.12	35.16	28.40
Totals	**74.09**	**5.94**		**49.91**	**4.74**		**31.63**		

Acknowledgements

Danny Rogers and Belinda Gillies (Department of Ornithology, Museum of Victoria) have been instrumental in getting this work on the go and the Australian birds on the plane: TP much enjoyed the correspondence and their stimulation. Cherry Ott, Anne Dekinga, Anita Koolhaas and Petra de Goeij helped with the carcass analyses of the Australian material.

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THE WORKING GROUP ON WADERS IN THE USSR

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Studies of waders in Russia have a long history, however they have generally been undertaken as part of more general ornithological or zoological studies, and only minor attention has been paid to these intriguing species (Parish *et al.* 1987, Tomkovich 1988). The All-Union Wader Conference which took place in 1973 was the first step in bringing together those in the USSR interested in wader studies. This and another two wader conferences, was planned and organised by Prof. Vladimir E. Flint as an activity of the Moscow Society of Naturalists'. The conferences have attracted more ornithologists to wader studies and assisted in maintaining the interest of those already studying waders. They have also been extremely useful as a means of increasing the numbers of publications on, and knowledge of, waders. Nevertheless the irregularity of these conferences (after 1973 they took place in 1980 and 1987) and the absence of communal projects led to a drop in interest in the 1980's with many researchers concentrating on other birds such as cranes, raptors and corvids where more activities occurred. As a result of this it was decided at the Third Wader Conference in October 1987 that a National Working Group on Waders (WGW or РГК in Russian) should be established under the auspices of the USSR Ornithological Society and an Executive Committee was elected at that time.

The aims of the WGW are to introduce planning elements into national wader studies and to increase and co-ordinate these studies. As part of this process an annual Bulletin *The Information of the Working Group on Waders* is published by the Executive Committee (in Russian only). Now that the WGW has been in existence for four years it seems timely to review its work and to judge its fruitfulness.

To date some 160 people have expressed interest in the WGW. Although this may seem a very low number for such a huge country one must take into account the fact that there are virtually no amateur ornithologists or birdwatchers in the USSR. Unfortunately only a few dozen ornithologists actively participate in WGW activities. Without doubt this is a result of the low density of ornithologists in the country which means that most need to have broad ornithological interests rather than a more narrow concern for waders only. Additionally in my view some researchers are involved in the WGW only so that they may receive information distributed by it.

Wader researchers are not evenly geographically distributed in the USSR, the majority live and work in the European section of the country with only a few scattered through Siberia. Very few studies are now being carried out in the Far East, where some interesting results were obtained in the 70's on breeding biology and ecology of many species with the studies of A. Ya. Kondratiev and the late A.A. Kistchinski; and on wader migration by Yu. N. Glustchenko. The majority of work in the area at present involves faunistic studies which give only passing information on waders. An extremely visible movement of waders across Sakhalin Island and along the western coast of Kamchatka has become evident however there is presently no detailed studies of migration, nor wader catching and banding, taking place in the area. In general it is only foreign banding activity (primarily ABBS banding) which yields any information on migration in the region.

In inland Siberia two banding centres have now been established. The primary one is situated at Krasnoyarsk University and it headed by Alexander P. Savchenko who has organised wader studies in central and southern Siberia with a network of field camps carrying out wader banding at various lakes throughout the region. He and his people band a few thousand waders annually and have caught Australian banded Red-necked Stint and Curlew Sandpiper. In 1990 a project involving the use of colour bands and flags to study post-breeding migration was begun there. The second banding centre in Siberia is located on the Chany Lakes near Novosibirsk, where Alexander K. Yurlov studies breeding and migration of waders. The results of his research should appear in the literature within the next year or two. This site is the more westerly of the two in Siberia and waders move from there to more westerly wintering grounds. One Sanderling banded in Thailand has been recorded there.

In the Asiatic Republics the Ornithological Laboratory of the Zoological Institute of Kazakhstan (Alma-Ata) under the leadership of Eduard I. Gavrilov is another important wader study centre, mainly for migration studies. Results of their research show that waders passing through central Kazakhstan migrate mainly to East Africa, while those from the eastern part of the Republics move to India. Andrej E. Gavrilov Jr. is now attempting to arrange counts of migrating waders in the Asiatic Republics in order to compile an inventory of wetlands important to waders.

Soviet ornithologists are also actively searching for rare and endangered species listed in the Red Data Books for the USSR and the Republics and some valuable sightings have been made. For instance following a report in a WGW Bulletin a number of interesting observations and records of Spoon-billed Sandpipers and Nordmann's Greenshanks have come to light. Interesting data have been obtained on the Ibisbill in south-east Kazakhstan and the Asiatic Dowitcher in southern Siberia. The three year search for the breeding grounds of the Slender-billed Curlew, which was conducted in collaboration with the ICBP, was unfortunately not successful. Project *Haematopus*, carried out to identify the breeding sites of the Eurasian Oystercatcher in central Russia, led to the population being included in the Russian Red Data Book. The status of other rare species and populations of waders is under discussion.

The WGW Executive Committee has organised a critical revision of some doubtful published wader records and are looked upon as the wader specialists on the recently established Faunistic Commission of the USSR Ornithological Society. New wader species of the American fauna are being registered almost annually for the USSR by the Commission in recent years. As yet however there has been no records of the Cox's or Cooper's Sandpipers.

The WGW Bulletin pays special attention to information on banding activities and colour marking projects of national and international interest. E.I. Gavrilov and A.A. Vinokurov are the national registrars of colour marking projects in the WGW. In spring of 1991 we hope to be able to obtain information on the geographic distribution of migrating waders by looking for birds which have become oiled, and therefore "naturally" colour marked, in the Persian Gulf. A round-up of information on international wader study projects is included in the WGW Bulletin in the hope that it may encourage USSR ornithologists to participate, unfortunately little activity has resulted as yet. Nevertheless when compared to the mid 1980's the overall increase in waders studies is significant, so the WGW does play a positive role. Moreover it is believed that WGW activities will show that waders are interesting birds to study and that international interest in wader problems makes the studies prestigious. We are also attempting to show that in many instances much important knowledge on waders can only be obtained by the co-operative effort of many people from different areas. By these various means it is hoped that more young ornithologists will be attracted to wader studies to cover some of the major gaps in our knowledge.

One more important piece of information now available to wader observers of the southern parts of the USSR and other countries is made known through the WGW Bulletin. Each year data on weather patterns and summer lemming numbers from various tundra areas is gathered via a questionnaire and the results published in the Bulletin. Fluctuations in breeding success are rather regular and predictable on the Taimyr Peninsula and adjacent areas, but not in north-east Asia, especially in the mountain areas. From what is now known about these fluctuations it can be safely predicted that the productivity of species such as Red-necked Stint, Red Knot (race *rogersi*) and particularly Great Knot, is much more stable than in some other Arctic species or populations, such as those wintering in South Africa (Summers & Underhill 1987) or the New Siberian Islands population of the Red Knot (the nominate race *canutus*) which probably migrates to Australia and/or New Zealand together with *rogersi* (Tomkovich 1990). Information on breeding conditions, and breeding success, of Arctic waders of the USSR should be published annually in English in the Wader Study Group Bulletin.

The establishment of the WGW has not only improved the situation for information exchange but has also made it easier to organise wader conferences in the USSR. Thus the Fourth Wader Conference took place on Donetsk in 1990, just two years after the previous conference. It is planned to hold an International Conference of the WGW in Odessa, on the Black Sea, in 1992 with the title "Migrations and International Conservation of Waders". It would be excellent if AWSG members could attend this conference. We hope that this will be the next step in wader studies and conservation in the USSR and that contacts between researchers of this and other countries will be established and strengthened.

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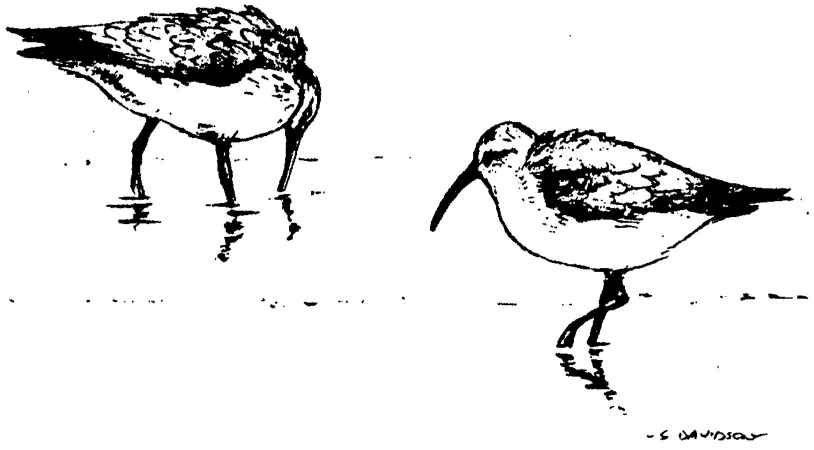

CONSERVATION OF WATERBIRDS AND WETLANDS IN THE EAST ASIA FLYWAY AND OBJECTIVES OF A FLYWAY NETWORK

Taej Mundkur, AWB

Wetlands and migratory waterbirds in the East Asia Flyway are under considerable threat and rapid action is required to prevent the loss of key sites and species. Some conservation and research activities relating to the migratory waterbirds in the Flyway have so far been carried out in most of the relevant countries, including Australia, China, Hong Kong, Indonesia, Japan, Malaysia, Philippines, Taiwan, Thailand and the USSR. There has been some interaction between the various individuals and countries, eg. through INTERWADER. With a rapid increase in the number of studies underway in the different countries, there is an urgent need for improved coordination of the activities of individuals working on waterbirds in the Flyway.

