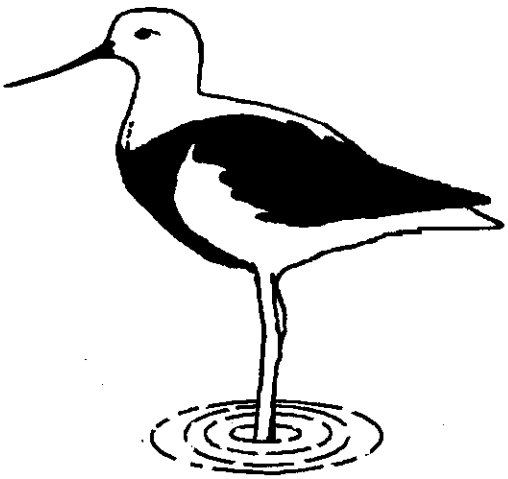
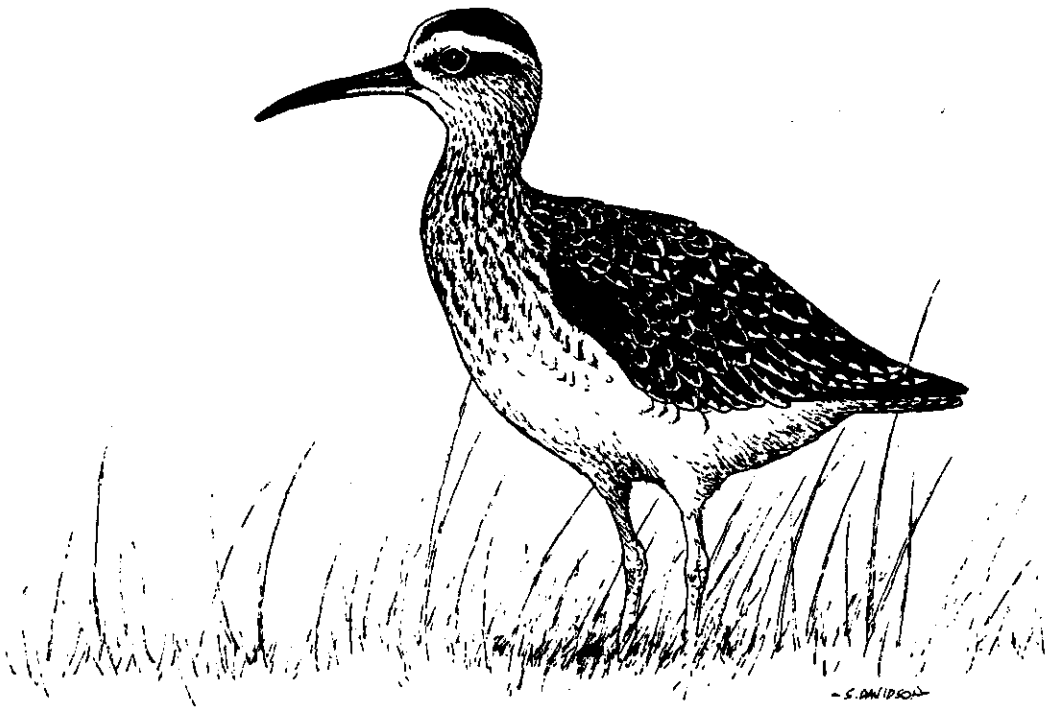
The Stilt



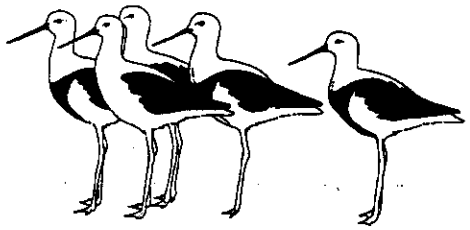
The Bulletin of the East Asian-Australasian Flyway



Australasian Wader Studies Group

A special interest group of Birds Australia

Number 43
April 2003



The Stilt

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MISSION STATEMENT

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

OBJECTIVES

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

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

MEMBERSHIP OF THE AUSTRALASIAN WADER STUDIES GROUP

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

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

AWSG WEB SITE: www.tasweb.com.au/awsg/index.htm

Cover Illustration: Stephen Davidson

EDITORIAL

As I write this, Australia is preparing to go to war in Iraq with the US and the UK. This makes it hard for me to focus on waders at a time like this, when humans are trying to destroy themselves. However, in the world of waders, there have been a few positive actions by the Australian government, including an announcement by the Environment Minister of a A$1 M grant for shorebird conservation activities over the next three years. This is excellent news and provide additional support for projects like the current WWF-administered "Shorebird Project" that is focusing on developing community-driven conservation initiatives at five key shorebird sites in Australia.

One of the sites in the WWF project is Roebuck Bay, northwestern Australia. In this issue we have a series of reports summarising the results of recent AWSG expeditions to Broome, Roebuck Bay, Eighty Mile Beach and Port Hedland. We also have three other articles on waders in the region, by the late Angela Jessop, Clive Minton and David Melville on diets of waders and Marsh Sandpipers and Red-necked Phalaropes at the Port Hedland Saltworks.

Further a field, its good to see data on waders from Singapore, where there is an active wader study group at the Sungei Buloh Nature Reserve in the north-west of the island. Falk Huettmann continues with a commentary of another trip to nort-eastern Russia and he also reviews Mark Barter's comprehensive report on waders in the Yellow Sea. Mark has shown that the Yellow Sea is a major migration stopover point for the majority of waders in the East Asian-Australasian Flyway. Unfortunately, it is also near a high proportion of China's huge human population and thus faces many real threats to its continuing viability as a rich shallow water marine system. As our knowledge of waders and their key habitats increases in Australia, it is increasingly obvious that there is a pressing need for the skills and ability of AWSG members to be applied to wader conservation projects throughout the Flyway. There have been a few tentative steps happening in this direction and I hope more AWSG effort will be focussed in this direction in the future.

David Milton

TREASURER'S REPORT FOR 2002

The Consolidated Accounts provided below show that income exceeded payments by $2,707.38, however this includes commitments for expenditure on contracts yet to be paid of $21,100.

Australian Wader Studies Group
Consolidated Accounts
Statement of Receipts and Payments
1 January 2002 - 31 December 2002

RECEIPTS Item	2002	2001 $	PAYMENTS Item	2002	2001 $
Balance B/f	51,728.15	47,139.43	Stationary/Printing	15,355.84	11,108.57
			Photocopying	121.14	129.39
Subscriptions	8,721.36	8,539.10	Insurance	110.00	100.00
E.A. Contract		6,000.00	Postage/Courier	1932.86	3,030.16
Contracts - Federal Govt	34,033.36	9,090.91	Consultants	26,785.33	15,903.20
Contracts - State Govts	7,000.00	19,250.00	Field Expenses	7,428.17	7,020.95
Contracts - Other	5,454.55				
Sales	988.64		Phone/Fax	119.04	321.75
Specific Donations	1,144.00	1030.00	Equipmt (consumable)	66.37	
Courses & Fees	275.00		Travel & Accomm.	1,752.78	
Adjustment		(7.27)			
			Admin Fee (BA)	1,000	1,000.00
			Depreciation	238.00	300.00
			Advance		400.00
TOTAL INCOME	**57,616.91**	**44,790.43**	**TOTAL EXPENSES**	**54,909.53**	**39,314.02**

BALANCE AT 31/12/02 **54,435.53**

The overall result, excluding one off contracts, is in accordance with the budget.

Research Fund

The Research Fund comprises Specific Donations and is included in the statement of accounts. In accordance with our Rules the following is a Report for the Fund as at 31 December 2002.

Brought forward from 31/12/00	$6,398.00
Donations 2001	$1,144.00
Total Research Fund 31/12/01	$7,542.00

Membership Statistics for 2002

The membership as at the end of 2002 was:

Australia/ New Zealand	200
Overseas (excl. NZ)	30
Institutions	18
EA Funded	90
TOTAL	338

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

Ken Gosbell, Secretary/ Treasurer

COMMENT ON RECENT CHANGES TO AWSG RULES

Dear AWSG members,

The rules of the AWSG were amended during my period as chair to bring them in line with developments since the original rules of 1985. The new rules were approved by Birds Australia and published in the April 2002 issue of *Stilt*.

Rule 11 states that: «the rules can be amended by a majority of members responding to a postal ballot, provided that notice of intention to make such amendment is given in the *Stilt* preceding that in which the ballot paper will appear, and provided that such amendments shall only be made with approval of or by direction of the Birds Australia Council».

As a postal ballot was not made, the rules of 1985 must still apply. The point here is that the rules cannot be changed without the approval of the members of the AWSG.

These rules were again amended in the October 2002 *Stilt*.

As a committee member of the AWSG, after moving to Norway, I was kept informed that the rules were being changed yet again and why these changes were necessary. I have three main objections to these changes.

Rule 3. Non-members of Birds Australia lose their voting rights.

This affectively disfranchises over 30% of the membership of the AWSG.

Rule 12. Birds Australia can now ammend the rules without a ballot of the members.
This is a change to the rules which I believe is against the wishes of the majority of members.

Rule 14. Any property or assets given to or held by or held on behalf of the AWSG is the property of Birds Australia.

Once the AWSG had their own bank account. The accounts and banking are now managed by Birds Australia. I have not been aware before that the monies owned by the AWSG are not in practice their property. In the unlikely event of Birds Australia being declared bankrupt - then the AWSG is also bankrupt.

I would suggest that the new rules are possibly not legally valid since they have not been approved by the members of the AWSG, as they must be under the old rules. Thus the new rules might not give the legal protection to committee members which they seek to do.

I feel that AWSG members, especially those who have been disenfranchised, deserve a better explanation of why such far reaching changes are necessary. What are the liability risks to the committee? Can the AWSG take out their own limited liability insurance? Has this possibility been investigated?

In my opinion the new rules need to be approved by ballot to be valid.

Best wishes from a very dark and cold Norway.

Jim Wilson. 18 November 2002

GUT ANALYSIS OF FIVE WADER SPECIES COLLECTED FROM THE NW OF WESTERN AUSTRALIA

Angela Jessop*
89 Sommers Drive, Altona Meadows, Victoria, 3028 AUSTRALIA
*Deceased

ABSTRACT
During the 1985 North-west Australasian Wader Studies Group Expedition, the guts of five wader species were collected from casualties of cannon-netting and preserved. The five species were Red-necked Stint *Calidris ruficollis*, Greater Sand Plover *Charadrius leschenaultii*, Red Knot *Calidris canutus rogersi*, Little Curlew *Numenius minutus* and Curlew Sandpiper *Calidris ferruginea*. Collection took place at Roebuck Bay, Broome; Lake Eda, Roebuck Plains, Broome; 80 Mile Beach, Anna Plains and the Port Hedland Saltworks. Information on the prey taken by the wader species collected has added to that which was already known.
The Port Hedland Saltworks provided a managed environment that allowed conditions to be suitable for waders. Birds that are pushed off their coastal feeding areas, move to the saltworks and take advantage of certain prey items which exist in higher numbers than if they were in a natural setting.

INTRODUCTION

Information on the diet of waders in Australia is incomplete and further study is needed to determine the type and number of prey taken by individual wader species (Marchant & Higgins 1993, Higgins & Davies 1996). In order to understand the biology of waders, information is needed not only on what sites that they use for feeding but why they use those sites in preference to others. One of the answers to why waders may use a particular site is the type and abundance of prey items in that area.

From 23rd March to 20th April, 1985 the Australasian Wader Studies Group Expedition was held in the Broome – Port Hedland area of Western Australia to study the northward migration of waders through this area. The main method of catching birds during the expedition was by cannon-netting. During the catching process some casualties unfortunately occurred. Casualties are routinely sent to the Western Australian Museum (AWSG permit condition), but permission was obtained to remove the guts from some birds during this expedition for dietary analysis. Representatives of the Western Australian Museum were present during the first half of the expedition and collected any casualties for specimens.

The guts analysed in this paper were collected with the intention that the Western Australian or Museum of Victoria would identify the contents as little is known of the diet of waders. After the expedition, the vials were taken to the Royal Australasian Ornithologists Union's (RAOU) Moonee Ponds address to be handed over to the Museum for analysis after I left employment with the RAOU. Unfortunately, the vials containing the gut contents plus the written up preliminary analysis have been misplaced. However, field notes taken regarding the guts collected, allow for a general analysis of what the waders had been eating prior to the time of death. Although detailed analysis did not occur, the information collected will add to the knowledge of what prey items are important to particular wader species and what prey items were taken in a period leading up to migration from Broome, 80 Mile Beach and Port Hedland Saltworks. Apart from identifying the prey items taken from birds at the Port Hedland Saltworks, the impact of an environment modified by man on both prey items and the waders consuming them was examined.

METHOD

Collection Sites

Roebuck Bay, Broome
The catch sites where gut samples were taken were within 10 km of the Broome Bird Observatory, Roebuck Bay, Broome, Western Australia. Due to the huge tidal range at Roebuck Bay, it has a large area at low tide of intertidal mudflat where waders feed.

Lake Eda, Roebuck Plains, Broome
Lake Eda is situated on Roebuck Plains, which is inland from Roebuck Bay. Lake Eda is a permanent lake that is surrounded by short grassland.

Table 1: The location and number of guts of each species of wader that were analysed.

Wader Species	Roebuck Bay, Broome	Lake Eda, Roebuck Plains	80 Mile Beach	Anna Plains	Port Hedland Saltworks	Total
Red-necked Stint	2	-	-	-	5	7
Greater Sand Plover	1	-	-	-	-	1
Red Knot	7	-	2	-	-	9
Little Curlew	-	5		6	-	11
Curlew Sandpiper	-	-	-	-	1	1
Total	10	5	2	6	6	29

80 Mile Beach

80 Mile Beach is actually closer to 200 km long and runs from 150 km south of Crab Creek, Broome, south-west to within 150km of the salt pans of Port Hedland (Tulp & de Goeij 1994). The main catch sites were situated along the beach in front of Anna Plains Station. 80 Mile Beach also has vast intertidal mudflats exposed at low tide.

Anna Plains

Anna Plains is located behind 80 Mile Beach and catch sites were located near the Anna Plains Station homestead. The catch sites consisted of low scrub and grassland with pools of water.

Port Hedland Saltworks

The Port Hedland Saltworks is located 30km north-east of Port Hedland and is owned by Rio Tinto. Salt is harvested from shallow pans for commercial use. The water in the saltworks area can be anything from brackish in the inlet channels to hypersaline where the salt is harvested. Most of the catching sites in the Port Hedland Saltworks were in low to medium saline ponds.

Processing of guts and contents

Guts were obtained from casualties as quickly as possible after death, by dissecting the gizzard and stomach from the body. The gizzard and stomach contents were then immediately placed in plastic screw top vials and preserved in alcohol to stop further digestion. Each vial was then labelled with date, species and catching area. Preliminary analysis was done on the gut contents in Melbourne. Using a binocular microscope, the gut contents of each bird was separated into different prey species. Preliminary identification of insect species was undertaken by referring to a well-known entomological text (Ross 1965).

As the actual specimens are lost, the number of prey items rather than percentage of gut contents has been recorded. Although prey items may have been identified as different species, there is the possibility that some of them were actually the same species. A different species was recorded if it looked sufficiently different from a species already labelled. For example, a gastropod taken by Red Knot may have been recorded as a different species if it had different markings on its shell to other gastropods, which were similar in shape and size.

RESULTS

Table 1 shows the species of wader examined, the locations they were collected and the number of guts of each species analysed.

Red-necked Stint

Table 2 shows the items found in the gut content of the Red-necked Stints analysed. Out of the two guts taken from birds feeding in Roebuck Bay, only one had identifiable prey items. These consisted of white, segmented worms and gastropods. The five guts taken from birds feeding in the Port Hedland Saltworks showed that all birds had been feeding on either the eggs or adults of Brine Shrimp. Two birds had taken adult insects, one of which had also consumed a chrysalis; while another had taken up to seven insect larvae that were probably either midge (Chronomidae) or brine fly larvae (Ephydridae). Two Port Hedland birds had also taken molluscs, one, which could be identified, as a bivalve while the other was just a fragment of shell. One bird had also taken two black seeds. Two of the Port Hedland birds were also carrying nematodes in their guts.

Table 2. Gut contents of seven Red-necked Stint that were collected at Broome (N = 2) and Port Hedland saltworks (N = 5). The number in brackets is the number of guts that had a prey item present.

Prey types	Broome	Port Hedland saltworks
Brine shrimp	-	-
Whole	-	1-14, in bits (2)
Pieces	-	Present-3 (3)
Eggs	-	Present->1000 (5)
Insect, sp. 1	-	1 (1)
Insect, Ant?, sp. 2	-	1 (1)
Insect pieces - head, unidentifiable	-	1 (2)
Chrysalis	-	1 (1)
Insect Larvae	-	7 (1)
White segmented worm, w=whole, f=fragment	2 w,4f (1)	-
White nematode	-	1-2 (2)
Bivalve	-	1 (1)
Gastropod, pink, large fragments	2 (1)	-
Unidentifiable pieces of shell	-	Present (1)
Black seeds, Ruppia?	-	2 (1)
Stones, size in mm	1 (1)	Few <1.8 (2)
Sand grains	Present (1)	-
Unidentifiable Matter	Brown (1)	-

One Roebuck Bay bird and two Port Hedland birds had small quartz stones in their gut. Stones in one of the Port Hedland birds were less than 1.8 mm in diameter.

Greater Sand Plover

Table 3 shows the items found in the gut content of the one Greater Sand Plover analysed. The gut contained one small crab and the pieces present were probably that of a crab.

Red Knot

Table 4 shows the items found in the gut content of the Red Knots analysed. Field notes recorded that Gastropod sp. 1 and sp. 5 were triangular cone shaped while Gastropod sp. 2 and sp. 6 were snail shaped.

Seven of the nine guts analysed came from birds in Roebuck Bay. The predominant prey items taken by Red Knot were molluscs and crabs, with one bird having 55 whole mollusc shells in its gut. However, no crab pieces were found in the guts taken from 80 Mile Beach. As there were no clearly distinguishable body parts of crabs to equate to a whole crab being present, an estimate of how many had been taken could not be made.

From the guts analysed, Red Knot took more gastropods than bivalves. Bivalves were only present in three of the guts from birds collected in Roebuck Bay. From Table 4 it can be seen that the 80 Mile Beach birds took few prey items. Where Shell sp. 1 was recorded, this was probably a gastropod species as well. In two cases where the size of the prey item had been measured, all were less than 3 mm long.

Table 3. Gut contents of a Curlew Sandpiper from Port Hedland saltworks and a Greater Sand Plover caught in Roebuck Bay, Broome.

Species	Prey types	Port Hedland	Broome
Curlew Sandpiper	Brine Shrimp	Present (1)	-
Greater Sand Plover	Small Crab	-	1 (1)
	Pieces of insect or crustacean	-	present (1)

Table 4. Gut contents of seven Red Knot from Roebuck Bay, Broome and 80 Mile Beach (N 2). Numbers in brackets are the number of guts with that prey type.

Prey types	Broome	80 Mile Beach
Bivalve, sp. 1	1 (1)	-
Bivalve, sp. 2	1 (2)	-
Bivalve, sp. 3, white oblong	1 (1)	-
Gastropod, sp. 1	1-34 (6)	sp. 1?, 3 pieces (1)
Gastropod, sp. 2	1-6, 4 whole, 5 pieces (5)	-
Length mm	2.2-2.8 (1)	-
Gastropod, sp. 3	1-2 (2)	-
Gastropod, sp. 4	1 (2)	-
Gastropod, sp. 5	1-2 (2)	-
Gastropod, sp. 6	1 (1)	-
Gastropod, sp. 7	1 brown (1)	-
Gastropod, sp. 8	3 (1)	2 (1)
Gastropod, sp. 9	-	3 (1)
Gastropod, sp. 10, size mm	-	2-21, all <3mm (2)
Gastropod, sp. 11	-	1 (1)
Gastropod pieces	-	2 (1)
Shell, sp. 1	1-15 (6)	-
Larvae or small fish	1 (1)	-
Crab, pieces	2-11 (6)	-
Insect pieces	Small piece, wings only (2)	wings only (1)
Stones, size mm	Very sml, 0.9 x 1.4 (2)	-
Sand grains	Present (2)	-
Pieces of shell	Unidentifiable (3)	Unidentifiable (1)
Unidentifiable matter	insect? (1)	soft material (1)

There was evidence that insects had been taken by three birds with the possibility of a fourth bird having taken an insect. However, there was only evidence of one insect in each of the three guts. One Roebuck Bay bird also had a small larvae or fish in its gut. There were unidentifiable pieces of shell in four guts. Whether the shell had been broken by the action of the gut on the whole shell or due to digestive juices or both is not clear. Small stones were only found in two birds and then only one stone in each bird's gut.

Little Curlew

Little Curlew were obtained on the 27 and 28 March 1985 during catches around Lake Eda on Roebuck Plains, Broome and on the 1 and 2 April 1985 at Anna Plains, located behind the sand dunes of 80 Mile Beach near the Anna Plains Station homestead.

Table 5 shows the items found in the gut content of the Little Curlew analysed. Ten of the 11 guts contained prey items. The main prey items were weevils, beetles and grasshoppers with a few other odd items such as an ant, two thrips, insect larvae, a spider and a piercing insect. One exception was one Anna Plains bird that had taken six slaters. Although the birds collected from Roebuck Plains all had the remains of grasshoppers in their guts, only three of the five guts collected from Anna Plains had grasshoppers present and in smaller amounts. The birds collected from Roebuck Plains all appeared to have full stomachs as though they had just fed.

In the case of beetles, the head or the body was the main parts found in the guts examined. Whereas, for the grasshoppers, the main body part left was

Table 5. Gut content of Little Curlew at Roebuck Plains (N = 5) and Anna Plains (N= 6). The number in brackets is the number of guts that had a prey item present.

Prey types	Roebuck Plains	Anna Plains
Order Coleoptera sp. 1	-	-
Family: Curculionidae (Weevil)	-	-
head	-	1, sp1? (1)
whole	6 (2)	-
total	~1(pieces)?-10 (4)	-
Size range mm (length)	4.5-7.3, 4.4-6.6 (2)	-
Order Coleoptera sp. 2	-	-
Family Curculionidae (Weevil)	-	1 (1)
Order Coleoptera sp. 3	-	-
Family Curculionidae (Weevil)	-	-
Head (* head with horns, dif. Sp.?)	-	15 + 1* (1)
legs	-	3 (1)
Order Coleoptera sp. 4, (Beetle)	-	-
abdomen	1 (1)	-
Order Coleoptera sp. 5, (Beetle)	-	-
Order Coleoptera sp. 6,		
Iridescent Beetle	-	-
Order Coleoptera sp. 7, (Beetle)	-	-
whole	-	4 (1)
head	-	1-33 (2)
wing	-	2 (1)
abdomen	-	1 (2)
Order Coleoptera sp. 8, (Beetle)	-	-
whole	-	10 (1)
head	-	26 (1)
Size mm (snout to tip of abdomen)	-	<9.5 (1)
Order Coleoptera sp. 9, (Beetle)	-	-
whole	-	1 (1)
head	-	1 (1)
Order Coleoptera sp. 10	-	-
Family Pentatomidae (Beetle)	-	-
whole	-	6 (1)
pieces	-	2 (1)
Order Orthoptera sp. 1	-	-
Family: Locustidae (Grasshopper)	-	-
head	7 (2)	-
jaw pieces	14-55 (5)	3, sp 1?, -22, sp 1? (2)
striating pads	20 (1)	-
wing	1 (1)	-
antenna	1 (1)	-
fragments	Present (2)	Present (2)
pieces of leg	1-few (3)	-
Total bodies present	5-8 (2)	1 (1)
Order Hemiptera sp. 1	-	-
Piercing insect	1 (1)	-
Order Hymenoptera sp. 1	-	-
Family Formicidae	-	-
Ant head	1 (1)	-
Order Thysanoptera sp. 1	-	-
Thrip	-	2 (1)
Insect, sp. 1	-	1 (1)
Insect larvae, sp. 2	-	1 (1)
Insect larvae, sp. 3	-	1 (1)
Insect pieces	-	-
unidentifiable	Present (1)	present-3 pieces (2)
Order Araneae	-	-
Spider, sp. D	1 (1)	-
Order Crustacea	-	-
Slater *Porcellio scaber*	-	6 (1)
Plant-Seed	-	1 (1)
Stones, number & size range mm	3,<5.2 - 6,<5.5 (2)	1,<3.7 - 4,<4.3 (2)
Piece of Shell, size of shell mm	-	1, 1.0 x 5.4 (1)

the jaw pieces and the head and body in two cases. Where the body was virtually intact, five to eight whole grasshoppers were present. In only one case were the striating pads of the grasshopper present and then in large numbers (20). Although not measured, the intact grasshoppers were at least 4-5 cm long (per. obs.).

While the Roebuck Plains guts contained mostly grasshoppers and one species of weevil, the Anna Plains guts contained a greater variety of prey items with one bird having one weevil, six slaters and 76 beetles of three different types in its gut.

When looking at the jaw pieces found in the guts of the Roebuck Plains birds and dividing by 2, the number of grasshoppers consumed ranged from seven to 28 per bird. In the Roebuck Plains birds, the weevils (Order Coleoptera sp. 1) measured from the guts of two birds ranged in size from 4.4 mm to 7.3 mm in length while 30 of one beetle species from the gut of an Anna Plains bird measured up to 9.5 mm in length. In five out of the 11 guts examined, stones of different sizes were found, but all less than 5.5 mm in diameter. The stones were of different colours and materials including quartz.

Curlew Sandpiper

Only one Curlew Sandpiper gut was collected from the Port Hedland saltworks. The gut contained only one Brine Shrimp (Table 3).

DISCUSSION

As the NW of Western Australia faces rapid development, it is important that there is information available to argue the case for protecting areas of ecological importance such as Roebuck Bay and 80 Mile Beach. Port Hedland saltworks, while at the moment run for commercial salt harvesting, could be sold and used for other purposes. Information collected through gut analysis complements research done on invertebrates in the substrate at Roebuck Bay and 80 Mile Beach by the WA Museum and CALM (Pepping *et al* 1999, Pearson *et al* 2000). Although detailed analysis did not occur on the collected guts, the information available from preliminary analysis is still important in filling in the gaps of knowledge on the diet of waders.

Red-necked Stint

The results of the gut analysis of the Red-necked Stints that were taken at the Port Hedland saltworks is consistent with the potential prey items which would be available to waders at a saltworks. In a study done at Laverton Saltworks, Victoria, Jessop (1982) found that all insect life stages provided food for water birds, particularly Ephydridae (*Ephydrella* sp.) and Chironomidae. Crustaceans from the family Gammaridae, Brine Shrimp and Ostracoda also could be potential prey items for water birds. It is quite possible that the insect larvae, chrysalis and some of the adult insect parts found in the guts of the Port Hedland birds were from the family Ephydridae or Chironomidae.

Unlike the results of the Laverton study, I found no annelids in the guts of the birds collected from the Port Hedland saltworks. This may indicate that the birds were feeding in areas that were highly saline that could not support annelids. Research at Laverton showed that annelids were present in up to 86 ‰, whereas Brine Shrimp were found in ponds with a salinity of around 269 ‰ (Jessop 1982). However, Brine Shrimp found at such high salinity may have been sluiced into the area by artificial means rather than living and breeding in the pond.

Alternatively, the reason for no annelids being found may have been due to the Red-necked Stints targeting those prey items that were most abundant or due to the annelids being digested and therefore not identified. Annelids were found in the gut of the Roebuck Bay bird and this suggests that if the Port Hedland birds had taken annelids, they would have appeared in the gut samples.

Although Rogers (1999) did not study the prey of the Red-necked Stint, it was assumed that they would concentrate on polychaetes and soft-bodied crustaceans between three and twelve millimetres long, bivalves and other hard-bodied animals such as gastropods, ostracods, hermit crabs and spider crabs less than five millimetres long. By observing where the Red-necked Stints were in relation to what was found in the substrate, it was suggested that Opheliidae, Capitellidae and *Solemya* would be very suitable prey types (Rogers 1999).

The food preferences suggested by Rogers (1999) was partly confirmed by the Red-necked Stint gut collected from the Roebuck Bay that contained worms and gatropods. Other studies have found that Red-necked Stints take a variety of prey depending on where they are feeding (Van Tets *et al* 1977, Poore *et al* 1979, Dann 1981, 1983 & 1999, Thomas 1986, Barker & Vestjens 1989, Johnstone & Storr 1998). Their prey is known to include seeds,

bivalves, gastropods, marine worms, insects, crustaceans, spiders and small fish (Barker & Vestjens 1989, Harrison 1997).

The taking of Brine Shrimp, both in the egg and adult form at the Port Hedland saltworks highlights the Red-necked Stint's ability to take advantage of prey items that are available in an area. Brine Shrimp were abundant at the Port Hedland saltworks where the Red-necked Stints were feeding (per. obs.). Whereas, the gut from the Roebuck Bay bird revealed white segmented worms and gastropods. Therefore, although only a small overall sample, the results show that Red-necked Stints take a variety of prey items depending on where they are feeding.

Greater Sand Plover

Results showed that the Greater Sand Plover collected in Roebuck Bay had been feeding on small crabs. Small crabs were observed at low tide along Roebuck Bay where the Greater Sand Plover would have been feeding (pers. obs.). Rogers (1999) observed Greater Sand Plover in Roebuck Bay feeding on small active prey picked up from or just below the surface. Most of these prey items were probably arthropods of some kind with Greater Sand Plover also being observed picking up small crabs (Rogers 1999). When the distribution of the Greater Sand Plover was plotted over the density map of assumed preferred prey, it suggested that Greater Sand Plover would concentrate on arthropods and Sternaspidae worms less than 12mm long (Rogers 1999).