During the last eight years, AWB has through its various cooperative programs supported numerous studies and conservation activities on migratory waterbirds in the Flyway. As a logical continuation of this work, an attempt is now being made to improve links between those working in the Flyway and to collate recent information to get a clear picture of the situation and priorities. It is therefore proposed that the AWB assist in the establishment of a network of individuals and organizations active in the study and protection of waterbirds and their habitats in the Flyway. Initially, there will be an emphasis on migratory shorebirds.

Funding for the establishment of the network has been allocated by the Australian National Parks and Wildlife Service, with some additional support from the MacArthur Foundation and World Wide Fund for Nature.

The primary objectives for the formation of a network of individuals working on waterbirds in the Flyway are: to promote the effective protection of important waterbird sites in the Flyway, to use existing information to identify future research needs, and to obtain additional required data by providing coordination for waterbird research and protection activities in the Flyway.

Activities that will be taken up include:-

1) Collation and analysis of existing ground and aerial count data on shorebird usage of wetlands of the Flyway, in order to revise listings of sites of importance.

2) Encouragement of wider coverage of the region during the midwinter waterfowl counts (Asian Waterfowl Census).

3) Assistance is communication and collaboration between individuals and organizations involved in shorebird research and protection in the Flyway. Production of a newsletter is being considered: it will be devoted to waterbird conservation and migration studies, colour marking and banding reports, important site counts, survey reports and so on.

4) Promotion, organisation and arrangement of support for teams to survey and conduct research at important or potentially important sites on the Flyway.

5) Support of the development of local agencies and units in key countries with expertise in waterbird research and conservation.

6) Promotion of establishment of waterbird reserves in each country.

7) Promotion of international agreements and conventions relevant to waterbirds.

8) Preparation of an overview document, with sections for each Flyway country, listing the important shorebird sites, identifying the conservation issues and recommended action to improve site protection.

9) Collection or revision of population estimates of different species using the Flyway.

10) Advice on research priorities in countries in the Flyway.

11) Production of information and educational material about shorebird migration in the Flyway.

12) Support of work on endangered migratory species of waterbirds, eg. Baikal Teal *Anas formosa*.

How individuals/organizations can help in the flyway networks:-

1) Inform others about your present and future activities.

2) Suggest potentially important sites which need further surveys. Help organize and support expeditions to these sites.

3) Send to AWB regular counts of shorebirds at different sites taken during the migration and winter season in your area.

4) Send in reports, articles and papers about shorebirds.

5) Provide banding (ringing) reports and totals of shorebirds banded, and if required send in recoveries to be followed up.

6) Provide information about threats to shorebirds and their habitats in your area.

7) Promote conservation of key sites and species.

8) Provide information to other network members.

Please address all information and enquiries to Taej Mundkur (Waterbird and Flyway Projects Officer) at AWB, Institute of Advanced Studies (IPT), University of Malaya, Lembah Pantai, 59100 Kuala Lumpur, Malaysia.

REPORT FROM OLANGO ISLAND, PHILIPPINES. NO.3. JANUARY 1 - MARCH 31, 1991.

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Introduction

Olango field station was manned in the period January 1-6, January 13-15 and February 1 - March 31, 1991.

One bird banding session was held in March for educational purposes. The weather conditions were however, poor. 1-2 weekly counts were performed in the period. The methods were described in Report No. 2. (See Stilt 17, October 1990).

Results and Discussion

The two most common waders were Mongolian Plover and Greater Sandplover. The latter overwintered in small numbers (25), while the former reached 500-800 individuals in December-January. In first week of February the Mongolian Plover reached a peak (1,425) and then gradually left on northward migration, until 600 were left by the end of March. The Greater Sandplover, however, reached a sudden peak (2,040) on March 3. Only 600 were left on March 29.

The majority of Great Knots left on Northward migration by the middle of February, but still 76 out of the maximum 275 could be seen at the end of March.

The Red-necked Stint only reached 1,500 individuals on March 29, 1991 while 3,000 could be seen in March 1990. Noteworthy is the big number of Common Terns in the month of February. The peak was reached on March 9, when a minimum of 3,500 terns roosted at the area at night time. Unusual also was 750 Black-headed Gulls on March 3. During bird banding, a bird was recovered for the first time on Olango with a foreign band. A Red-necked Stint with band no. Taipei A06869 was caught on March 15.

Table 1 - 1991. Maximum counts of waders per week

Species	January				February				March				
	1 1-5	2 6-12	3 13-19	4 20-26	1 27-2	2 3-9	3 10-16	4 17-23	1 24-2	2 3-9	3 10-16	4 17-23	5 24-31
Pluvialis squatarola			325			375	250		375	650		525	310
Pluvialis fulva			5			3		4	3		14	9	
Charadrius alexandrinus			51			56		175		325		140	75
Charadrius mongolus			525			1425		1200	900	360		450	1200
Charadrius leschenaultii			18			75		75	20	2040		450	1200
Numenius phaeopus			49			48	64		34	34		26	64
Numenius arquata						7	2	3	3	4		2	6
Numenius madagascariensis			6			6	4	10	19	11		6	10
Limosa limosa			3			3	3	3					1
Limosa lapponica			95			7	285			155		225	220
Tringa totanus			90			123				10			65
Tringa nebularia			18			33	20	77	82	41		37	44
Tringa glareola							1		2				
Tringa terek			41			20		32	38	20		18	15
Tringa hypoleucus			2			6			2	2			
Tringa brevipes			145			256		360		385		165	260
Arenaria interpres			82			95		92	90	77		56	48
Limnodromus semipalmatus			22			23	47	30		20		33	21
Calidris canutus			14			41	20		16	43		49	48
Calidris tenuirostris			79			275			108	124		110	76
Calidris alba						3			1	4			
Calidris ruficollis			285			900	800	800	900	900		450	1500
Calidris ferruginea			120			500	500	500		500		150	50

Table 2 - 1991. Maximum counts of Waterfowl and other birds per week.

	January				February					March			
	1 1-5	2 6-12	3 13-19	4 20-27	1 28-2	2 3-9	3 10-16	4 17-24	25-2	1 3-9	2 10-16	3 17-23	4 24-31
A. Ducks													
Anas clypeata								1	1				
B. Herons and Egrets													
Egretta garzetta			6				1	1			3	1	6
Egretta eulophotes	5		2							3	30	10	34
Butorides striatus			19				1	3					1
C. Terns and Gulls													
Sterna hybrida			3			300	18	50	200	100		25	300
Sterna nilotica			3			14	68	59	65	23		25	40
Sterna albifons			28			25	8	15	4	20		80	95
Sterna sumatrana												18	27
Sterna hirundo						1500	625	3000	2500	3500		600	550
Larus ridibundus			60			750	11	210	120	50		35	2
Larus crassirostris									1	1			

Table 3 - Waders and Terns banded on Olango Island,
January 1 - March 31, 1991.

Pluvialis squatarola	4
Charadrius alexandrinus	5
Charadrius leschenaultii	3
Numenius phaeopus	1
Limosa lapponica	1
Tringa terek	1
Tringa hypoleucos	8
Calidris tenuirostris	3
Calidris ruficollis	17
Calidris ferruginea	7
Sterna hybria	6
Sterna nilotica	3
Sterna albifrons	1
Sterna hirundo	3
A total of 14 species and	63 birds.

WADERS OF FAR NORTH-WEST TASMANIA

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Introduction

Kayaking alone in the Hunter Group of islands (Fig. 1) in November 1983 I pulled ashore one afternoon onto the mudflats of western Robbin's Island, a couple of kilometres south of the entrance of Mosquito Inlet (Fig. 2). Not yet afflicted by the supplementary masochism of water-watching, I found myself somewhat taken aback, yet delighted, at the hub of an impressively single-minded, wheeling cloud of several thousand birds in cryptic plumage. By pure chance, I had chosen to camp at Bird Point, which turned out to be the principle roost for the island and a main contender for the best roost for the whole region.