Van Tets *et al* (1977), Marchant and Higgins (1993), Johnstone and Storr (1998) found that Greater Sand Plovers feed on crabs. The four Greater Sand Plover stomachs analysed by Johnstone and Storr (1998) revealed that the plovers had been feeding on small crabs, small molluscs, an earwig and other insects. Marchant and Higgins (1993) cited molluscs, worms, crustaceans, insects and occasionally lizards, with one record of plant material. Prey items identified by previous studies and this analysis show that Greater Sand Plovers can hunt very active prey (crabs, lizards, insects). Although they may expend more energy hunting very active prey presumably the energy benefits are worthwhile considering one crab probably provides the energy of many small worms.

Red Knot

In a preliminary study conducted by Tulp and de Goeij (1991), Red Knot were occasionally observed feeding on bivalves in Roebuck Bay, Broome. Most prey items taken were very small, and hence almost impossible to identify. However, in a later study, Tulp and de Goeij (1994) found that Red Knot took bivalves, gastropods, worms, crabs and a sea cucumber. Of these prey, bivalves made up a large part of the diet of the Red Knot in Roebuck Bay. Studies in New Zealand (Piersma 1991) also found that Red Knot fed mainly on a few small thin-shelled bivalve species ranging in length from 3 to 15 mm, even though a commoner thicker shelled species was available. However, Piersma (1991) noted that at another site, trochid gastropods were also taken. At both sites the diet of the Red Knot consisted entirely of molluscs.

Tulp and de Goeij (1994) admitted that it is difficult to determine what prey items Red Knot are taking. In Roebuck Bay, they foraged in a continuous pecking motion, hardly ever lifting their bills completely out of the mud. This characteristic behaviour of rapidly drilling soft sand and mud was also highlighted in a study in Victoria (Dann 1983). There, it was assumed that Red Knot were taking gastropod molluscs and amphipod crustacea.

As the Red Knot is considered a tactile rather than visual feeder, the use of stomach analysis to determine diet can help determine what prey items are being taken when identification of small prey items using only visual observation is difficult. In this study, it is interesting to note that Red Knot at Roebuck Bay had been taking crabs and that six of the seven guts analysed contained crab pieces. Thomas (1986) observed Red Knot taking Welks *Paracanassa* sp. off rocks well above the water's edge. This shows that although the predominant method of feeding by Red Knot may be tactile, they can take advantage of a prey item that requires visual cues to catch. Three out of the nine guts analysed contained parts of insects and one stomach contained a larvae or small fish. This also supports the idea that Red Knot can be opportunistic when it comes to taking prey items.

The analysis of the guts from Roebuck Bay and 80 Mile Beach also showed that gastropods were more common in the diet than bivalves. That visual analysis shows bivalves as the most common prey item taken and gut analysis that gastropods and crabs are taken may be explained by Red Knot selecting prey items based on whether they can

digest them rather than just on abundance. Piersma (1991) hypothesised that Red Knot preferred small and probably less profitable prey to large prey to reduce the risk of not being able to successfully swallow or stomach crack the prey taken. My gut analysis showed that Red Knot had taken crabs, suggests that further visual investigation would be interesting to see if crabs were swallowed whole by Red Knot or broken up for digestion.

The size two gastropods species measured in Red Knot guts were small (3 mm) and supports Piersma's (1991) and Tulp & de Goeij (1994) theory that Red Knot take very small prey items that are easy to digest. In a study in Roebuck Bay at Richards and Falls Point (Rogers 1999), Red Knot were observed feeding with Great Knots on very small bivalves. When the substrate was sampled *Anodontia*, *Nucula*, *Solemya* and *Macoma exotica* were found in high densities. Further along the bay near Crab Creek a flock of mainly juveniles was observed gorging themselves on mangrove moon-snails (Rogers 1999). The study also reported observing Red Knot occasionally eating tiny hermit crabs, shells and all.

Pearson *et al* (2000) found that although diversity of potential prey items off 80 Mile Beach was high it did not rival that in Roebuck Bay. However, as 80 Mile Beach is used by more waders than Roebuck Bay it suggests that diversity is not a major critical factor in waders using the area (Pearson *et al* 2000). When the gut analysis of Roebuck Bay and 80 Mile beach were compared, Red Knot from both areas took gastropods but no bivalves were found in the guts samples taken from birds that had been feeding on 80 Mile Beach.

Small stone were found in only two out of the nine guts examined suggesting that although Red Knot may use their stomachs to crack open hard shell prey (Tulp & de Goeij 1991), they do not need stones in their stomachs to aid digestion.

The studies by Tulp & de Goeij (1991,1994) are of particular relevance to the gut samples taken of Red and Great Knot as the work was done at Roebuck Bay, Broome and to a lesser extent at 80 Mile Beach. The study also overlapped the same time of year as when my samples were collected, which was March – April.

The other main study of Roebuck Bay by Rogers (1999) assumed the preferred prey of Red Knots to be:

- Bivalves, *Siliqua*, *Cultellus* and *Ensis* if < 29 mm long, *Macoma* (and most *Tellina*) if < 23 mm long, *Modilous* (and *Ledella*, *Nucula* and *Anadara*) if < 22 mm long, *Tellina piratical* (and *T. capsoides*, *Solemya*, *Donax*, *Gari*, *Laternula*, all Mactridae, Semelidae, and most Veneridae) if < 20 mm, *Anomalicardia* if < 15 mm and *Anodontia* (and *Divaricella*, *Ctena* and *Placamen*) if < 14 mm long.
- Cumaceans, shrimps, hermit crabs, spider crabs and *Lingula*.
- *Leucosia* crabs if < 14 mm.

Little Curlew

The Little Curlew is a nomadic species that is abundant throughout northern Australia (Lane 1987). Lane (1987) and Bamford (1990) described the typical habitat the Little Curlew utilized during the dry season. They found Little Curlew prefer dry flood or black soiled plains covered with dry short grass and sedge lands with access to shallow fresh water pools. Both catch sites in this study fitted this typical habitat description. In Broome, the Little Curlew has also been observed feeding in gardens and open areas plus on the town's golf course (Lincolne 1970, Jessop & Collins 1999). Dr. R. Jessop and P. Collins (pers. comm.) also noted seeing them feed in the Horse Yards near Broome, where they roosted at night but didn't feed. The only prey item they could see that they could possibly be eating was ants.

The results from the guts analysed support previous findings that the main prey items of Little Curlew are insects. While Higgins & Davies (1996) listed the Little Curlew as taking both plant and animal prey items with the main plant items when taken, being the seeds of Poaceae, Setaria, Fabaceae and Convolvulaceae, only one seed was found in all the guts I analysed.

Examination of the guts revealed that the Little Curlew diet at the two sites consisted of weevils, different types of beetles, grasshoppers, thrips, slaters, spiders, ants and insect larvae. This fits in with the Little Curlew's known animal prey (Higgins & Davies 1996, Johnstone & Storr 1998). Two prey items found in the analysis not recorded before are thrips and slaters. Although the slater is a crustacean, it is not surprising it was taken, as it would presumably appear like a small beetle to a foraging Little Curlew.

In an analysis of banding data of the Little Curlew caught at the same time as the gut samples were taken at Roebuck Plains, it was found that only 5 out of the 342 birds measured were above the minimum weight necessary for migration to southern China (Barter 1992). It was also noted that almost all Little Curlew had departed by the end of the expedition on 20 April 1985 (Lane & Jessop 1985). Thus, the birds collected were most likely putting on weight for migration and did this in a month or less. The idea that the Little Curlew were consuming large amounts of prey items in order to gain weight for migration was supported by the evidence that all Roebuck Plains birds had full stomachs of their main prey item, grasshoppers and to a lesser extent weevils. One bird, in particular, not only had consumed at least 28 grasshoppers but had also taken 10 weevils, the largest being 7.3 mm long. Although not measured, some of the whole grasshoppers observed in the stomachs were at least 4 cm long, a sizable prey item and well worth catching.

As it is not known how long body parts such as jaw pieces remain in the stomach after digestion of the main body, it has been assumed that the indigestible parts would move out of the stomach after feeding has finished. One Roebuck Plains bird had five - eight whole grasshoppers (at least 4 cm long), six whole weevils (up to 6.6 mm) plus the abdomen of a beetle in its gut shows that a large amount can be taken before the stomach appears full. Little Curlew can eat seven to 31 grasshoppers along with zero to 10 weevils. This shows that a large number of prey items were being consumed during one feeding session.

Birds from Anna Plains took a greater variety of prey items compared to birds that had been feeding on Roebuck Plains. There may have been two contributing factors for the greater variety of prey items. One, that there may not have been as many grasshoppers present on Anna Plains and two, there was a greater diversity of prey items present in the area. It was interesting to note that while it is the jaw piece in grasshoppers which seems to survive initial digestion, in beetles it appears to be the head that survives, as illustrated by the beetles in gut 10. The results show that birds took grasshoppers and weevils whole and relied on their gut to break down the prey.

The presence of intact bodies of grasshoppers and weevils in the guts of Roebuck Plains birds indicates that the birds had been feeding shortly before they were caught. This supports previous observations that Little Curlew do their feeding during the day then retire at night to roost (Bamford 1989, Jessop & Collins 1999). This contrasts with the conclusions of Lane (1987) who found Little Curlew roosting during the day. He inferred that the birds were feeding at night instead. However, its more likely that the birds were resting during the heat of the day.

Small stones were found in only five of the 11 guts analysed. The stones were of different materials and colours and not found in all birds. This tends to suggest that they were accidentally consumed rather than purposely picked up to aid digestion or the latter but picked up at different times and places.

Curlew Sandpiper

Previous studies have shown that Curlew Sandpiper take mainly worms, molluscs, crustaceans and insects along with seeds (Higgins & Davies 1996, Dann 1999). Only one gut was taken of a Curlew Sandpiper and in a modified environment, therefore not a large enough sample for generalising what prey items they normally take.

Minton (2000) noted that in the Port Hedland saltworks, Curlew Sandpiper regularly feed by swimming and picking food from the surface of the water in a manner similar to that of phalaropes *Phalaropus* and Banded Stilts *Cladorhynchus leucocephalus*. This method of feeding would be ideal for picking up the soft bodied Brine Shrimp floating near the surface, which were found in the gut of the Curlew Sandpiper examined. When present the Brine Shrimp at the Port Hedland saltworks could be found along the shoreline of evaporating ponds and further out in the ponds near the surface of the water (per. obs.). Minton (2000) suggested that the salt water in the ponds, which is greater than that of normal seawater, would aid the buoyancy of the birds.

The Port Hedland Saltworks – An environment modified by man

Information on the prey items taken by birds at the Port Hedland saltworks is interesting as the saltworks is a highly modified environment. Unlike Roebuck Bay and 80 Mile Beach, the Port Hedland saltworks has been modified for the commercial purpose of harvesting salt. It has provided a habitat suitable for waders to feed. This would not have been considered when the area was first developed. As more wader habitat around the world is taken

over and modified by humans, it has become vital that information on how waders utilize these areas is collected.

The Port Hedland saltworks, like the Laverton saltworks, Victoria is a hypersaline environment, which can be described as 'stressed' (Nixon 1974). Organisms within a 'stressed' system must expend energy to remain part of the system. This is achieved in the case of potential prey organisms by physiological adaptations. Brine Shrimp cope with the saline environment through osmo-regulation and have been found in salinities of 300 ‰ (Bayly & Williams 1973). Staaland (1976) found that the size of nasal glands in waders correlated with the amount of time spent in a saline environment. Thus, the longer they spent in such an environment, the larger their nasal glands.

Both Curlew Sandpiper and Red-necked Stint at the Port Hedland saltworks would have been subjected to this stressed environment, taking prey and presumably ingesting at the same time a certain amount of saline water that they would need to be excreted.

As the Port Hedland saltworks is a managed environment, the conditions would be ideal for certain prey items to exist in higher numbers than if they were in a natural setting. Unlike Roebuck Bay and 80 Mile Beach, the Port Hedland saltworks is used at high tide rather than low tide. The saltworks provides an area where small waders can continue feeding after being pushed off their feeding areas along the coast. It would be interesting to find out if the Port Hedland saltworks enables small waders to "fuel up" quicker for migration or whether the extra hours of feeding compensates for perhaps poorer low tide feeding grounds than those encountered at Roebuck Bay and 80 Mile Beach, which finishes about 150km away from the saltworks. Another explanation may be that birds that are less efficient at feeding use the area to enable them to put on enough weight to migrate.

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THE FIRST CATCH OF BANDED STILTS IN VICTORIA: BIOMETRICS, MOULT AND AGE/SEX STRUCTURE

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ABSTRACT

This study describes the results from a single catch of 151 Banded Stilts, *Cladorhynchus leucocephalus*, at the Western Treatment Plant, near Werribee, in Victoria on 28 December 2000. More than half of the birds were juveniles, confirming that the breeding event at Lake Eyre during the winter of 2000 was successful. Adults and juveniles had similar bill lengths and total head lengths, but juveniles had shorter wings and were lighter. Our results further indicate that the breast band can be completely absent in adults, and that adults moulted their primary feathers soon after the breeding event. Whereas, juveniles started their primary moult about four months after fledging. Field observations of flagged birds over the following year and a half (to mid 2002) confirmed that adult birds did not necessarily have complete breast bands.

INTRODUCTION

One of the ornithological highlights during the winter of 2000 was the breeding of large numbers of Banded Stilts, *Cladorhynchus leucocephalus*, at Lake Eyre. After two earlier attempts, in late February/May, which largely failed due to heavy predation by Silver Gulls, *Larus novaehollandiae*, the birds finally bred successfully during June-July 2000 (Anon. 2000). The success of the third breeding attempt was due to management measures taken to reduce the numbers of Silver Gulls at the breeding site (Anon. 2000). The previous known successful breeding attempt by Banded Stilts also occurred at Lake Eyre during February-November 1997 (Minton 1997). A breeding attempt at Lake Goongarrie in Western Australia in 1999 failed (Minton & Pearson 1999, Anon. 1999). The previous successful breeding in Western Australia was at Lake Ballard in 1995 (Minton & Pearson 1999).

Very little is known about the biology of this intriguing species. Banded Stilts breed on inland salt lakes, which only fill after heavy rains (Jones 1945). As such rains are unpredictable and infrequent, breeding events are scarce. Furthermore, documentation on these breeding events is limited, due to the remoteness of most salt lakes (Jones 1945) and their inaccessibility after heavy rains. When the inland lakes dry out, birds move to coastal areas (Marchant & Higgins 1993). Two populations are thought to exist,: one in Western Australia and one in South Australia and Victoria (Jones 1945). However, western and eastern birds appear to be similar in size (Marchant & Higgins 1993). The observation at the Lake Eyre breeding colony of an individual previously flagged in Western Australia (Minton, Collins & Jessop, pers. obs.) further suggests that Banded Stilts from WA are not isolated from eastern birds. Whether the Banded Stilt is separated into two distinct populations therefore remains to be established.