Cursory scrutiny of the 1:100,000 Welcome and Circular Head Tasmaps (their salient features condensed into Fig. 2) shows that region to accommodate a good 100 km^2 of tidal mudflat. The coastline demarking this extensive and ornithologically fertile habitat remains essentially remote and difficult of access with all the known roosts being on islands of uninhabited or not permanently inhabited, islets off islands, and isolated spits. Urban development is entirely lacking west of the small fishing/agricultural town of Smithton and access is further compromised by land tenure which is almost entirely lease or freehold and controlled by a number of parties.

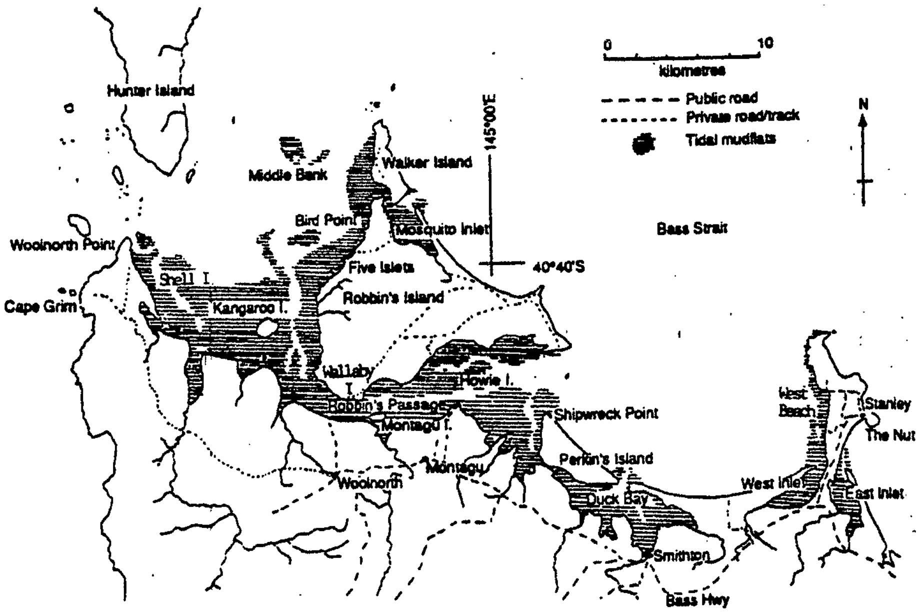


Fig. 2. Count Sites and major geographical points, N.W. Tasmania.

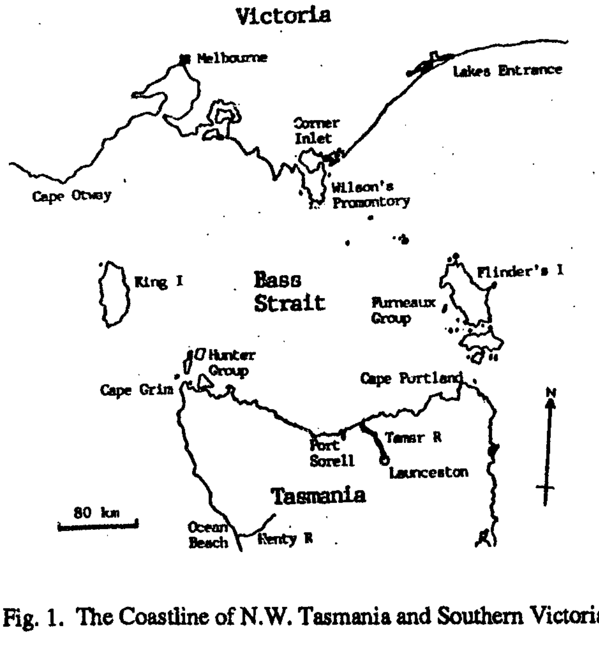


Fig. 1. The Coastline of N.W. Tasmania and Southern Victoria

There seems to have been no previous wader censussing activity in the region at all, bar a few marginal forays, but moves are afoot for a more intensive study to begin later this year (1991) pending approval of funds.

Data collection for the RAOU Atlas ceased as I was making preliminary observations and I have found ten species of summer visitor from the northern hemisphere not acknowledged in the Atlas as occurring west of the 145° meridian. This seemingly insignificant corner on a map of Australia, even of Tasmania, has become a strong contender for the best wader habitat in the state.

To the east, between Stanley and the Tamar River (on whose upper reaches sits Launceston) 130 km as the crow flies, there is no wader habitat of any consequence, except perhaps Port Sorell where 100-200 birds may be found in summer. South of Cape Grim, along the entire west coast of Tasmania, sandy open beaches abound and accommodate sprinklings of the resident species one would expect there, oystercatchers, Masked Lapwing, Red-capped and Hooded Plover and modest numbers of migrants. The Henty River/Ocean Beach area in particular, 160 km south of Cape Grim, seems to be a Tasmanian stronghold for Hooded Plover.

Geological considerations aside, spring tidal range on the open ocean west coast amounts to little more than a metre and tidal flats are few and far between. Stanley's spring range by comparison, in the relatively enclosed south-west corner of Bass Strait, is in the order of three metres.

For the five principle known roosts in the vicinity of Robbin's Island, summer counts are incomplete prior to 1988, winter counts prior to 1989. A pattern of bird activity has begun to emerge but it is much too early to attempt to draw conclusions about fluctuation of numbers and factors which could be interpreted as causative. Moreover, the data are almost entirely those of a solitary observer in a quite considerable area. Whether the very marked fluctuations in flock sizes at given sites in given seasons are real, or local movements between roosts, or dispersal to other sites, is yet to be established. However, the last four summer counts have fallen in the range 6000 to 8500 birds (excluding Stanley and the far west, which could add a maximum of a further 1000 birds) with 24 species having thus far been recorded. Table 1 gives the range of species to be found in the region as a whole and the sites at which each species roosts. It should be noted however that I have visited Shell Islets only once and East and West Inlets and West Beach at Stanley once recently in winter but not at all in the previous five years. For logistical reasons counts are not available for all of these sites and hence Tables 2 and 3 are intended to give an impression of the numbers which have been in evidence at the five main roosts in February and July during the last four years.

Table 1 - Species present at each of the eight surveyed sites

	Bird Pt.	Five Is.	Kangaroo Is.	Perkin's Is.	Montagu Is.	Shell Is.	Wallaby Is.	Stanley
Pied Oystercatcher	*	*	*	*	*	*	*	*
Sooty Oystercatcher	*	*	*	*	*	*	*	*
Masked Lapwing	*	*	*	*	*	*	*	*
Grey Plover	*	*	*					
Lesser Golden Plover	*		*	*	*		*	*
Hooded Plover				*		*		*
Mongolian Plover	*			*	*			
Double-banded Plover	*	*	*	*	*	*	*	*
Red-capped Plover	*	*	*	*	*	*	*	*
Black-fronted Plover		*						
Ruddy Turnstone	*	*	*	*	*		*	*
Eastern Curlew	*	*	*	*	*		*	*
Whimbrel	*		*			*		
Grey-tailed Tattler	*			*				
Greenshank	*	*	*	*				
Terek Sandpiper						*		
Latham's Snipe	*					*		
Bar-tailed Godwit	*	*	*	*		*		*
Red Knot	*	*	*	*	*	*		
Great Knot	*			*				
Sharp-tailed Sandpiper	*		*	*	*			
Red-necked Stint	*	*	*	*	*		*	*
Curlew Sandpiper	*	*	*	*	*			*
Sanderling				*				

Table 2 - Numbers of waders present, Summer counts

	Bird Pt					Five Islets				Kangaroo Is.				Perkin's Is.				Montagu Is.			
	91	90	89	88	87	91	90	89	88	91	90	89	88	91	90	89	88	91	90	89	88
Pied Oystercatcher	5		2	1	2	118	145	135	89	45	16	30	80	440	200	140	220	119	123	100	- Not Visited -
Sooty Oystercatcher	5	6	3	2		75	120	72	59	28	85	140	60	122	250	70	104	143	44	75	
Masked Lapwing	2	2	2	2	3	2	2	4	2		4	2		59	80	53	10	12	54	2	
Grey Plover	15			2	1	120			40	2											
Lesser Golden Plover					1	42				47	230		200	81	80	31	43	42	60	58	
Hooded Plover														18	7	19	2				
Mongolian Plover		4	11																	2	
Double-banded Plover	6	7	1				1					1			20	4	3				
Red-capped Plover	9	7	3			11	11	12	6		17	13		33	40	120	40	9	3	5	
Ruddy Turnstone	80	200	170	85	35	1	100	480	150	25	250		450	550	350	190		2		1	
Eastern Curlew					1				3	220	250	10	1	23			2		42	21	
Grey-tailed Tattler		9			7																
Greenshank	5	42	16	1	5					20			9								
Latham's Snipe			1	2																	
Bar-tailed Godwit	40	4			90				5	87				6							
Red Knot	5	1000			120		1		70	1500			1		20	2	5				
Great Knot		1			60					2											
Sharp-tailed Sandpiper													20								
Red-necked Stint	460	300	200	200	35	25	150	600	500	700	800	600	1100	1100	800	350	1600	125	50	100	
Curlew Sandpiper	320	500	60	200	6		150	300	200	700	800	300	700	500	600	350	700		100	50	
Unidentified			1000			380		100				120					10	3			
Total	952	2082	1469	495	366	694	722	1703	1124	3376	2452	1216	2621	2932	2447	1329	2729	455	476	314	