The irregular, highly synchronised breeding events must lead to a very unusual age structure of the population of Banded Stilts. The entire population should consist of discrete, unevenly spaced, age-cohorts. It was previously thought that Banded Stilts could be aged on the presence or absence of a breast band (Alcorn & Alcorn 1990). However, examination of museum skins has shown that adults in non-breeding plumage can also lack the breast band (Marchant & Higgins 1993). Such birds were identified as adults by the lack of white-tipped juvenile coverts or primaries, or (in case of females) by their convoluted oviducts, which indicate that they had previously bred (D. Rogers, pers. comm.). Juveniles can be recognised by their brown wing coverts, which have white tips when fresh, and their grey legs (Marchant & Higgins 1993), but can probably only be identified with certainty in the hand.

The unpredictability of breeding events probably also means that the birds have no way of timing their moult optimally in relation to breeding. For example, 25% of adults breeding in the early stages of the breeding event at Lake Ballard in March 1995 had nil or only partial breeding plumage, although these birds were actively engaging in breeding activities (Minton, pers. obs.). After 3-4 weeks all birds at the Lake Ballard and Lake Eyre breeding events had acquired full breeding plumage (Minton, pers. obs.). Full breeding plumage has been recorded in all months, while primary moult occurs mainly in winter or spring (Marchant & Higgins 1993).

This paper presents information obtained from the first catch of Banded Stilts in Victoria made by the Victorian Wader Study Group (VWSG). This was the first significant catch of adult Banded Stilts ever made and therefore provided a unique opportunity for gathering data for comparison with museum specimens. Our aims were to describe biometrics, primary moult and plumage patterns. Banded Stilts show slight sexual dimorphism in measurements (Marchant & Higgins 1993), which we used to assess whether the sex ratio of the sample was biased.

METHODS

The sample of Banded Stilts analysed in this study were caught by the VWSG in a single cannon-net catch at the Murtcaim Wildlife Area at the Western Treatment Plant of Melbourne Water, near Werribee, at 11 a.m on 28 December 2000. For each individual, we recorded bill length, head-bill length (both to the nearest 0.1 mm, using callipers), wing length (maximum chord, to the nearest mm, using a butt-ended ruler) and body mass (to the nearest g, using an electronic balance). We further recorded primary moult and the extent of the dark breast band and belly-patch (scored as 0, 25, 50, 75 or 100% - individuals with grey smudges on an otherwise white breast were scored as 'trace'). Putative age was assessed from (1) presence or absence of a dark breast band and belly-patch (their presence was taken as evidence for adult age), (2) leg colour (juveniles have grey legs, Marchant & Higgins 1993), and (3) state of the primaries and wing coverts (brown feathers were taken as evidence for juvenile). The birds were banded with a metal band of the Australian Bird and Bat banding Scheme on the left tibia and an orange leg flag on the right tibia and released.

All bill, head-bill and wing measurements were made by three of us (CM, KK and PC). Bill measurements (but not head-bill and wing) differed significantly between the three measurers (ANOVA $F_{2,148} = 7.16$, $P < 0.001$). This difference was not due to differences among observers in the percentage of juveniles measured ($\chi^2_2 = 2.68$, $P = 0.26$). Each observer measured a similar number of birds ($n = 46$, 55 and 50), and visual inspection of the data suggested that the differences were not due to outlying data points. Bill measurements were therefore standardised by adding/subtracting the difference between mean measurement of each observer and the overall mean (-1.81 mm, +0.50 mm and +1.11 mm, all <3% of the overall mean). The mean bill length for each sex and the sex ratio of the sample were calculated from the observed frequency distribution, using the method of Rogers (1995). Other statistical tests were performed in SYSTAT 7 (Systat 1997). Means are presented ± standard deviation.

RESULTS

Age structure and biometrics

A total of 151 Banded Stilts were caught and measured. We classed 62 (41.1%) birds as adult and 89 (58.9%) as juvenile. The biometrics of these groups are summarized in Table 1. Juveniles had significantly shorter wings and lighter weight than adults. There were no differences in bill and head-bill length between juveniles and adults. In adults, moulting birds were significantly lighter than birds without moult (237.0 ± 18.0, $n = 10$ and 251.9 ± 18.1, $n = 50$, respectively, $t_{58} = -2.37$, $P = 0.02$). This was not the case for juveniles (235.0 ± 15.9, $n = 59$ and 231.9 ± 15.0, $n = 30$, $t_{87} = -0.87$, $P = 0.39$).

Sex determination and sex ratio of sample

Bill length is the most sexually dimorphic measurement in Banded Stilts (Marchant & Higgins 1993). The histogram for bill length (Fig. 1) was bimodal and we calculated the mean and standard deviation for each mode using the method of Rogers (1995). Mean bill length for males was 72.02 ± 2.97 ($n = 62$) and for females 66.41 ± 2.74 ($n = 89$). For comparison, Figure 1 also shows the expected distributions of bill lengths for males and females based on the mean and standard deviations of museum specimens reported in Marchant & Higgins (1993).

Table 1. Means and variation in biometric measurements (mm) and body mass (g) of adults and juveniles. Bill length was adjusted for differences between measurers. Difference tested with *t*-tests using a sequential Bonferroni analysis (Rice 1989) (*n* = sample size; SD = standard deviation and CI = confidence interval).

Measurement	Adults				Juveniles				Difference	
	n	Mean	95% CI	SD	Range	*n*	Mean	95% CI	SD	Range	*t*	*P*
Bill	62	68.4	67.4-69.4	3.9	61.5-76.6	89	68.1	67.2-68.9	4.0	59.7-79.0	0.48	0.63
Head-bill	62	104.4	103.3-105.6	4.6	95.6-114.3	89	104.2	103.2-105.2	4.8	92.5-116.4	0.34	0.74
Wing	58	200.6	199.3-201.9	5.0	189-212	76	196.5	195.1-197.8	6.0	184-217	4.26	0.0001[b]
Mass	60	249.4	244.5-254.2	18.8	199-293	89	233.9	230.7-237.2	15.6	203-274	5.45	0.0001[b]

The estimated sex ratio of 58.9% females was significantly different from the expected 50% (χ^2_1 = 4.8, P = 0.03). However, when an outlying data point of 79.5mm was removed from the data set, the estimated sex ratio was 56.7% female (65 males and 85 females), which did not differ significantly from parity (χ^2_1 = 2.7, P = 0.10).

Moult patterns

A partial or complete breast band was present in all but four adults (Fig. 2). Seven juveniles showed grey smudges on the breast, but the remaining 82 juveniles had white breasts.

Juveniles were significantly more often in active primary moult than adults (juveniles: 66.3%, adults: 16.1%, χ^2_1 = 37.1, P = 0.0001). Of the 30 juveniles that were not in active primary moult, 28 had not yet started primary moult, while two had recently completed their moult (Fig. 3). In contrast, all 52 adults that were not in primary moult had fresh primaries (Fig. 3). Three adults showed an unusual pattern of primary moult in which one primary was growing (P3, P8 and P9), while all others appeared fresh.

Most of the adults that were in active primary moult had no, or only a partial breast band (Fig. 4). One out of 24 birds with a full breast band was in primary moult, while nine of 38 adults with no, or a partial breast band were in primary moult (χ^2_1 = 4.1, P = 0.04).

Resightings of leg flags

Banded Stilts with orange leg flags have been regularly observed at the Western Treatment Plant, at Laverton Saltworks, and at other locations on the Bellarine Peninsula since the 28 December 2000 catch. Throughout this period (up to July 2002) flagged birds seen have been in a range of plumages. Even during 2002, when juvenile birds marked in December 2000 would have been 1.5 to 2 years old, flagged birds could be seen with negligible breast bands and belly patches.

DISCUSSION

The third breeding attempt at Lake Eyre in 2000 resulted in successful hatching of chicks (Anon. 2000). Although Banded Stilts are known to abandon their chicks when the breeding sites dry out (Burbidge & Fuller 1982), ornithologists were confident that Lake Eyre had stayed in a suitable condition long enough to allow chicks to fledge.

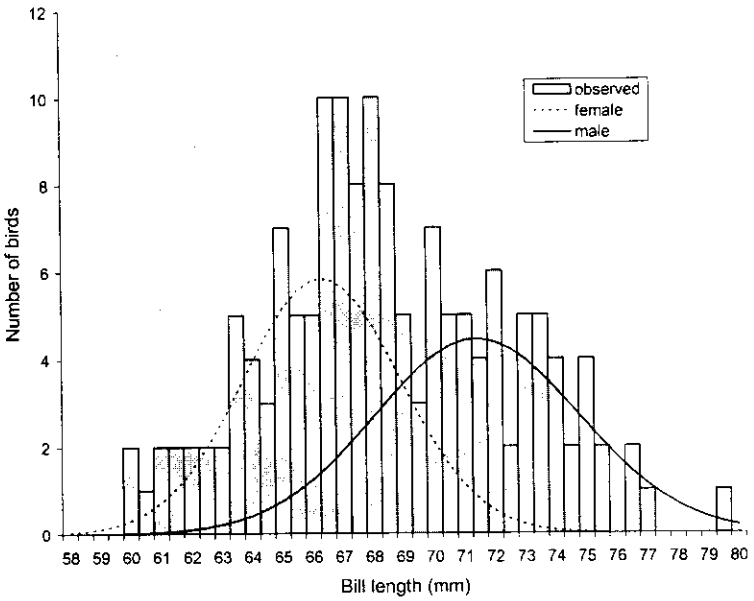

Figure 1. Frequency distribution of bill length among the complete sample of Banded Stilt. Bill length was adjusted for differences between observers. The expected distributions for males and females are based on the means and standard deviations of sexed museum specimens reported in Marchant & Higgins (1993).

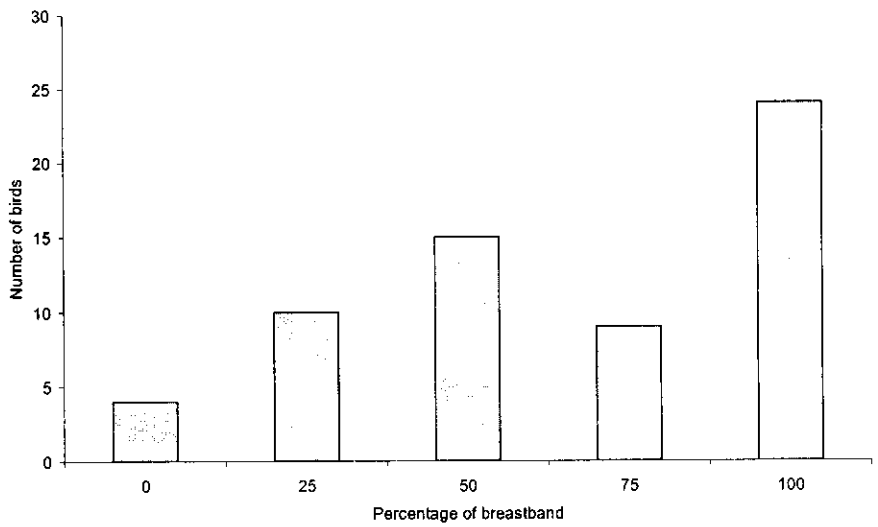

Figure 2. Frequency distribution of the presence of a breast band in adult Banded Stilt.

The results of this study confirm that a high proportion of chicks must have fledged successfully as more than half of our sample consisted of juveniles. As the Lake Eyre breeding event was the only one recorded during the previous year, it is reasonable to assume that the juveniles we caught came from there. However, it is not known whether the juveniles were evenly spread among the Banded Stilts population in December 2000. Therefore, we do not know whether the proportion of young birds in our sample was representative of the entire eastern Australian population.

The estimated mean bill lengths for males and females corresponded closely to those of museum specimens (Marchant & Higgins 1993). The mean wing length in our sample was slightly longer than that reported for specimens (Marchant & Higgins 1993). This is probably due to shrinkage of the specimens compared with live birds. It has been suggested that the populations of Banded Stilts in South Australia/Victoria is largely separated from the population in Western Australia (Jones 1945). The mean bill length and head-bill length of a

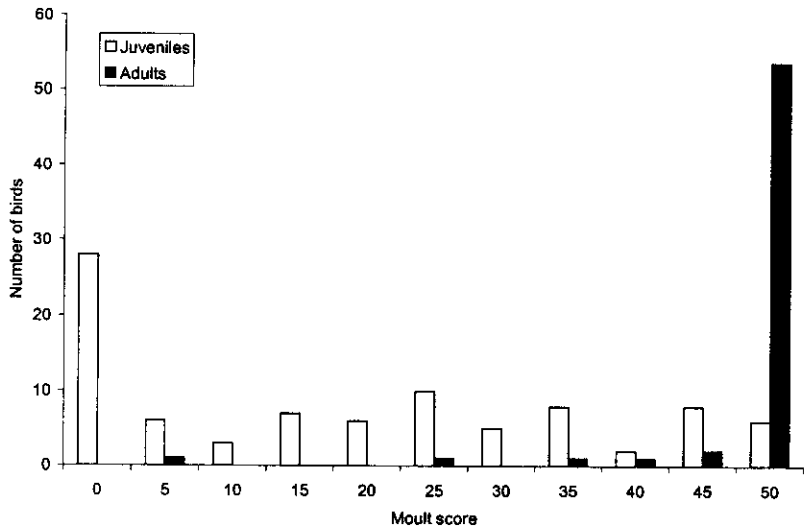

Figure 3. Frequency distribution of moult scores for adults and juvenile Banded Stilt.

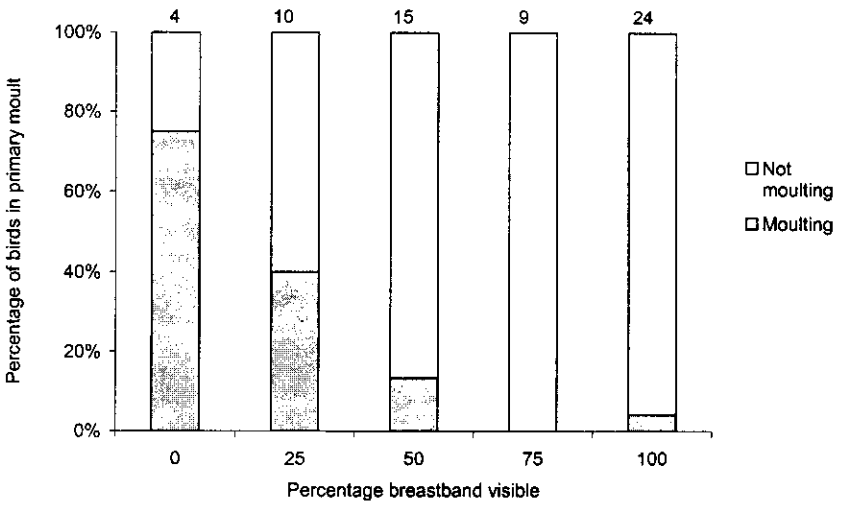

Figure 4. Percentage of birds with different amounts of breeding plumage that were in active wing moult. Sample sizes are indicated above the bars.

sample of adults caught at Port Hedland (68.1, n = 71 and 103.8, n = 46; Marchant & Higgins 1993) are both within the 95% confidence intervals of the means for our sample from Victoria. The mean wing length of the Port Hedland sample (198.8, n = 20) was slightly shorter than that of the adults in our sample, but longer than that of juveniles, which could be due to differences in measuring technique and feather wear. Therefore, there is no compelling evidence that the two populations differ in measurements.

Based on data from museum specimens and birds caught in Western Australia, Marchant & Higgins (1993) suggested that moulting birds are lighter than those without moult. This was confirmed for adults in our sample, but not for juveniles. The mean weight of adults without moult reported in Marchant & Higgins (1993) is 263 g (males, n = 9) and 261 g (females, n = 5), both heavier than in our sample (252 g). Most of the adults we caught may thus still have been accumulating weight.

About one-third of the Banded Stilt eggs at Lake Eyre had hatched by 16 July 2000 (Anon. 2000) and most chicks would have fledged in August (chicks fledge after c. 50 days, Marchant & Higgins 1993). More than half of the juveniles in our sample, taken

about four months later, were in active primary moult. Two juveniles had even completed their primary moult, but these could have been from the relatively small numbers of chicks that hatched from the first nesting attempt in late March/early April and survived the Silver Gull predation. In contrast, most adults had already finished primary moult, indicating that they had started moulting soon after the breeding event was completed. Their duration of primary moult may therefore only be c.100 days, which is shorter than the 120 days typically required by migrant waders from the Northern Hemisphere. The outer (non-moulted) primaries of three moulting adults were in very good condition, perhaps indicating that they had previously been moulted just prior to breeding. If so, these birds were then replacing these relatively new primaries again after breeding. Breeding events might thus re-synchronise moulting among adults.

It is clear that adult Banded Stilts have a non-breeding plumage, where the breast bands and belly patch are only partial or are completely lacking. Therefore, it is inaccurate to categorise all birds seen in the field without these plumage features as juvenile/first year birds. However, it is uncertain how frequently adult birds change their body feathers and flight feathers between breeding periods and whether this always involves a stage when the dark breast band and belly plumage are lost. Marchant & Higgins (1993) state that primary moult and body moult are initiated at about the same time, but that primary moult is completed before body moult. If this is true, than the adults in our sample were moulting into 'breeding' plumage and must have been acquiring a breast band. This seems odd, considering that they had just bred, but may be in preparation for the next, unpredictable, breeding opportunity.

ACKNOWLEDGEMENTS

We would like to thank the management of the Western Treatment Plant for allowing us to conduct this research at the Murtcaim Wildlife Area and for their continued commitment to the conservation of birds. We offer many thanks to all the volunteers from the VWSG who were involved with the catch. We would also like to thank the South Australian Parks and Wildlife Service for their efforts in reducing numbers of Silver Gulls at the Lake Eyre breeding sites, which finally resulted in successful breeding by the Banded Stilts. We also thank the Australian Bird Banding Office for the provision of bands and both they and the Department of Natural Resources in Victoria for permission to band. Danny and Ken Rogers provided valuable comments on earlier drafts of this paper.

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BREEDING BY AUSTRALIAN PAINTED SNIPE IN THE DIAMANTINA CHANNEL COUNTRY, SOUTH-WESTERN QUEENSLAND

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ABSTRACT
A nest of the Australian Painted Snipe was discovered on an islet at the margins of a shrub-sedge swamp on the Diamantina River floodplain in January 2001. Details were obtained of habitat, bird behaviour, nest and eggs, including a probable date for clutch completion. This was possibly only the second documented breeding record of this nationally vulnerable species from arid south-western Queensland.

INTRODUCTION

The Australian population of Painted Snipe *Rostratula benghalensis* is thought to be a separate species, Australian Painted Snipe *R. australis*, distinct from the other Old World populations (Lane & Rogers 2000). The Australian Painted Snipe occurs sparsely in low numbers over much of the continent, less commonly in the south-west (Marchant & Higgins 1993). Garnett & Crowley (2000) declared the Australian Painted Snipe to be nationally vulnerable on the basis of substantial decline in reporting rate over the last 50 years (Lane & Rogers 2000). It has been proposed for listing as a threatened species under the Environmental Protection and Biodiversity Conservation Act 1999 (D. Rogers pers. comm.).

In Queensland, the Painted Snipe is listed as Rare and has been proposed for listing as Vulnerable under the *Nature Conservation Act 1992*. Occurrence in the Channel Country biogeographic region (Environment Australia 2002), specifically in the Diamantina catchment, is shown on maps in *The Atlas of Australian Birds* (Blakers *et al.* 1984) and in the *Handbook* series (Marchant & Higgins 1993: possibly based on the *Atlas*) but not in the bioregional review of McFarland (1992) or in the second Atlas (Barrett *et al.* 2002).

During 2000-2002, I conducted ground surveys of waterbirds in wetlands of the Channel Country in Queensland. This work included a survey of wetlands on middle reaches of the Diamantina, Cooper and Georgina (Eyre Creek) river systems in January 2001. A small to moderate flood had passed through both the Diamantina and Cooper reaches in weeks preceding the 2001 visit and a particularly large flood had inundated the Eyre Creek wetlands (R. Jaensch pers. obs.).

LOCATION AND DESCRIPTION OF HABITAT

On 12 January 2001, I discovered a breeding pair of Australian Painted Snipe on inundated floodplain of the Diamantina River. The site was an extensive, tree-less shrub swamp (25° 41.8' S, 140° 16.2' E) that retains floodwaters from the Diamantina River, Farrars Creek and Browns Creek (D. Trapp pers. comm.) in a maze of distributary channels and interconnected gutters.

The birds were found in the marginal zone of the swamp. This zone was 100-200 m wide, extending for more than 2.0 km around the floodplain edge, and had numerous small (eg. 10 m x 5 m) low islets. The islets were possibly derived from gilgai hollows and mounds that commonly occur in the cracking clay substrate of floodplain swamps in this region. However, they differed in being larger in area and more elongate in shape than typical gilgai mounds. The floodplain edge was formed by gibber terraces, sandhills and associated clay slopes.

The islets had a sparse to moderately-dense cover of green fertile tussocks of rat's tail couch *Sporobolus mitchellii* (to 0.4 m tall) associated with sparse sedge *Cyperus* sp. (0.5 m), nardoo *Marsilea* sp. and annuals such as joyweed *Alternanthera* sp. Open shrubland of lignum *Muehlenbeckia florulenta* over an extensive understorey of dense sedge (ribbed spikerush *Eleocharis plana*) occupied the swamp inward of the marginal zone. The swamp and marginal zone were almost totally inundated, mostly to a depth of about 0.4 m, with tops of islets less than 0.2 m above water level. Water was slowly

rising in the system due to a minor flow in the Diamantina River and a westward flow was perceptible in some gutters.

DISCOVERY AND BEHAVIOUR OF THE BIRDS

While wading in the transition area between the marginal zone and the lignum swamp at about 1600 h on 12 January, I flushed a Painted Snipe that was identified as a female due to its very dark hood. It rose from small islets 3 - 10 m apart, 1 - 15 m in width, with a few, spindly lignum shrubs. After flying for 150 m at height of less than 2.0 m above water in an arc of 270°, it disappeared in the lignum-sedge swamp. Soon after, a male Painted Snipe rose close to the observer, flying low around him in a complete circle, then back and forth restlessly until the observer moved on. No calls were detected. The pair was not seen again that day.

At 0645 on 13 January, a male Painted Snipe was disturbed on an islet 150 m from the previous sightings, in rat's tail couch and *Cyperus* (to 0.5 m) with bare mud, nardoo and annuals including nut-heads *Epaltes cunninghamii*. The bird scampered quickly through the ground cover, took flight and was not re-discovered. It is not known if this was a third bird or the male from 12 January.

Search effort in broadly similar habitat at the site amounted to six hours of slow wading over 2 - 3 ha. It included observations in the late evening and early morning, all during extremely hot weather. Searching over similar or smaller areas at seven other swamps in the Channel Country during 10 - 18 January 2001 amounted to about ten hours of effort but yielded no other Painted Snipe.

NEST DESCRIPTION AND CONTENTS

Careful searches made after both sightings revealed one nest with eggs at the location of the first sighting. It was found late on 12 January on an islet 10 m long by 6 m wide, 3 - 10 m from several surrounding islets and roughly in the middle of the islet zone. It was at the NNW end of the islet only 0.8 m from water and a little less than 0.2 m above the (rising) water level. Water between islets was more than 0.3 m deep.

The nest was a small scrape between four pug-holes made by cattle feet and a number of cattle were in the islet zone. It was partly shaded by five thin tussocks of rat's tail couch to 0.4 m tall and a few nardoo and annual plants were also present. The scrape contained just a few twigs and dry stems, pressed into the mud. Three intact eggs were in the nest.

A line of windy but mostly rain-less thunderstorms passed through the area overnight. Next day the nest was re-visited at 1230 h and four eggs were present. The eggs had many irregular, bold black spots and traces of mud were on some eggs. A number of photographs were taken. No adults were seen on this occasion.

Other shorebirds nesting (nests with eggs) in the islets zone were Black-winged Stilt *Himantopus himantopus* and Red-kneed Dotterel *Erythrogonys cinctus*. A nest with eggs of Australian Pratincole *Stiltia isabella* was amongst gibber stones on upland about 50 m from the wetland edge.

CONCLUSIONS

One other published record of breeding by Australian Painted Snipe in the Diamantina catchment in Queensland is known. Duncan-Kemp (1933) mentioned that the species bred in a swamp in the Farrars Creek sub-catchment after a local November thunderstorm. That site, about 85 km northeast of the site of the January 2001 nest, was possibly an isolated lignum swamp that I know.

Most opportunities for breeding by this species in the Queensland Channel Country are likely to occur between late spring and early autumn, due to the usual timing of thunderstorms and river floods. These months are hot and road access may be limited, so ornithologists tend not to visit in this period. As the land is under pastoral lease and grazing operations, certain access requirements apply. Furthermore the species is secretive and suitable habitat is extensive in the Channel Country. Consequently, breeding by Painted Snipe in this region is probably under-recorded.

Fortuitously, the observation described here provided a date for completion of laying, a piece of information that is rarely recorded but important for conservation management. Clutch size is normally 3-4 eggs (Marchant & Higgins 1993), hence it can be assumed that the 2001 clutch was completed late on 12 January or early on 13 January. The Australian Nest Record Scheme indicates that in southern Queensland, eggs have been recorded in January (Marchant & Higgins 1993). Several broods of juvenile Australian Painted Snipe were observed in December and January 2002 at a

swamp in coastal South-East Queensland (T. Pacey *et al.* pers. comm., R. Jaensch pers. obs.).

The fate of the 2001 Diamantina brood was not determined because there was no opportunity to revisit the site several weeks later. The rising flood waters may have inundated the nest, but this particular flood was not especially large. Although cattle were wading in the shallow margins of the swamp during the site visit, rising water levels and increased bogginess may have discouraged cattle from trampling the nest area through the incubation period (thought to be only 16 days: Marchant & Higgins 1993). Conditions tend to limit cattle use of these floodplains through the flood and early recession periods. Biting insects drive cattle onto the higher dry country, particularly at night (G. Campbell pers. comm.).

The type of wetland habitat and nest site used by these birds has much in common with other accounts of breeding by Australian Painted Snipe. Freshwater swamp with scattered lignum is a known habitat and small muddy islands are frequently used as a nest site (Marchant & Higgins 1993, Hassell & Rogers 2002, D. Rogers pers. comm.). In the inland of Australia, occurrence of nests in or beside particularly large wetlands has been documented (Jaensch in press) though small wetlands are also used (Hassell & Rogers 2002).

As for most other waterbirds, the primary threat to continued breeding by Australian Painted Snipe on the Diamantina floodplain is potential reduction or cessation of river flows. Major water resource developments have been identified as coinciding with a decline of the species in the northern Murray-Darling Basin (Garnett & Crowley 2000).

The present account and other records from the past decade (Jaensch in press, Hassell & Rogers 2002, J. Reid pers. comm.) show that Australian Painted Snipe occur and breed in wetlands under active pastoral grazing operations. Further study is needed to ascertain the potential impact of cattle on breeding by this species and to determine suitable management strategies that permit sustainable grazing and biodiversity conservation both to continue in floodplain wetlands of the Channel Country.

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RED-NECKED PHALAROPES AT PORT HEDLAND SALTWORKS

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ABSTRACT
The Red-necked Phalarope is an uncommon non-breeding visitor to Australia. This paper reports on biometrics and moult of 23 birds caught at Port Hedland, NW Australia in October and November.

INTRODUCTION

The Red-necked Phalarope *Phalaropus lobatus* is a non-breeding visitor to Australasia. Most birds in the East Asian-Australasian Flyway winter on the open sea north of New Guinea between central Indonesia and western Melanesia (van Gils and Wiersma 1996; Mörzer-Bruyns 1965; White & Bruce 1986). However, small numbers are regularly recorded at several locations around the west and southern coasts of Australia (Higgins & Davies 1996). The largely pelagic habits of this species away from the breeding grounds mean that relatively little is known of its habits in the non-breeding season and very few birds have been captured and banded.

METHODS

Red-necked Phalaropes were first recorded on salt ponds at Port Hedland, north-west Australia, in November 1981 (Saunders & de Ribeira 1987). Small numbers (1-6) have been regularly recorded there in most years since then, between October and early April. The maximum present has usually been about 15 birds. However, 53 Red-necked Phalaropes were present at Port Hedland Saltworks between 13 - 19 October 2001 and was the largest number ever recorded. The opportunity was taken to try to catch some in order to collect biometric and moult data.

After initial difficulties, 22 Red-necked Phalaropes were caught in a cannon net on 18 October 2001. There had been one Red-necked Phalarope banded in Australia previously – also caught at Port Hedland, on 6 November 1983.

All birds caught were fully processed, with measurements taken of bill length (to the nearest 0.1 mm), head and bill length (to the nearest 0.1 mm), wing length (to the nearest mm) and weight (to the nearest g). Primary moult score was recorded on a scale of 0 to 5, where '0' is an old feather, '5' is a fully-grown new feather, '1' is a missing feather or one fully in pin, and 2-4 are intermediate stages of feather growth (Ginn & Melville 1983).

RESULTS

Biometrics

Details of biometric measurements taken are given in Table 1.

Table 1. Biometrics of 22 adult Red-necked Phalaropes at Port Hedland Saltworks, 18 October 2001

Parameter	Culmen (mm)	Head + bill (mm)	Wing (mm)	Weight (g)
Mean	20.76	42.84	109.86	30.41
S.D.	1.03	1.17	2.07	1.95
Range	18.7-22.4	40.3-45.0	104-113	27-34

All measurements fall within the recorded range for the species (Cramp & Simmons 1983; Higgins & Davies 1996; Prater *et al.* 1977). Higgins & Davies (1996) state that females are larger than males, but sexual size dimorphism is slight, with considerable overlap in all parameters. It is only possible to determine sex by plumage characteristics in the breeding season. Red-necked Phalaropes are monotypic and there is no evidence of geographic variation in breeding populations (Cramp & Simmons 1983; Higgins & Davies 1996).