Table 3 - Numbers of waders present, winter counts (Note: Not all sites visited in all years)

	Bird Pt.				Five Is.				Kangaroo Is.				Perkins Is.				Montagu Is.		
	91	90	89	86	91	90	89	86	91	90	89	88	91	90	89	88	91	90	89
Pied Oystercatcher	5	2	2	4	211	210	151	90	113	150	70	63	135	220	200	200	63	77	70
Sooty Oystercatcher	4	4	4	8	116	74	60	30	108	110	50	70	105	260	110	120	23	25	50
Masked Lapwing	4	3	2	2	2	2			3		2	2	12	2	3	35	83	2	
Grey Plover				10	14			2				4							
Lesser Golden Plov.										4									
Hooded Plover													10	23	10	22			
Double-banded Pl.			4	5	82		10		1		110		50	126	100	150	32		35
Red-capped Plover			5	4	6	3		4	34		22	25	165	221	120	58	3	13	15
Ruddy Turnstone	2		8	20	23			30			170	80	3	6	30	25			31
Eastern Curlew									4		16	14	2				6	12	5
Grey-tailed Tattler													1						
Whimbrel												1							
Bar-tailed Godwit								47					11						
Red Knot																3			
Sharp-tailed S'piper																20			
Red-necked Stint				15	58				4		59	110	250	6	140	200			25
Curlew Sandpiper				3								8	60	1		9			
Unidentified	20							20											
Total	35	9	25	71	512	289	221	223	257	264	339	377	804	865	713	842	210	129	231

Maximum flock sizes of chosen species certainly seem remarkable by the standards of this southern migratory terminus and I continue to be pleasantly surprised. For example, in February 1991 there were 1500 Red Knot at Kangaroo Island, 120 Grey Plover at Five Islets, 550 Ruddy Turnstone and 440 Pied Oystercatcher at Perkin's Island. In February 1990 Kangaroo Island had 250 Eastern Curlew and in January Bird Point hosted 350 Bar-tailed Godwit. Peter Atkinson counted 250 Sooty Oystercatcher on Perkin's Island in June 1990 (pers. comm.). There were 60 Great Knot at Bird Point in February 1987 (probably the first and thus far, only true flock recorded for Tasmania) and 2500 Red-necked Stint at the same site in November 1986.

Roosts

The samphire-edged, marram grass-covered, rocky outcrop of Bird Point backs on to old sand dune country clad in struggling Tree-tree, boobyalla, banksia and fern on the primarily heath-covered Robbin's Island. With 20 species of wader so far found here - 4 residents, one trans-Tasman and 15 trans-equatorial migrants - it remains the most satisfactory site and the one at which birds can be most closely scrutinised (from a few metres at best), up to 3000 of them in an exceptionally good summer. The price is a 30 km return day-walk (camping is not permitted by the owners) including the 1 1/2 km wide channel of Robbin's Passage to be negotiated twice, sometimes in the dark. As a winter site, Bird Point is usually all but deserted. It is conveniently central to some of the rich zostera beds which abut the western flank of Robbin's Island. A minute's flight to the east, Mosquito Inlet, cursorily examined years ago but not visited at all recently, seems to hold little of interest for migratory waders, although sprinklings of the larger residents eke out an existence there, plus the ubiquitous White-faced Heron, Black Swan, Pacific Black Duck and Chestnut Teal.

A couple of kilometres to the south of Bird Point five low samphire islets act as a supplementary roost in that there is a good deal of feathered traffic between the two localities if the birds should be disturbed. When spring tides and strong westerlies coincide these islets become totally submerged. The southernmost of them is the haunt of pelicans, gulls and cormorants, the next northerly of oystercatchers, terns and ducks. Only the most northerly, with its complex association of rocky outcrops, is regularly patronised by migratory waders.

Six kilometres to the south-west of the most southerly of these islets, embedded in a 50 km^2 quadrilateral of zostera beds, lies a square kilometre of low-lying saltmarsh/samphire-fringed Tee-tree and fern-covered dspit called Kangaroo Island. Requiring an 18 km round trip with three channels to be negotiated twice to visit, this is another principle roost in its own right, although I suspect it may be party also to the special relationship between Bird Point and Five Islets. However birds presumed to be commuting between the latter points and Kangaroo Island are lost sight of long before re-alighting.

It would be reasonable to suppose that there are supplementary roosts to be west of Kangaroo Island in the direction of Woolnorth Point and indeed the 1:100,000 map shows a number of promising-looking mudflat-bound islets. I have made only one visit so far and found Shell Islets to be worthy of continued investigation with, among other species, Latham's Snipe, Whimbrel and Bar-tailed Godwit putting in an appearance. Ray Pierce from New Zealand, searching for leg-banded Double-banded Plover in winter 1987 saw a Terek Sandpiper here, a conspicuous species I have never seen at the other sites, suggesting the possibility that there may be a body of birds here in addition to the main counts. However, I have also seen substantial flocks (200) of Bar-tailed Godwits flying at altitude directly from that vicinity to Bird Point. Further investigation is obviously warranted.

Western Robbin's Passage, for reasons I do not fully understand, tends to be largely bereft of migrants at all times of the year. Perhaps rapid drainage associated with the proximity of deep, sandy channels prevents the substrate from remaining saturated at least at the surface, thus limiting the distribution and density of prey species. There is so much attractive mudflat elsewhere that marginal-quality habitat can be ignored. Wallaby Islets guard this western Passage but have only ever been visited at low or mid-tide when in transit to and from Bird Point and Five Islets. There are never more than 100 birds in the vicinity. The Eastern Golden Plover shown for Five Islets in February 1991 and implied as being in the company of Grey Plover were actually nearer to Wallaby Islets.

Montagu Island in Robbin's Passage is another expanse of salt-marsh fringed with samphire, easy of access but so low-lying that at spring tide it is heavily waterlogged. It tends to have larger flocks of Masked Lapwing, presumably owing to the proximity on the Tasmanian mainland of improved pasture.

The small rock outcrop of Howie Island has been visited only once and was completely dominated by Pacific Gulls, many on eggs plus a few score Silver Gulls and cormorants.

It took me several years to come to appreciate the merits of Perkin's Island and I have paid a lot more attention in recent years to the easily accessible large shell/sandspit at Shipwreck Point. It has yielded 19 species of wader and seems quite unaffected by the commercial oysterbeds (and associated transient human activity) which adorn the island's western shore. With a couple of hectares of sandspit exposed even at spring high water, plover and other small waders are frequently able to continue feeding on surface prey. As with all five main roosts, cattle are to be seen from time to time, particularly in winter, churning up a rather fragile saltmarsh littoral to some degree but causing negligible inconvenience to roosting flocks. Much to the chagrin of the long-term lessee, Perkin's Island has recently reverted to Crown Land. He maintained a locked gate at the tidal crossing thus excluding 4WD's and trail bikes. One hopes that the termination of this lease does not prove, on balance, to be a retrograde step.

Bird Point, Kangaroo Island and Shipwreck Point are also favoured haunts of Fairy Terns with winter flocks of up to 100 on occasion. Small numbers of Little Terns are usually about and may be on the increase.

Observations at Duck Bay on a single kayak crossing and on numerous foot patrols of its eastern boundary in years past, show it to be largely bereft of the migratory species of wader. Treated domestic sewage and the effluent from a couple of food-processing plants in Smithton drain into the southernmost confines of the bay. Apart from agricultural run-off, this would represent the sum total of any human waste which could be seen as compromising the viability of wader habitat in the entire region in any way. The lack of birds here other than the ubiquitous oystercatchers, swans, ducks, gulls and terns, may well be the natural order. Len Wall found the area similarly little-used in 1955. However, small flocks (up to 60) of Eastern Curlew flushed at "The Jam" - the shallow channel separating Perkin's Island from the mainland - almost invariably fly south-east into Duck Bay.

East and West Inlets at Stanley - patchy zostera on sand - and West Beach - bare sand to the south, basalt cobbles to the north - support several hundred birds including migrants in the warmer months, but the much richer pickings to be had further west have, since the early exploratory years, completely consumed my attention. I have never visited the obvious spits guarding the mouths of the two inlets but am informed that they are used as roosts. Therefore bird populations at these sites are not included in the counts shown in Tables 1 and 2, nor are they likely to be in the foreseeable future.

Species Accounts

Pied Oystercatcher *-Haematopus longirostris*

Pied Oystercatchers are common all around the coast of Tasmania and are particularly well-represented in the far north-west with flocks of over 100 being the norm at Five Islets, Perkin's Island, Montagu Island and East Inlet at Stanley. Perkin's Island commonly hosts 200 with the record in the few years I have been visiting standing at 440. I do not know quite where they breed but have been the target of aggressive behaviour on occasion.