The weight of the single bird caught in 1983 was 33 g and four birds shot at Port Hedland in November 1981 weighed 34 (2), 33 and 32g (Saunders & de Ribeira 1987). There are very few published weights of Red-necked Phalaropes away from the breeding grounds. In India, Ali & Ripley (1983) recorded an average weight for non-breeding birds of 27.6 g (range 20-38 g, sample size not given), and 10 birds caught in November at Point Calimere, Tamil Nadu, averaged 30.1 g. (D.S. Melville unpublished). Three females in wing moult off Peru weighed 26.5, 31 and 36 g (Cramp & Simmons 1983). These weights are similar to those measured at Port Hedland, indicating that the birds were within the usual range for the non-breeding season.

Weights of birds preparing for migration appear to be generally heavier (two caught at Point Calimere in April weighed 35 g and 40 g, (D.S. Melville unpublished). Five females caught on northward migration in Hong Kong in May averaged 34.7 g (31 - 40.5 g) (Melville 1984). Weights of adults on southward migration in Kazakhstan averaged 32.2 – 39.0 g, whereas juveniles averaged 28.2 – 35.6 g. The heaviest birds (both adult and juvenile) weighed 52 g (Gavrilov *et al.* 1983).

Moult

All except two of the 23 birds caught in October and November at Port Hedland were in active primary moult (Table 2).

Most of the birds caught were about halfway through primary moult although there was a considerable spread of moult scores. All birds were largely in non-breeding plumage. A few breeding plumage feathers remained in some individuals. The exception was one of the two birds that had not yet started primary moult and this bird retained significant traces of breeding plumage, noticeable even in the field. There was no evidence of any juvenile plumage on any of the birds.

Table 2. Primary moult scores of Red-necked Phalaropes at Port Hedland Saltworks, 18 October 2001 and 6 November 1983*.

Moult Score	Moult inner to outer
0	0000000000
0	0000000000
4	2110000000
11	4421000000
15	5541000000
16	5542000000
17	5552000000
19	5553100000
19	5553100000
21	5554200000
24	5555310000
25	5555410000
25	5555410000
25	5555410000
25	5555410000
26	5555420000
26	5555420000
27	5555520000
29	5555540000
31	5555542000
37	5555555200
37	5555555200
36*	5555555100

There is still relatively little known about moult in Red-necked Phalaropes. Bent (1962), describing North American populations, stated that adults had a complete moult from July to October and that juveniles underwent a partial moult in September and October but that they retained juvenile wing feathers. However, Paulson (1993) noted that wing moult usually occurs in midwinter, but begins in August during migration for birds visiting Mono Lake in California. He found this pattern differed from the moult of the body feathers, as this occurs very quickly and starts on the breeding grounds,. Dement'ev & Gladkov (1969) recorded that the complete post-breeding moult, including remiges, starts on the breeding grounds in July and terminates in middle or late August. They recorded that birds on southward migration in Kazakhstan have fresh remiges and feathers of upperparts in process of moult. However, this contrasts with the findings of Gavrilov *et al.* (1983), who recorded very few birds in wing moult in Kazakhstan in July and August. It appears that some birds may start primary moult on the breeding grounds or at a

migratory staging area and then suspend until arrival on the non-breeding grounds, but most moult from late Austral spring-summer (Cramp & Simmons 1983, Prater *et al* 1977). It is possible that the November 1983 bird at Port Hedland was resuming moult having previously suspended.

Stresemann & Stresemann (1966) recorded four birds in active moult from eastern Indonesia (Table 3), which are clearly moulting later than most of the Port Hedland birds.

Interpretation of much published moult information is confounded by the fact that until recently it was thought that juvenile Red-necked Phalaropes did not undergo a complete moult in the winter quarters (Bent 1962; Prater *et al.* 1977; Hayman *et al.* 1986). It is now apparent that many juveniles do replace flight feathers in their first winter (Melville 1995; Paulson 1993). Thus, birds can only safely be aged if they still retain some juvenile plumage such as inner median coverts. It is possible that the two late moulting birds in March recorded by Stresemann & Stresemann (1966) were juveniles. However, it is noteworthy that adults do not necessarily moult before juveniles (Melville 1995). Melville recorded a juvenile with a moult score of 18 in November, at a time when adult moult scores varied from 13 to 25.

The fact that juvenile Red-necked Phalaropes undergo a complete moult calls for caution when ageing birds caught away from the breeding grounds. Melville (1995) noted that juveniles in southern India apparently started primary moult in October/November, at a time when they had moderately worn primaries and still retained juvenile inner median coverts, whereas adults had very worn primaries (wear categories after Prater *et al.* 1977).

The Port Hedland birds have all been aged as adults (2+) on the basis of a lack of any juvenile plumage, the presence of traces of breeding plumage on some birds, and the uniformly worn state of the primaries on all birds caught.

DISCUSSION

Saunders & de Rebeira (1987) found a trend of increasing numbers of sightings of Red-necked Phalaropes in Australia and suggested that the status of this species may be changing from that of vagrant to one of non-breeding migrant, albeit in small numbers. This pattern is apparently emerging around Port Hedland at the Leslie Salt Work ponds. The species is now a regular non-breeding visitor in small numbers to the Port Hedland saltworks where it is invariably recorded from Pond 5, where salt concentrations are high.

Some records of Red-necked Phalaropes in Australia appear to relate to storm-driven birds, including a male, which died in January 1974 at the incredibly light weight of 15.6 g (Saunders & de Rebeira 1987). It is notable that all other Australian phalaropes for which weights are available (all from Port Hedland) appear to be in good condition and these birds may have 'overshot' their usual non-breeding area in eastern Indonesia.

In pelagic environments, phalaropes often feed in areas of upwelling and around sea fronts where prey is concentrated (Haney 1985; Mercier & Gaskin 1985). The lack of upwelling areas off the coast of northwest Australia (Underwood & Chapman 2000) probably makes the area generally unattractive to phalaropes. This contrasts with areas with high productivity and where upwelling occurs in Indonesian waters (Tomascik *et al.* 1997). Migrating Red-necked Phalaropes regularly utilise natural salt lakes in the northern hemisphere

Table 3. Primary moult scores of Red-necked Phalaropes from eastern Indonesia (after Stresemann & Stresemann 1966). * moult scores based on descriptions in Stresemann & Stresemann (1966).

Date and location specimen collected	Moult score*
4 December, New Guinea (female)	5543000000
4 December, New Guinea (male)	5555554200
28 March Ambon (female)	5555553000
March, New Britain (female)	5555555534

(Rubega & Inouye1994; Mikkola *et al.* 1990) and thus the coastal saltworks at Port Hedland would be expected to provide an attractive habitat.

In October 2001, the Red-necked Phalaropes were concentrated along the windward side of Pond 5 at the Port Hedland saltworks where they fed while swimming near the embankment. This pond, which usually has a salinity of about 15%, also is the main feeding pond at Port Hedland for Banded Stilts *Cladorhynchus leucocephalus* and Red-necked Avocets *Recurvirostra noveahollandiae.* Curlew Sandpipers *Calidris ferruginea* also have been recorded in this pond, feeding while swimming, in a manner similar to that of phalaropes. It has been suggested that they may have also been feeding on brine shrimps (Minton 2000).

Interestingly, although brine shrimps *Artemia salina* have been recorded in the diet of Red-necked Phalaropes (Cramp & Simmons 1982), Rubega & Inouye (1994) found that Red-necked Phalaropes maintained on a diet of the Mono Lake brine shrimp *Artemia monica* lost weight rapidly and some died. Although Red-necked Phalaropes can often be seen swimming over brine shrimp plumes, stomach content analyses of birds collected at Mono Lake, California, Great Salt Lake, Utah and throughout the Great Basin of the USA have confirmed that they feed mainly on brine flies *Ephydra.* These flies occur in association with brine shrimp plumes (Rubega & Inouye 1994, M. Rubega in litt., J. Jehl in litt.). It suggests that the phalaropes at Port Hedland were feeding on brine flies rather than brine shrimps.

Much remains to be learned about Red-necked Phalaropes in the non-breeding season, but it seems likely that catching opportunities will remain largely opportunistic and that Port Hedland provides one of the few places where this can occur.

ACKNOWLEDGMENTS

We gratefully thank the AWSG NW Australia 2001 Wader Expedition team that made the Red-necked Phalarope catch, the owners of Port Hedland Saltworks (Rio Tinto) for permission to visit and the Australian Bird Banding Office and the Department of Conservation and Land Management in Western Australia for banding permits and the provision of bands. Drs. Margaret Rubega and Joseph Jehl kindly provided information about phalaropes and *Artemia* in North America.

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MARSH SANDPIPERS CAN ALSO SWIM WHEN FEEDING

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The regular swimming of Curlew Sandpipers *Calidris ferruginia* in up to one metre of water when feeding at the saltworks near Port Hedland, Western Australia, was reported previously (Minton 2000). This behaviour had been recorded almost annually over a twenty-year period but was confined to Curlew Sandpipers and other species that more normally swim when feeding (Red-necked Phalarope *Phalaropus lobatus*, Banded Stilt *Cladorhynchus leucocephalus* and Red-necked Avocet *Recurvirostra novaehollandiae*).

In October 2001, during a six-day visit (13th to 19th) by the AWSG NW Australia Wader Expedition, Marsh Sandpipers *Tringa stagnatilis* were also seen behaving in a similar manner. They were nearly always in association with Curlew Sandpipers, with typical feeding groups containing five to twenty Curlew Sandpipers and one to five Marsh Sandpipers. The feeding location was the same salt lagoon (Pond 5) as used in all previous years by Curlew Sandpipers.

The Marsh Sandpipers joined feeding groups out on the deeper water both by swimming out from the lagoon perimeter and by flying and then alighting on the water. Equally, they left feeding groups in similar ways showing no difficulty whatsoever in taking off from the surface of the water even after they had been swimming for a prolonged period.

This behaviour was seen under both calm conditions and when the water was quite choppy with the wind blowing a froth to the downwind edge of the lagoon. The Marsh Sandpipers appeared very buoyant, with tail cocked high, and fed by probing food from the surface of the water.

On many occasions, Red-necked Stints *Calidris ruficollis,* which were the most common species at the saltworks, seemed somewhat baffled by the presence of these Curlew Sandpipers and Marsh Sandpipers (and a flock of 55 Red-necked Phalaropes) out on the water. The Stints flew around the swimming birds low and hesitatingly, seeking to land but not quite daring to do so. Presumably, they expected the water to be shallow enough for wading but when they were close to landing realised that this was not the case. No Red-necked Stints were seen to actually land on the water, although several got to the stage of dipping their feet in it whilst still flying.

We have no explanation as to why this "swimming when feeding" behaviour by Marsh Sandpipers was observed in October 2001, but not in some twenty or more visits over the previous two decades (at various times of the year, including several times in October). It is possible that the food resources available to swimming birds were particularly high at that time. The flock of 55 Red-necked Phalaropes was the largest ever recorded there and this may be because casual visitors such as these were attracted to remain by abundant food.

The above observations further confirm the growing evidence that wading birds can swim on water (and even dive) for prolonged periods if the need arises. An interesting note was published recently in the International Wader Study Group Bulletin (Volume 97, April 2002, pp. 42-44) by Theunis Piersma and colleagues who found many flocks of waders resting on the sea at night in the Dutch Wadden Sea during periods of thick fog, when they had clearly lost their ability to orientate and fly to their normal high tide roosting locations.

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OBSERVATIONS AT A BREEDING COLONY OF ORIENTAL PRATINCOLE *(GLAREOLA MALDIVARIUM)* NEAR SONGKHLA LAKE, SOUTHERN THAILAND

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The Oriental Pratincole (*Glareola maldivarium*) breeds at scattered localities across the Indian sub-continent, in Sri Lanka, parts of mainland east Asia, Taiwan, Japan and sporadically in northern parts of South East Asia (Lane 1987; Robson 2000; Strange 2000).

In the Thai-Malay Peninsula, documented breeding records appear to be scarce (Wells 1999), although breeding has been confirmed as far south as Perlis on the peninsula's west coast (Strange & Jeyarajasingham 1993), and suspected as far south as Pahang on the east coast (Wells 1999). The breeding season in the South East Asian region has been reported as April-May (Robson 2000) and March-

June (Wells 1999). The following are observations made during a visit to an Oriental Pratincole breeding colony found in Songkhla Province, Southern Thailand on 14 June 1994.

The colony was found on an area of newly reclaimed land near the southern shoreline of Thale Sap Songkhla, part of the Songkhla Lake complex, and the largest lake system in Thailand. It was separated from the lake shore by a wide band of mangrove forest and swampland. Approximate co-ordinates were 7° 7'N, 100° 31'E. The site was located several kilometres northwest of the main Hat Yai – Songkhla highway. It was discovered while exploring an unsealed vehicle track that passed from the highway through land reclamations into remaining areas of mangrove and wetland. The pratincole colony occupied part of a large area (viz. 15 – 20 ha). It was comprised of recently scraped earth, largely devoid of vegetation, with a number of shallow surface-water pools and several deeper drainage ditches running through it. Mangrove forest lined the northern and western sides, while marshland and rice fields lay to the south and east.

The breeding colony contained about.140 adult birds, including many pairs attending chicks. The age of chicks varied between less than one week (estimated from size) to newly fledged. No active nests containing eggs were found. It was not possible to count the number of broods, but I estimate the colony comprised at least 50 breeding pairs. Many adult birds were observed on the ground attending 1-3 chicks. Adults and young were scattered over approx. two ha of largely bare earth on both banks of a deep drainage ditch (c. 4 m wide) running through the centre of the reclaimed land. It appeared that birds had nested on higher ground along both banks of this ditch.

At the approach of an observer, most of the adult birds (100+) rose and circled the colony site. A number subsequently returned to their broods, while others continued to circle and give distress calls for the duration of the visit (approx. 30 minutes). Several adult birds were observed to give "broken wing" distraction displays on the ground, but no "dive-bombing" or other aggressive anti-intruder behaviour was encountered. Throughout the period of observation, small groups of birds were noted arriving and departing for nearby rice fields. The visit was made shortly before dusk when many night insects were becoming active and departing birds were observed hawking insects over near and more distant rice fields.

Associated with the colony were three pairs of Little Tern (*Sterna albifrons*), which exhibited strong defensive behaviour, indicating the presence of nests or chicks. A pair of Black-winged Stilt (*Himantopus himantopus*) was also present but did not appear to be nesting. Other species noted within close proximity of the pratincole colony were Great Egret (*Egreta alba*), Intermediate Egret (*Egretta intermedia*), Striated Heron (*Butorides striatus*), and Lesser Whistling-Duck (*Dendrocygna arcuata*), all of which were either roosting or feeding.

This record of an Oriental Pratincole breeding colony supports statements by Wells (1999) that breeders are attracted to bare earth sites including large earth scrapes. He also noted that the species has an opportunistic capacity to utilise temporary breeding habitats. The reclaimed land upon which the colony was sited was of very recent creation (several months only). Given that some chicks had just fledged on 14 June while others were recently hatched, and assuming that Oriental Pratincoles have similar incubation and fledgling periods to the closely related Collared Pratincole (*Glareola pratincola*) (17-18 days and 22 days respectively - Harrison & Castell 1998), egg-laying probably commenced in the first week of May and continued to the fourth week of May. These dates approximate with a single nest record (30 March) and reported dates of suspected nest/chick behaviour (April, May and June) collated for other sites on the Thai-Malay Peninsula by Wells (1999).

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VARIATIONS IN APPARENT ANNUAL BREEDING SUCCESS OF RED-NECKED STINTS AND CURLEW SANDPIPERS BETWEEN 1991 AND 2001

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INTRODUCTION

The reproductive rate is one of the two fundamental parameters (mortality is the other) that govern the population size of a species. In Arctic-breeding waders, it is difficult to directly measure reproductive success on the breeding grounds and certainly impractical to do this for a wide range of species simultaneously and for a prolonged period.

An alternative applied to goose and swan populations has been to scan flocks on the non-breeding grounds to determine the proportion of juvenile (first year) birds. These are still recognisable by plumage differences throughout most of the year. This is not so feasible in waders because many immature birds soon become almost identical in appearance to adult birds, often before they have reached their non-breeding destinations.

For waders, the best quantitative estimates of breeding success have been obtained by catching samples from flocks on the non-breeding grounds and determining the proportion of juvenile/first year birds by ageing them in the hand. Whilst there may be potential biases in such data, this information can be used to produce an annual breeding success index for each species. Short and long term changes in this index may be helpful in understanding changes in wader populations identified from systematic annual counts.

We report on estimates of the breeding success of Red-necked Stints and Curlew Sandpipers that spend the non-breeding season in SE Australia. We also relate the index of breeding success to changes in population counts during the period from 1991 to 2001.

METHODS

The Victorian Wader Study Group has been catching and banding waders in SE Australia since late 1975. Birds were initially caught by mist netting, but since early 1979, mostly by cannon netting. Up to April 2002, approximately 168,000 wader have been caught (135,0000 newly banded and 33,000 retraps). By far the greatest number caught has been Red-necked Stints (108,000) and Curlew Sandpipers (28,000).

We analyse the proportion of juveniles of these two species caught over the last 11 years. All the birds included were cannon-netted, at a variety of sites along the coast of Victoria and in the southeast corner of South Australia. Only catches made in the period between the end of November and the end of February were included (except for a few Red-necked Stint catches up to 20th March in some years). This is the period when populations in SE Australia are at their most stable with the majority of adult and juvenile birds being present in their non-breeding area destinations (Minton et al 2000; 2001).

RESULTS

Table 1 shows the number of Red-necked Stints (47,007) and Curlew Sandpipers (9,491) caught in SE Australia each austral summer between 1991/92 and 2001/02. It also shows the number of first year birds caught annually.

The table also indicates that the level of sampling of each species has been relatively consistent throughout this 11 year period, with between 11 and 19 (23 – 25 in the last three years) Red-necked Stint catches each year and 7 – 18 Curlew Sandpiper catches annually. For the whole period combined,

Table 1. Catches of Red-necked Stints and Curlew Sandpipers in SE Australia between 1991/92 and 2001/02.

Year	Red-necked Stint					Curlew Sandpiper					
	No. of catches		Total caught	No. of first years	% of first years	No. of catches		Total caught	No. of first years	% of first years	% Curlew Sandpipers in catches
	Large >50	Small <50				Large >50	Small <50				
91/92	8	4	1994	580	29	4	3	437	198	45	21
92/93	15	-	4340	163	3.8	6	6	2232	6	0.3	34
93/94	10	3	6015	892	15	6	4	1239	215	17	17
94/95	7	8	3191	594	19	3	9	954	92	9.6	23
95/96	8	3	1804	452	25	4	5	506	30	5.9	22
96/97	10	7	3526	421	12	5	13	636	56	8.8	15
97/98	11	8	4232	331	7.8	5	10	934	196	21	18
98/99	9	6	4854	1572	32	5	5	737	30	4.1	13
99/00	19	6	4885	1108	23	6	4	1016	206	20	17
00/01	11	14	5815	770	14	2	11	381	26	6.8	6.1
01/02	15	8	6351	2188	34	3	5	419	115	27	6.2
Total			47007	9091				9491	1170		Average = 16.8%
Average % first year			19.3%					12.3%			

the percentage of first year birds in the Red-necked Stints captured was 19.3% and in Curlew Sandpipers it was 12.3%.

Figure 1 shows the percentage of first year birds in each of the 11 annual samples of each species.
A number of interesting facts are apparent.

a) The percentages of juvenile Red-necked Stint and Curlew Sandpiper each year do not correlate closely. In six of the ten year-to-year changes, the direction of change was opposite for the two species. The extreme example was 1997/98 to 1998/99 when the percentage of juvenile Red-necked Stint increased from 7.8% to 32% but Curlew Sandpiper dropped from 21% to 4.1%.
b) There is no evidence for a strong regular three-year cycle of breeding success associated with, for example lemming/predator fluctuation periodicity. The nearest approximation is that 1991, 1995, 1998 and 2001 were apparently the best breeding years for Red-necked Stints compared with adjacent years. However, of these, only 1991 and 2001 were really good for Curlew Sandpipers.
c) In Red-necked Stint:
   i) Only two years were below 10%
   ii) Five years were above 20%
   iii) Five of the six years in the 92/93 to 97/98 period were below average

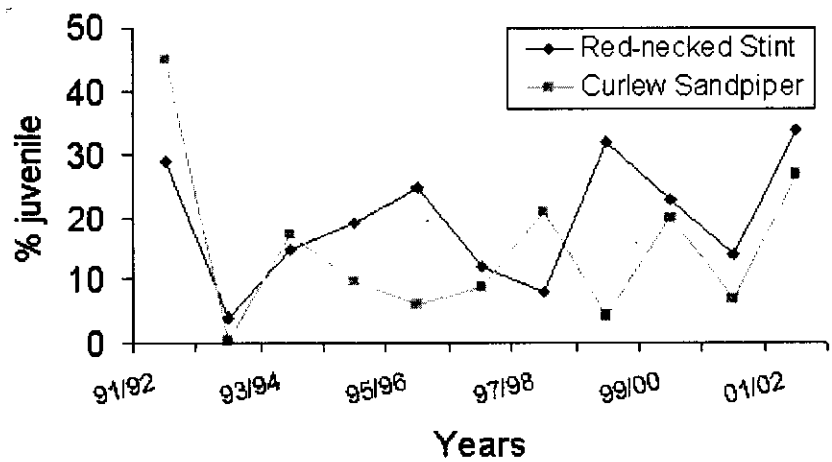

Figure 1. Percentage of first year Red-necked Stints and Curlew Sandpipers in wader catches in SE Australia from 1991/92 to 2001/02.

iv) Three of the last four years have been above average (two years at record levels)

d) In Curlew Sandpiper
   i) Six years were below 10%
   ii) Four years were above 20%
   iii) Six of the nine years in the 92/93 to 00/01 period were below average.

Overall, there is a clear picture that Curlew Sandpipers appear to have less successful breeders than Red-necked Stints during the last decade. Relative population counts have changed (see later also) and this is apparent too from the decreasing proportion of Curlew Sandpipers in catches of small waders made by the VWSG over the period (Table 1). In the earlier years, the proportion of Curlew Sandpipers in such catches was usually above 20% but in the last two years it has dropped to only 6%.

DISCUSSION

Patterns of breeding success of both Red-necked Stint and Curlew Sandpiper in the 1990s seem to have departed from the more regular situation of the 1980s, when a three - yearly cycle was more apparent with "good" years in 1982, 1985 and 1988 (followed also by 1991) (VWSG unpublished data).

Both species had a long run (Red-necked Stint six years, Curlew Sandpiper nine years) with generally below average breeding success. This started with the universally disastrous 1992 breeding season. At this time, world weather effects following the Mount Pinitubo volcanic eruption accentuated normal negative breeding factors (Ganter & Boyd 2000), In the case of Red-necked Stint, this was followed by four years of good breeding success, with two of these years being at record levels.

The effects of these patterns of breeding performance have, not unexpectedly, been apparent in population counts. Curlew Sandpiper numbers in Australia have declined by 70% over the last 20 years at sites counted by the AWSG (Wilson 2001a,b) . Many of these sites are in Victoria (SE Australia) and all except one of the count sites showed this marked downward trend. In the eastern half of Corner Inlet (Victoria), Curlew Sandpiper numbers averaged 2,440 (range 1,400-2,700) in the February counts in the period 1981-1985 but only 665 (range 500-920) in the period 1998-2002 (Minton and Dann in prep.). Most of that decline has occurred since 1994.

Red-necked Stint numbers in SE Australia also declined during the period of below average breeding success in the 1990s. However, their numbers have now rebounded, to record levels. For example, in the eastern half of Corner Inlet – which has the largest Red-necked Stint population of any of the 20-30 Australian sites that are counted annually by AWSG – the population averaged 21,465 in the February 2000-2002 counts (range 19,300-23,675). For the previous 19 years (1981-1999) the February count averaged 9,895 (range 6,300-14,300) (Minton and Dann in prep.).

Red-necked Stints have also spread extensively into new habitats as a result of the larger population present over the last four years. Flocks of hundreds, sometimes thousands, are now present on ocean beaches where previously only tens occurred normally. Numbers in all the traditional areas – muddier bays and estuaries – have also increased but not as dramatically as in the previously more marginal Red-necked Stint habitats.

It is interesting that the species appears to have been able to adapt to such a major increase in numbers. No reductions in weight has been measured and behaviour patterns seem to be similar to normal. However, it is possible that there may be effects on survival rates. It will be interesting to see if habitat utilisation returns to previous patterns should Red-necked Stint breeding success reduce to previous levels.

Another consequence of the ubiquitous presence of Red-necked Stints recently is that it is almost impossible to make a cannon-net catch of any species of wader (except Oystercatchers and Eastern Curlew) without obtaining a significant by-catch of Red-necked Stints !

Data on breeding success will continue to be collected in the future. It will be especially interesting to monitor Red-necked Stints and Curlew Sandpipers, given past similarities and recent divergences in their apparent breeding performance and consequent population levels.

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SHOREBIRD MIGRATION ON NORTHERN SAKHALIN ISLAND, RUSSIA IN EARLY NORTHERN AUTUMN 2002

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TRIP COMMENTARY

The northern section of Sakhalin Island is believed to act as a stop-over and resting site for migratory shorebirds, specifically for Great (*Calidris tenuirostris*) and Red Knots (*Calidris canutus*). The area is already a well-known migration hot spot for swans and geese. Since the published literature does not provide specific evidence of its importance for shorebirds (Huettmann 2002), I will summarise shorebird sightings for seven large bays, sand spits and tidal mudflats from this region (see Figure 1 for all locations mentioned in the text). Other sightings of interest are mentioned as well.

From 9 - 25 August 2002, I travelled with Russian co-workers by train, public and private bus, boat, hitch-hiking and rented cars in order to investigate regions mentioned below and relevant for migratory shorebirds. Except for the first and last surveys based in Poronaysk (48° 20' N, 141° 30' E), all other surveys were conveniently carried out from the village of Ocha (52° 30' N, 141° 30' E).

The first shorebird survey on 9 August investigated the coast of Poronaysk (sandy beach) during high tide. This location has no true mudflats; on a 2km section only small numbers of gulls (<20) (Black-headed Gull *Larus ridibundus*, Black-tailed Gull *Larus crassirostris*, Slaty-backed Gull *Larus schistisagus*, Glaucous Gull *Larus hyperboreus*) and few Carrion Crows (*Corvus corone*) were observed; no shorebirds were found.

On 10August and after reaching Ocha, the southern muddy corner of Urkt Bay, approximately 4 x 5 km in size, was surveyed during mid-tide. Over 500 Black-headed Gulls were counted (half of them still in moult), eight *Tringa* (likely Wood Sandpiper *Tringa glareola*), terns (mostly Common Terns *Sterna hirundo*), a shrike and a Siberian Rubythroat (*Luscinia calliope*) were observed.

During the next day (11 August), the six kilometre long sandy beaches between Ketu Bay and Urkt Bay were investigated, including the narrow channels where the bays meet the ocean. At Ketu Bay, Wagtails (Yellow Wagtail *Motacilla flava* and Black-backed Wagtail *M. lugens*), two shrikes, Bank Swallows (*Riparia riparia*), Common Terns, Emperiza Buntings (likely Reed Bunting *Emberiza schoeniclus*), Lesser Sand Plover (*Charadrius mongolus*; some in breeding plumage), four *Tringa* (likely *Tringa glareola*), two Godwit and one Great Knot were found. In order to classify the migration readiness for Great Knots, Abdominal Profile Index (API) scores (Wiersma and Piersma 1995; Huettmann unpublished) were used; the identified Great Knot had an API of 5 (likely an adult bird). Ketu Bay is linked through a narrow channel at the spit with the ocean, and on the ocean-side two White-winged Scoter (*Melanitta fusca*), teals, few gulls and one seal (the seal species on Sakhalin Island is *Phoca hispida*, not *Phoca vitulinas* as found elsewhere in coastal Sea of Okhotsk) were seen. Along the 6km long beach walk from Ketu Bay to reach the spit of Urkt Bay several gull flocks, with a typical species composition of 300 Black-headed Gulls, 100 Common Gulls (*Larus canus*), 50 Black-tailed Gulls, two Herring Gulls (*Larus argentatus vegae*), three Glaucous Gulls (immature) and 20 Common and Aleutian terns (*S. aleutica*) were observed. Of interest were six Harlequin Ducks (*Histrionicus histrionicus*) dive-feeding off a channel near the beach. At the mouth of Urkt Bay, on the brackish mudflats inside of the bay, 200 Great Knots (mostly juveniles with APIs of 5, but also 3s and few 4s; most of the birds were feeding, few preening), 10 Dunlin (*Calidris alpina*), 60 Red-necked Stint (*Calidris ruficollis*) and three Black-tailed Godwits (*Limosa limosa*), three Whimbrels (*Numenius phaeopus*) and regular numbers of gulls were sighted.