Sooty Oystercatcher - *Haematopus fulginosus*

A similar situation prevails for Sooty Oystercatchers and Bass Strait seems to be their stronghold. They are well-represented at the same sites as Pied Oystercatchers although are said to prefer feeding on rockier terrain. Flock numbers here tend to be half to three quarters those for Pied Oystercatchers but not infrequently exceed them. Peter Atkinson (pers. comm.) counted 260 birds in a single flock on Perkin's Island in June 1990 and Doug Watkins suggests a minimum national population of only 4000 (pers. comm.). If that is the case then the far north-west of Tasmania holds a good 10% of the national stock. I do not know where they breed.

Masked Lapwing - *Vanellus miles*

Masked Lapwing are extremely common in rural Tasmania (as for south-east Australia generally) with non-breeding flocks of over 100 being not uncommon. On the parts of this coastline which remain undeveloped saltmarsh, they are seen in the small numbers which were the norm at the time of European settlement. At sites proximal to improved pasture much larger flocks (50-100) are in evidence.

Grey Plover - *Pluvialis squatarola*

Grey Plover seem only ever to have been found elsewhere in Tasmania in dribs and drabs but turn up on Robbin's Island by the dozen, their favoured haunt being on or about Five Islets (120 birds in February 1991) with frequent forays to Bird Point. In 1986/7/8 they were present in small numbers even in winter.

Lesser Golden Plover - *Pluvialis dominica*

As direct resource competitors with Grey Plover these birds congregate generally at sites other than Bird Point and Five Islets, their preferred roost being Kangaroo Island, where 230 turned up in February 1990. They are common in Tasmania between September and March.

Hooded Plover - *Charadrius rubricollis*

Hooded Plover prefer sandy beaches on or close to open sea. Consequently they are to be found only on Perkin's Island (seldom more than 20) and sprinkled thinly about Stanley, north-east Robbin's Island and near Woolnorth Point. They breed on Perkin's Island. The west coast is almost entirely open with numerous sandy beaches and that is their major stronghold in Tasmania. Doug Watkins (pers. comm.) estimates a minimum national population of only 2200 birds.

Mongolian Plover - *Charadrius mongolus*

These attractive little birds turn up in ones and twos around the state with Bird Point being the region of preference in the north-west. When roosting here they tend to remain aloof from the main flocks but do mix with the small numbers of Double-banded Plover that sometimes remain through the summer, or arrive early/leave late. I have not seen them feeding. Of the nine birds at Bird Point in late November 1986, one was still in full breeding plumage.

Double-banded Plover - *Charadrius bicinctus*

Double-banded Plover are in evidence at all sites at some time during the winter and there are stragglers about al through the year, especially on Perkin's Island. Ray Pierce, over from New Zealand in July 1987, looking for Double-banded Plover which he and his colleagues has colour-banded in the South Island highlands, found a flock of 845 birds on Kangaroo Island (pers. comm.). In the same month I saw 600+ on Perkin's Island. He suggested the region supported 1000-1200 birds in winter (pers. comm.).

Red-capped Plover - *Charadrius ruficapillus*

Red-capped Plovers can be found at all sites and all variations of the local habitat but they prefer the sandy or shelly beaches and bare sandflats to the wetter zostera areas. They breed in the region.

Black-fronted Plover - *Charadrius melanops*

One specimen of this frequenter of inland freshwater lagoons was observed amongst rocks on the high water line at Five Islets in May 1987.

Ruddy Turnstone - *Arenaria interpres*

This species commonly appears in the north of the state in summer flocks of hundreds but for reasons unknown, fails to percolate south in more than handfuls. Some birds remain all year round in the far north-west and winter concentrations of a few dozen are not uncommon. At these sites they commonly roost and feed in the company of Red-necked Stints and Curlew sandpipers.

Eastern Curlew - *Numenius madagascariensis*

These nervous birds, fortunately so easily seen and heard from afar, are common summer visitors to appropriate Tasmanian habitat and are likely to be found at any of these north-western sites. Their roosting preference however is strongly in favour of Kangaroo Island where summer flocks of 120-250 are the norm, although not always conveniently present for the February counts.

Whimbrel - *Numenius phaeopus*

A single bird, or occasionally a pair, turns up irregularly, as is the case for the rest of Tasmania.

Grey-tailed Tattler- *Tringa brevipes*

Grey-tailed Tattlers choose to confine their activities almost entirely to the Bird Point region of Robbin's Island. About 20 of them were in evidence in December 1984 and November 1985 but in recent years they have failed to return in such numbers, and in some years not at all. They are even sparser in the south of the state. I saw one shaking the legs off a crab at Bridport in the north-east but cannot recall having witnessed them feeding in the north-west at all.

Greenshank - *Tringa nebularia*

Greenshanks also display a marked preference for the vicinity of Bird Point Flocks are small (maximum of 70 thus far) and erratic, an impression which is probably artificial, created by the lack of simultaneous observations at adjacent sites.

Terek Sandpiper - *Tringa terek*

Ray Pierce saw one bird at Shell Islets in winter 1987 (pers. comm.). I have yet to find another.

Latham's Snipe - *Gallinago hardwickii*

Tidal coastline is not this bird's preferred habitat but small numbers of individual birds can sometimes be flushed from the marram grass at Bird Point in summer. Recently, on my first visit to Shell Islet, there were eight along about 4 km of basalt-cobble beach between Woolnorth Point and Shell Islets.

Bar-tailed Godwit - *Limoas lapponica*

Again Bird Point is the site where this particular species is most likely to be found. There were 350 in January 1990 but this was a remarkable flock. A conspicuous, easily identified bird, its appearance is highly erratic but again it is difficult to know if such fluctuation is real or an artefactual impression created by solitary viewing at multiple, widely-spaced sites.

Red Knot - *Caladris canutus*

Red Knot were thought to be uncommon in Tasmania until they started turning up at Robbin's and Kangaroo Islands. There were summer flocks of hundreds at these sites when I first visited them in 1983/84, but my inexperienced observations were probably (and rightly) regarded with scepticism. Numbers declined in the late eighties but have more recently recovered with generous compound interest. Thus 680 birds put in an appearance at Bird Point in January 1990, rising to 1000 in February, fully half of all the waders there. In February 1991 Kangaroo Island hosted 1500 Red Knot which must be a record for Tasmania.

Great Knot - *Calidris tenuirostris*

This is a rare species for Tasmania and I am told that the 60 birds (all of which were well into breeding plumage) at Bird Point in February 1987 were the first true flock for the state. Apart from this occasion the species occurs sporadically in ones and twos.

Sharp-tailed Sandpiper - *Calidris accuminata*

Similarly, Sharp-tailed Sandpiper cannot be relied upon to put in a regular appearance at any of the sites and although there was a flock of 20 abroad in winter 1988 and summer 1988/89, I have not seen a single representative since.

Red-necked Stint - *Calidris ruficollis*

Red-necked Stint flocks have diminished markedly in southern Tasmania in recent years but whether the same may be said of the far north-west in total is by no means obvious. Flocks of 1000+ (2500 in November 1986) were routine in 1983-86 at Bird Point and Kangaroo Island but have not reached 1000 since then. However, regular seasonal data for the region are so scant and over such a short time span that such comparisons are of no real value. The species is present in summer at all sites (except for the single November visit to Shell Islets).

Curlew Sandpiper - *Calidris ferruginea*

This species too, judging by the February counts, has declined in numbers in the south of the state in the late eighties. No such trend makes itself obvious in the sporadic north-west figures. Perhaps when the data for ten years of regular censussing are to hand and observations have been made simultaneously at associated sites, then some meaningful conclusions may be drawn. Curlew Sandpipers are also present at all sites most of the time during the summer months.

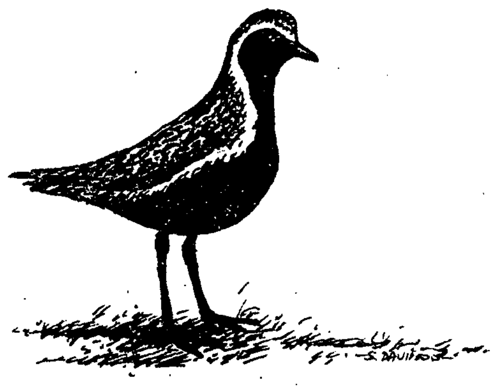
Sanderling - *Calidris alba*

At least 20 specimens of this little bird turned up on Perkin's Island in January 1990. It remains for me the only sighting for the region. Six kilometres of open sandy beach line the north-east aspect of Perkin's Island and indeed from Mosquito Inlet at the northern end of Robbin's Island to West Inlet near Stanley there are 30km of long sandy beach opening directly onto Bass Strait. These beaches have not been investigated more than cursorily. Henty River/Ocean Beach on the west coast is probably the Tasmanian stronghold for Sanderling.

Conclusions

The wader habitat of far north-west Tasmania remains, for the time being, satisfactorily remote and essentially undisturbed by human activity. Industry on associated land is almost entirely agricultural and that confined to grazing. No civil works or land reclamation schemes have modified tidal flushing and apart from fishing boats moving between the small ports of Stanley and Smithton and the open west coast, there is negligible shipping. The area's remoteness from major population centres and its land tenure have meant that recreational activity, in particular the more destructive motorised versions, are absolutely minimal. The known roosts are all on islands, islets off islands or on lonely spits isolated from roadheads by tidal channels, long beaches or extensive mudflats.

Birds which have survived the multiple hazards of long migration from their northern hemisphere breeding grounds, hazards including human predation and human incursion onto crucial staging grounds, find here, at the end of their range, at least a provisionally secure welcome.



FOOD HABITS OF SHOREBIRDS FROM THE GREAT VEDARANYAM SALT SWAMP OF TAMIL NADU, INDIA

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Introduction

Knowledge of the food of shorebirds (*Charadriiformes*) helps in the understanding of their distribution and is a useful tool for monitoring the quality of the habitat and therefore the protection of these birds. The habitats of shorebirds are also shrinking or under deterioration from increasing human pressures. In India, work on the ecology of shorebirds, including the food habits, are very few (Sampath 1989, 1990, Sampath & Krishnamurthy 1989, 1990, Sampath *et al.* 1990).

An increasing amount of literature is available on the food habits of shorebirds from various countries, but it seems that works similar to the present study of high salinity environs are very limited from any parts of the globe. The few such works have been carried out by Anderson (1970), Davis (1978), Britton (1905) and Jehl (1981, 1986). The only studies done elsewhere on gut analysis of the species dealt with in this paper are by Goss-Custard (1969, 1970, 1976, 1977), Goss-Custard and Jones (1976) and Goss-Custard *et al.* (1977) on Redshank, and Piersma (1986) on Terek Sandpiper.

This paper deals with the food habits of six species of shorebirds from the high salinity Great Vedaranyam Salt Swamp of the Kodiakkarai region

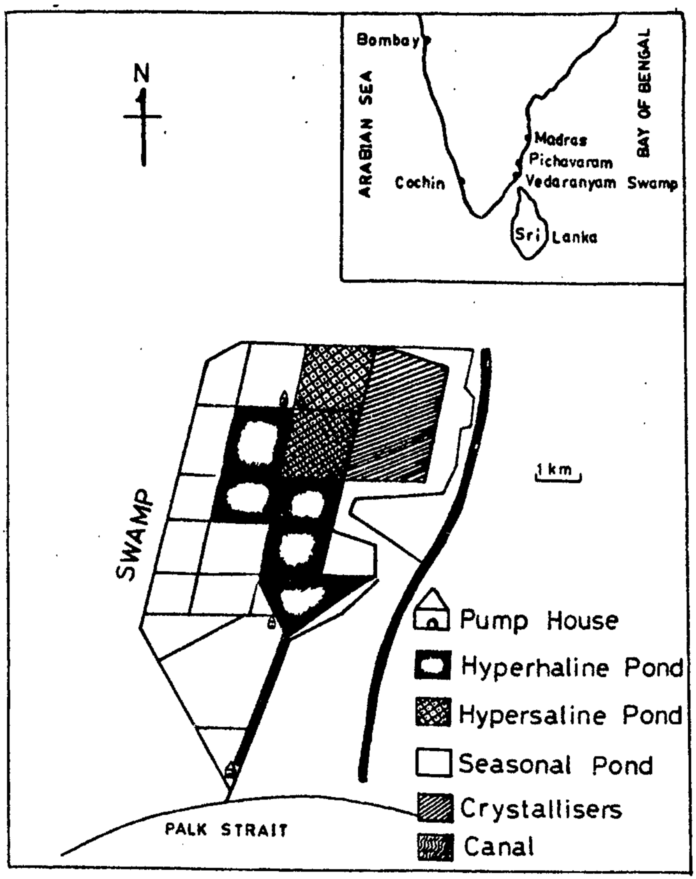

Fig. 1 Location of study site and map of salt processing area.

Study Site

The Great Vedaranyam Salt Swamp (10°18'N 79°51'E) located on the Bay of Bengal Coast of Tamil Nadu, India, is one of India's important wintering grounds for many species of migratory shorebirds. This swamp extends over an area of 2400 ha with intertidal areas, mudflats and salt ponds. In the swamp area large scale extraction of Table Salt and Industrial Grade Salt is carried out. In order to produce this salt many salt ponds and pans have been created in parts of the swamp (Fig. 1). The salinity in the swamp ranges from 10 ppt during the monsoon season (October) to 650 ppt during summer (April to June).

Materials and Methods

The food habits of four common species of shorebirds of the swamp, namely: Mongolian Plover *Charadrius mongolus*, Marsh Sandpiper *Tringa stagnatilis*, Little Stint *Calidris minuta* and Curlew Sandpiper *Calidris ferruginea* were studied from December 1986 to March 1987 and are detailed elsewhere (Sampath 1989). During the same period some of the less common shorebird species, viz. Kentish Plover *Charadrius alexandrinus*, Redshank *Tringa totanus*, Greenshank *Tringa nebularia*, Wood Sandpiper *Tringa glareola*, Terek Sandpiper *Tringa terek* and Ruff *Philomachus pugnax*, became entangled in the noose spread for trapping the former four species. When this occurred and they were severely injured they were killed and the gut contents analysed.

In the field itself the birds were dissected and the alimentary canal of each bird removed and preserved in a separate bottle containing neutral formalin. Each alimentary canal was later cut open and the contents (food items) were emptied into a petri dish. The other parts of the alimentary canal were also examined for their remnant contents of food. From the petri dish the food items were handpicked, sorted into groups, counted and identified. Algal materials, pebbles, sand and feathers were found in most stomachs of all species. These were considered as non-food items (Tuck 1972 in Senner & Mickelson 1979). Numerical methods as adopted by others were employed to quantify the food materials (Reeder 1951, Bengtson & Svensson 1968, Davidson 1971, Puttick 1978, Senner & Mickelson 1979, McLachlan *et al.* 1980).

Even if only remnant parts of an organism were obtained it was considered as one unit. In the case of *Ceratonereis costae* (a polychaeta) only the jaws were encountered. As each specimen of *C. costae* has two jaws the total number of jaws was divided by two to calculate the total number consumed by the bird (Goss-Custard & Jones 1976). Those items which could not be identified were put under "unidentified organisms".

During the study period three *C. alexandrinus*, nine *T. totanus*, two *T. nebularia*, one *T. glareola*, two *T. terek* and two *P. pugnax* were killed and analysed (Tables 1 & 2). Only *T. totanus* was collected in all three months, all other species were obtained only in one of the months of the study period.

Macrobenthos of the area and gut contents

An extensive study of the area was carried out between 1984 and 1987 (Sampath & Krishnamurthy 1989) and included detailed investigation of the macrobenthos of the region. Some 11 species of benthic organisms are available to feeding shorebirds (Tables 1 & 2). All of these groups of organisms were found in the stomachs of *C. mongolus*, *T. stagnatillils*, *C. minuta* and *C. ferruginea* (Sampath 1989, Sampath *et al.* 1989).

Redshank

From the gut analysis it is evident that the most preferred food of *T. totanus* was the polychaete *C. costae*. The other favoured food items were chironomid larvae and amphipods *Grandidierella* sp. Similar observations were made by Goss-Custard (1977) and Boere & Smith (1981), however they did not report the presence of chironomid larvae. The preference for *C. costae* could be attributed to: 1. the comparatively large size of the prey; 2. the apparent high energy turnover; 3. less competition for their prey from other predators; 4. the long stout bill of this bird being suited to catching prey from comparatively deep areas where *C. costae* are usually found.

Among the other food items recorded in the present study, only molluscs (gastropods and bivalves) have been recorded as being taken elsewhere. In the present study the gastropod like *Cerithidea* sp, *Phalium* sp. and *Tellina* sp. were collected from the stomach. The other prandial items like ephydrid pupae and larvae, foaminiferans, which were recorded in the present study do not appear to have been reported from the gut of *T. totanus* by other workers.

Other Shorebird Species

As in *T. totanus* all the other shorebird species fed on some or all of the groups of organisms listed in Tables 1 & 2. Of these species the only one with the Brine Shrimp *Artemia* sp. in the gut contents examined was *C. alexandrinus*. This is possibly an artefact of the low numbers of birds taken. The reason that no *Artemia* sp. were recorded in the stomach contents of *T. totanus* was possibly that this species was not killed during December when Brine Shrimps are most abundant; as was also found to be the case in the salt pans of Mongolia (Cramp & Simmons 1983); although they do occur in lesser numbers from early September when the salinity range is in the order of 50--175 ppt (Sampath & Krishnamurthy 1989).

Table 1 - Groups of food items recorded from the stomach of Redshank

Food Items	January (2)	February (3)	March (4)
1. Chironomid larvae	108	92	52
2. Amphipods	59	74	38
3. Artemia	-	-	-
4. Polychaetes	212	180	230
5. Molluscs	18	22	38
6. Ephydrid pupae & larvae	28	43	53
7. Beetles	7	11	13
8. Ostracods	19	14	28
9. Copepods	9	18	17
10. Foraminiferans	14	18	22
11. "Unidentified Organisms"	8	6	13

Table 2. Groups of food items recorded from the stomach of five species of shorebirds.

Food Items	*C.alexandrinus* (3) December	*T.glareola* (1) March	*T.nebularia* (2) January	*T.terek* (1) January	*P.pugnax* (2) February
1. Chironomid larvae	105	29	39	9	30
2. Amphipods	28	6	18	11	-
3. Artemia	8	-	-	-	-
4. Polychaetes	-	-	90	-	-
5. Molluscs	19	4	9	-	17
6. Ephydrid pupae & larvae	23	9	8	18	8
7. Beetles	14	4	6	11	15
8. Ostracods	22	-	-	15	-
9. Copepods	8	11	6	-	-
10. Foraminiferans	5	6	-	6	-
11. "Unidentified organisms"	4	2	6	4	7

Figures in parentheses show the number of birds examined.

It is difficult to arrive at any positive conclusions on the food habits of the species taken because of the small number of birds examined. However some deductions can be made on *C. alexandrinus* and *T. nebularia*. The high numbers of chironomid larvae in the stomach of *C. alexandrinus* could be attributed to the visual foraging nature of this bird (Peterson & Peterson 1979, Pienkowski 1981) and its habit of feeding at the edge of the water. This enables the bird to observe movement of the larvae, in addition the larvae were often washed ashore by the wind and lay exposed in plenty at the edges. Contrary to the above however, Cramp & Simmons (1983) have reported only a few chironomid larvae in the stomach of *C. alexandrinus*.

The relatively greater occurrence of the polychaete *C. costae* in the stomach of *T. nebularia* may be attributed to its long and stout bill. This enables the bird to probe into the deep mud to catch its prey.

Apart from the line of preference for specific food items by each species studied, it could be considered that all six species dealt with in this paper are opportunistic feeders since they fed on all available food items in varying proportions.

Acknowledgements

I am indebted to Dr. K. Krishnamurthy, Professor, Centre of Advanced Study in Marine Biology, Parangipettai (Tamil Nadu) and to Dr. V.S. Vijayan, Project Scientist, Bombay Natural History Society Ecological Research Station, Bharatput (Rajasthan) for their critical comments on this paper and other assistance.

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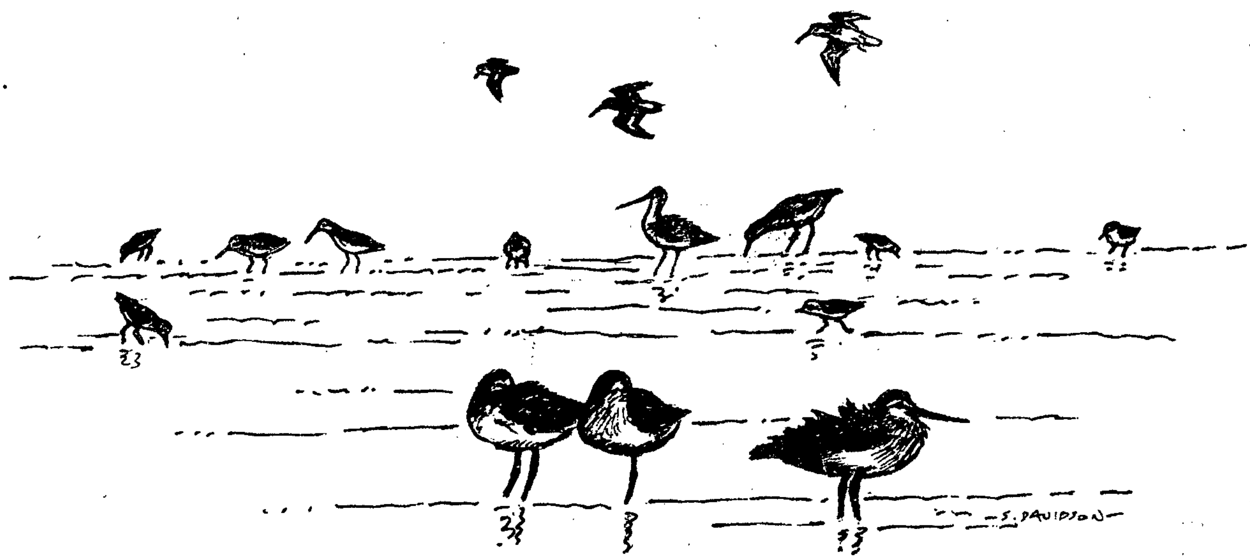
AUTHOR INDEX Stilts 13 - 18

SPECIES INDEX Stilts 13 - 18 (note: species in alphabetical order)


S. DAVIDSON

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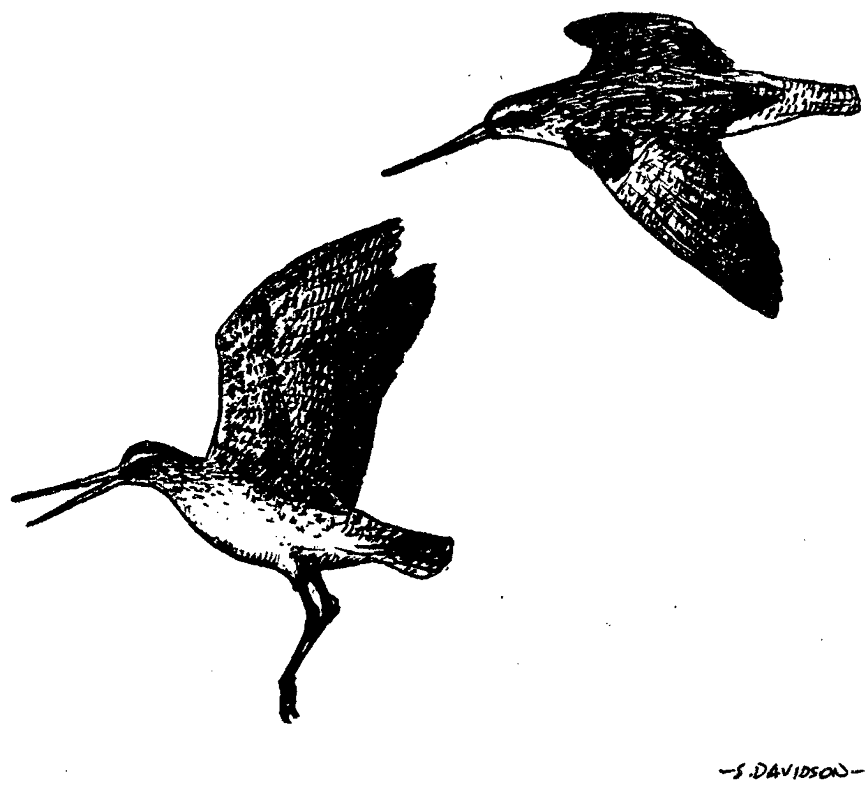
–S.DAVIDSON–

BANDING ROUND-UP

Compiled by Jamie Pook, Australian Bird and Bat Banding Schemes, Australian National Parks and Wildlife Service, GPO Box 8, Canberra, ACT 2601.

The following lists are supplied from data supplied to the Scheme between March 1990 and March 1991. Permission must be sought from the banders and clearance given by the 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:
01 = probably trapped;
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;
25 = bird sick or injured;
31 = collided with a moving road vehicle;
40 = band found on a bird, no further data on how encountered;
41 = band returned, not reported if on a bird;
46 = colour marking sighted in field, bird one of a cohort marked in this manner;
48 = colour marking sighted in field;
54 = beachwashed;
61 = shot - reason unknown;
63 = taken for scientific study;
67 = taken for food or feathers;
68 = shot for food or sport;
99 - found dead, cause unknown.

Status after encounter:
00 = status of bird and band is unknown;
01 = status of bird unknown, band left on bird;
02 = status of bird is unknown and the band was left on the 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;
09 = rehabilitation attempted but bird died, band status unknown;
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.

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129       RUDDY TURNSTONE                           ARENARIA INTERPRES
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051-29700 04SWAN ISLAND QUEENSCLIFFVIC              38d15m S 144d40mE 891118   2    U  VICTORIAN WADER STUDY GROUP
05 13     04SWAN ISLAND QUEENSCLIFFVIC              38d15m S 144d40mE 901118   +2   U  VICTORIAN WADER STUDY GROUP
Distance: 7244 km         Direction: 0 degs.                 Time elapsed:   1 yrs 0 mnths 0 days


153       BAR-TAILED GODWIT                         LIMOSA LAPPONICA
--------- ----------------------------------------- ---------------------------------------------

071-85037 01BEACHES CRAB CK RD ROEBUCK BAY BROO     18d0m  S 122d22mE 880326   1    U  AUSTRALASIAN WADER STUDY GROUP
67 05     6FFENGXIAN COAST OF SHANGHAI CHINA        30d50m N 121d45mE 910416   U    U  SHIQUAN
Distance: 5429 km         Direction: 359 degs.               Time elapsed:   3 yrs 0 mnths 21 days


160       TEREK SANDPIPER                           TRINGA TEREK
--------- ----------------------------------------- ---------------------------------------------

051-38600 03SHORES OF THE 80 MILE BEACHWA           19d15m S 121d20mE 880331   +2   U  AUSTRALASIAN WADER STUDY GROUP
67 05     05MIAO-GANG YANGTZE RIVER ESTUARY CHINA   30d52m N 121d52mE 910430   U    U  EAST CHINA WATERBIRD GROUP
Distance: 5572 km         Direction: 1 degs.                 Time elapsed:   3 yrs 0 mnths 30 days


161       CURLEW SANDPIPER                          CALIDRIS FERRUGINEA
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041-25257 01WERRIBEE SEWERAGE FARM (SPIT, PT WILSO 38d3m  S 144d32mE 870118   +2   U  VICTORIAN WADER STUDY GROUP
03 13     05MAI PO MARSHES HONG KONG                22d29m N 114d19mE 910410   U    U  MELVILLE
Distance: 7432 km         Direction: 330 degs.               Time elapsed:   4 yrs 2 mnths 23 days

041-43141 01WERRIBEE SEWERAGE FARM (SPIT, PT WILSO 38d3m  S 144d32mE 880103   +2   U  VICTORIAN WADER STUDY GROUP
06 13     8FTAJMYR PENINSULA NORTH SIBERIA USSR     76d4m  N 98d32m E 910624   U    U  TOMKOVICH
Distance: 13096 k         Direction: 349 degs.               Time elapsed:   3 yrs 5 mnths 21 days

041-46645 05SALTWORKS, PORT HEDLANDWA               20d15m S 118d55mE 880409   +2   U  AUSTRALASIAN WADER STUDY GROUP
03 13     05MAI PO MARSHES HONG KONG                22d29m N 114d19mE 910410   U    U  MELVILLE
Distance: 4777 km         Direction: 354 degs.               Time elapsed:   3 yrs 0 mnths 1 days

041-60318 05YALLOCK CREEK NEAR KOOWEERUPVIC         38d13m S 145d28mE 910112   +2   U  VICTORIAN WADER STUDY GROUP
25 16     5FYING KOU CITY PROVINCE OF LIAONING CHI 40d4m  N 122d14mE 910510   U    U  ZHENG KUN
Distance: 9018 km         Direction: 342 degs.               Time elapsed:   0 yrs 3 mnths 28 days

041-62931 05SALTWORKS, PORT HEDLANDWA               20d15m S 118d55mE 900323   +1   U  AUSTRALASIAN WADER STUDY GROUP
03 13     05MAI PO MARSHES HONG KONG                22d29m N 114d19mE 910410   U    U  MELVILLE
Distance: 4777 km         Direction: 354 degs.               Time elapsed:   1 yrs 0 mnths 18 days

GNV-52467 03MAI PO MARSHES HONG KONG                22d29m N 114d2m E 900825   +2   U  MELVILLE
05 13     01WERRIBEE SEWERAGE FARM (SPIT, PT WILSO 38d3m  S 144d32mE 901230   +2   U  VICTORIAN WADER STUDY GROUP
Distance: 7445 km         Direction: 154 degs.               Time elapsed:   0 yrs 4 mnths 5 days
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164 RED KNOT CALIDRIS CANUTUS

050-48031 KOKOORAGANG ISLAND NATURE RESERVENSW 32d52m S 151d46mE 881204 +1 U HARDY
05 13 01MOUTH OF BRISBANE RIVERQLD 27d22m S 153d10mE 901021 U U THOMPSON
Distance: 626 km Direction: 13 degs. Time elapsed: 1 yrs 10 mnths 17 days

051-54414 01BEACHES CRAB CK RD ROEBUCK BAY BROO 18d0m S 122d22mE 900409 +2 U AUSTRALASIAN WADER STUDY GROUP
67 05 6FFENGXIAN COAST OF SHANGHAI CHINA 30d50m N 121d45mE 910414 U U SHIQUAN
Distance: 5429 km Direction: 359 degs. Time elapsed: 1 yrs 0 mnths 5 days

NC4-5844 34MIRANDA FIRTH OF THAMES NEW ZEALAND 37d10m S 175d19mE 901103 +1 U NEW ZEALAND BANDING SCHEME
67 05 05MIAO-GANG YANGTZE RIVER ESTUARY CHINA 30d52m N 121d52mE 910414 U U EAST CHINA WATERBIRD GROUP
Distance: 9384 km Direction: 316 degs. Time elapsed: 0 yrs 5 mnths 11 days

165 GREAT KNOT CALIDRIS TENUIROSTRIS

061-39743 096K SW OF BROOMEWA 17d58m S 122d16mE 820401 +2 U WA WADER STUDY GROUP
67 05 01EAST CHONGMING ISLAND SHANGHAI CHINA 31d30m N 121d52mE 910421 U U EAST CHINA WATERBIRD GROUP
Distance: 5499 km Direction: 360 degs. Time elapsed: 9 yrs 0 mnths 20 days

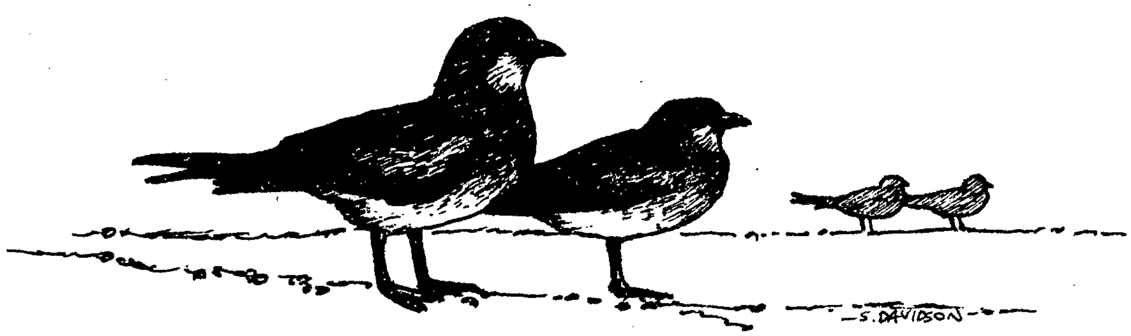
061-41608 1680 MILE BEACH 3KM SOUTH OF ANNA PLAINS 19d15m S 121d23mE 831031 +3 U WA WADER STUDY GROUP
67 05 01EAST CHONGMING ISLAND SHANGHAI CHINA 31d30m N 121d52mE 910421 U U EAST CHINA WATERBIRD GROUP
Distance: 5642 km Direction: 1 degs. Time elapsed: 7 yrs 5 mnths 21 days

061-69755 01BEACHES CRAB CK RD ROEBUCK BAY BROO 18d0m S 122d22mE 880325 1 U AUSTRALASIAN WADER STUDY GROUP
67 05 6FFENGXIAN COAST OF SHANGHAI CHINA 30d50m N 121d45mE 910330 U U SHIQUAN
Distance: 5429 km Direction: 359 degs. Time elapsed: 3 yrs 0 mnths 5 days

061-70671 01BEACHES CRAB CK RD ROEBUCK BAY BROO 18d0m S 122d22mE 880406 1 U AUSTRALASIAN WADER STUDY GROUP
67 05 6FFENGXIAN COAST OF SHANGHAI CHINA 30d50m N 121d45mE 910514 U U SHIQUAN
Distance: 5429 km Direction: 359 degs. Time elapsed: 3 yrs 1 mnths 8 days

061-70798 01BEACHES CRAB CK RD ROEBUCK BAY BROO 18d0m S 122d22mE 880407 1 U AUSTRALASIAN WADER STUDY GROUP
67 05 6FFENGXIAN COAST OF SHANGHAI CHINA 30d50m N 121d45mE 910412 U U SHIQUAN
Distance: 5429 km Direction: 359 degs. Time elapsed: 3 yrs 0 mnths 5 days

061-71354 01BEACHES CRAB CK RD ROEBUCK BAY BROO 18d0m S 122d22mE 900331 +2 U AUSTRALASIAN WADER STUDY GROUP
67 05 05MIAO-GANG YANGTZE RIVER ESTUARY CHINA 30d52m N 121d52mE 910410 U U EAST CHINA WATERBIRD GROUP
Distance: 5433 km Direction: 359 degs. Time elapsed: 1 yrs 0 mnths 10 days



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