Due to the Great Knot numbers seen in Urkt Bay, we returned to this mudflat for the next two days, and also five days later on 18 August. This allows

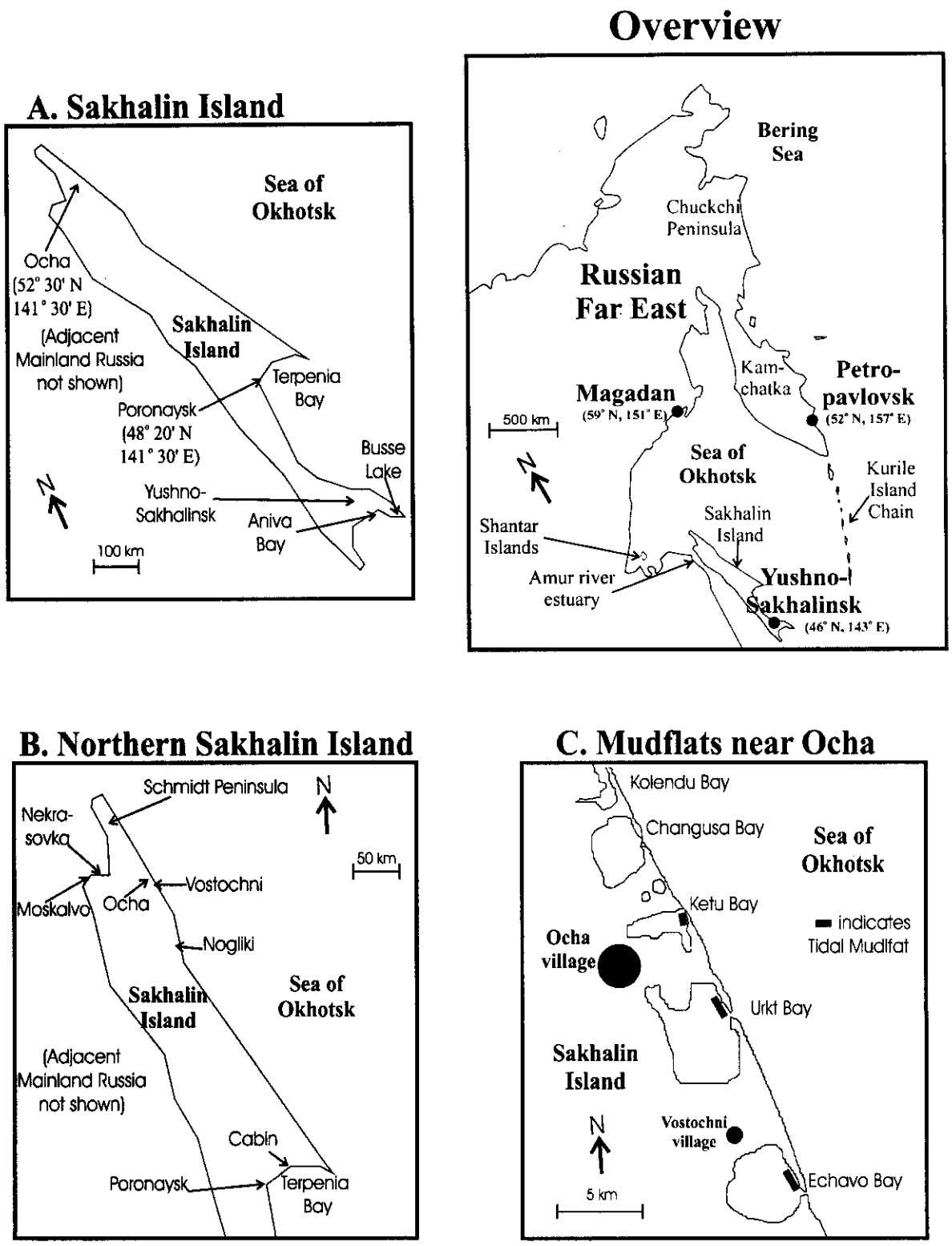

Figure 1. Location of sites visited during my survey of northern Sakhalin Island in August 2002.

us to estimate turn-over rates of migratory Great Knots for this location. On 12 August, during low tide, three loons (likely *Gavia pacifica*), wagtails, buntings and one Sylviidae Warbler were observed. Of interest are 22 Parasitic Jaegers (*Stercocarius parasiticus*; three of a dark morph), likely on migration. This flock caused disturbances among birds on the mudflats. Some Aleutian Terns, approximately 400 Black-headed Gulls, 300 Red-necked Stint, approximately 40 Dunlins but only

eight Great Knot (API 5) were found. This suggests a turn-over rate of less than two days. The next day, 13 August, we saw 19 Great Knot (APIs of 5 and 3) in Urkt Bay and a second flock of 15 Great Knot (APIs of 5). Most of the Great Knots were juveniles and I think that these birds are feeding in the high organic mud on small white mussels less than 0.5 cm long. In addition, two Godwits, 20 Red-necked Stint, eight Parasitic Jaegers, two Crows and one *Buteo* raptor were sighted. Four seals were also seen at the spit. An interesting sighting of 43 Great Knots in the tundra near the mudflat was made during high tide of the same day. These birds flew off when approached and were probably resting, preening, and taking in 'gastrolites' (which was observed for three individual birds). This finding is in agreement with Huettmann (2001) who reported such observations for Yana river, near Magadan on the northern shore of Sea of Okhotsk. The coastal tundra, such as Krummholz pine, seems to host large numbers of ground squirrels and a lower abundance of warblers.

The two villages of Nekrasovka (an old and a new settlement) are located on a large bay on the west coast of northern Sakhalin Island, approximately 30 km northeast of Ocha. Large migration flocks of Wagtails (e.g. Grey Wagtail *M. cinerea*, White Wagtail *M. alba*), some migratory Oriental Greenfinch flocks (*Carduelis sinica*), and few Pipits (mostly Olive-backed Pipit *Anthus hudgsoni*) were found in the pine and birch forest of the villages. Near the old village, a sighting of a Spotted Redshank (*Tringa erythropus*) was made in the brackish meadows at the coast. In addition, 25 Red-necked Stints, six Common Sandpipers (*Actitis hypoleucos*), two Grey-tailed Tattlers (*Heteroscelus brevipes*), one *Tringa* Sandpiper and two Little Ringed Plovers (*Charadrius dubius*) were seen. During low tide, 10 Black-tailed Godwits and gulls (140 Black-headed Gull, three Black-tailed Gull) were found on a 6 km section of the extensive sandy beaches near the mouth. A migratory flock of 80 Lesser Sand Plovers and two Dunlin were also seen. One Whimbrel was also heard. The extensive mudflats consisted of pure sand and had no Great and Red Knots whatsoever.
On 15 August, the next two northern bays (Changusa and Kolendu) were visited. Usual gull numbers (400 Black-headed Gulls, 200 Common Gulls, 11 Herring Gulls, two Slaty-backed Gulls, two immature Glaucous Gulls and four Black-tailed Gulls), two Long-tailed Jaegers (*S. longicaudus*), Common and Aleutian Terns, a pair of Steller's Sea Eagle (*Haliaeetus pelagicus*), eight Bank Swallows, Wagtails (mostly *M. alba*), 18 Whimbrels (on the coastal tundra) and one Harbour Porpoise (*Phocoena phocoena*) were found. About 200 *Aythya* ducks were seen on the coastal lakes along with four Black-tailed Godwits, 20 Red-necked Stints and one Lesser Sand Plover. The low numbers of shorebirds observed might be explained by the fact that Changusa Bay is not directly connected to the ocean and thus has no tides.

Moskalvo, located on the western side of northern Sakhalin Island and further south than Nekrasovka (about 32 km away from Ocha), was investigated for shorebirds on the 16 August. The coastline at Moskalvo consists mostly of pure sand with no relevant numbers of shorebird observed. During a 3 km walk along the beach at low tide Jaegers (4 Long-tailed and 1 Pomarine *S. pomarinus*), gulls (150 Common Gulls, 80 Blackheaded Gulls, nine Glaucuous Gulls), terns, two Godwits, three Little Ringed Plovers, 10 Red-necked Stints, and 20 Wagtails (*M. cinerea* and *M. lugens*) were seen. However, an inside bay south of Moskalvo presents a similar tidal habitat to that found in Aniva Bay (near Yushno, visited during spring migration 2000, Huettmann 2001). It is about 3km long and had shorebirds, wagtails and gulls present. Due to access issues (flooded) only a smaller portion of this inside bay was visited, resulting in 10 Red-necked Stints, 10 Dunlins, two Godwits, two Little Ringed Plovers and eight Redshanks (*Tringa totanus*). We did not visit the island, Usch, located just off Moskalvo, since we think it consists of sandy beaches where we never found Great and Red Knots or Bar-tailed Godwit.

The village of Vostochny is located approximately 15km southeast of Ocha, and the coastal habitat consists of tundra and a long sand spit. The tundra habitat supported 150 Whimbrel, which were either resting or feeding on the abundant and ripe berries as well as a snipe and a small falcon (likely a Merlin *Falco columbarius*). On the shores of Echavo Bay, we saw 130 Dunlins, 40 Red-necked Stints, 50 Whimbrels and the regular set of gulls and terns. Pipits and wagtails (*M. alba* and *M. cinerea*) were seen as well. Twenty Great Knots (mostly juveniles with an API of 4) were found. Of interest is one adult bird within the flock that was still in breeding plumage. This is the first bird ever observed with such a plumage on expeditions in the coastal Sea of Okhotsk (Huettmann 1999, 2001). A flock of eleven Grey Plovers (*Pluvialis squatorola*) was seen as well. In a coastal freshwater mudflat

(Green Meadows) near the village, a Pectoral Sandpiper (*C. melanotos*) was found.

Urkt Bay was visited again during low tide on 18 August. This trip resulted in the confirmation of Great Knot abundances. However, this time a flock of 300 intensively feeding birds was found and this consisted mostly of juveniles with APIs of 4 and 3. This flock also had 50 Red Knots, which represent the largest aggregation for this bird ever reported in the Sea of Okhotsk during autumn migration (Huettmann 2002). As well, a flock of 500 Black-tailed Godwits were also feeding intensively on the mudflats. Other shorebird sightings included 100 Dunlins, 40 Red-necked Stints, four Whimbrels and 14 Ruddy Turnstones (*Arenaria interpres*). One Steller's Sea Eagle was also observed. Large numbers of wagtails (*M. lugens* and *M. alba*) were found as well, and along with some Oriental Greenfinches and the usual numbers of gulls and terns were seen, including four Long-tailed Jaegers. All shorebirds, and most gulls and terns, flew off when one Pomarine Jaeger appeared on the mudflats. On the muddy section between Urkt and Ketu Bay, two Greenshanks were seen while driving back. Although they were not further identified it is likely that these were Nordmanns' Greenshank (*Tringa guttifer*) as this species has been reported for this region during autumn migration (Nechaev 1991).

20 – 22 August - Terpenia Bay

Terpenia Bay is located in central eastern Sakhalin Island next to Poronaysk. It offers extensive long sandy beaches and spits exposed during low tides. However, mudflats are only found inside the bay. During a 40km long drive on the sandy beach and through adjacent coastal meadows, large numbers of Red-necked Stints (on a 10km section: 4,000 birds in small flocks) and Dunlins (50 birds on the same 10km section) were seen. *Locustella* warblers, wagtails (*M. alba, M. lugens*), pipits and Whimbrels were also sighted. The large inland bays on the western section of Terpenia Bay are mainly freshwater and are muddy with little tidal effect. These bays harboured waterfowl, seven Grey Herons (*Ardea cinerea*) and several Common Sandpipers. Specific sections of the oceanshore, bay and coastal meadows were surveyed near a cabin, about 50km east of Poronaysk. Over one thousand waterfowl were counted in the nearby freshwater bay, as well as several eagles (Steller's Sea Eagle and White-tailed Eagle *H. albicilla*). The coastal meadows had very abundant insect and bird life, with migratory flocks of Oriental Greenfinches, crows, ravens, pipits, wagtails (*M. flava, M. alba, M. cinerea*), Stonechats (*Saxicola torquata*) and one unidentified nightjar *Caprimulgus* (likely *Caprimulgus indicus*). One juvenile *Locustella* warbler was found as well. This finding is in agreement with earlier work in coastal Sea of Okhotsk (Huettmann 1999) confirming that some of these birds still breed in August. A beach-scan resulted in a count of 15 Black-tailed Gulls, 150 Black-headed Gulls, 25 Herring Gulls, 100 Common Gulls and eight juvenile Glaucous Gulls and one bay had over 50 seals. At the channels where the bays meet the Sea of Okhotsk, large flocks of gulls were found. In general, the sandy beachfront was dominated by Red-necked Stints, which seemed to migrate through the area quickly. However, the direction of movements was of shorebirds was variable, individual loons were seen flying by, Ruddy Turnstones, two Lesser Sand Plovers and a flock of 55 Crows and Ravens were also seen. Spoon-billed Sandpipers (*Eurynorchus pygmeus*) were not observed, but they have been previously reported for Terpenia Bay later in the season by other observers (Nechaev 1991).

GENERAL

General shorebird migration peaked from 15 August onwards. The lack of Long-toed Stint (*C.subminuta*) sightings is unusual compared to previous years (Huettmann 2001). During our stay no Bar-tailed Godwits (*L. japonica*) were observed. This would well confirm the hypothesis that Bar-tailed Godwits seen in the Sea of Okhotsk region would come from Alaska and Chukotka and use mostly the eastern sections of the Sea of Okhotsk on southward migration. Every shorebird reported was scanned for (Australian and Japanese/U.S) leg flags; none were found. This could be due to the high proportion of juvenile birds, or that flagged birds migrate at different locations or at a different time.

The larger bays and spits of Nogliki (51° 50' N, 142° 0' W) are already well known for their shorebirds (Nechaev 1991; Zykov & Revyakina 1996; Tomkovich 1997; Zykov 1997; Pronkevich 1998), and thus were not investigated further. The mentioned references for Sakhalin Island shorebirds were used and gave accurate and very helpful information.

Although weather conditions were colder and wetter than in average years, it did not affect the

daily survey work. Border guards, military control, fishing inspection or other administrative bodies did not cause any delay or obstacles allowing for effective survey work. During the stay on Sakhalin Island, insects (butterflies, dragonflies, flies and mosquitos), frogs and bats were found. Other data on specific and on-going research projects were also collected; results on this subject are still being collated and will be reported later.

The number of gulls observed, and their species and age compositions were in agreement with earlier work elsewhere in the coastal Sea of Okhotsk (Huettmann 1999, 2001). During my visit, we did not find any alcidae nor Marbled Murrelets (*Brachyramphus marmoratus perdix*). The latter bird is believed to occur predominantly off the Schmidt Peninsula, northern Sakhalin. All the villages visited had large numbers of Tree Sparrows (*Passer montanus*) and very few House Sparrows (*P. domesticus*). Jungle Crows (*Corvus macrorhynchos*), swifts, wagtails and pipits were abundant as well. Fishing boats were in view from most parts of the shoreline we visited, and coastal small scale fisheries are widespread (Huettmann 1999, 2001). There appears to be little pollution, but most beaches had vehicular traffic (trucks, cars and helicopters). Fisheries debris, plastic and metal was found on many beaches, such as around the abandoned oil facility at Moskalvo. None of the villages visited had a proper sewage system. Other potential environmental threats for migratory shorebirds exist due to oil pollution from offshore oil extraction, pipelines and ships. The hunting season started on 15 August, at a time when migratory Whimbrel numbers increased. However, except for this shorebird species, I doubt that any relevant local threats exist for shorebirds as ammunition is too expensive. Although hunters and experts were contacted at various survey locations, no new band recoveries were discovered. The beaches near Poronaysk are important for fishing, with numerous fishing observer helicopters flying over and cars and trucks driving on the beach bringing supplies. However, other than for the direct disturbance, I have never seen shorebirds being affected by such activities.

During the trip, scientists in Vladivostok and the Zapovetnik staff in Terpenia Bay, Poronaysk, were visited for potential future collaborations and projects, and for confirmation and exchange of bird sightings. I was also able to meet representatives of Sakhalin Energy, one of the biggest (international) offshore-oil companies in the region.

CONCLUSIONS

As shown earlier, a large number of extensive mudflats and sand spits exist on the coastal Sea of Okhotsk region. No Great and Red Knot, nor Bar-tailed Godwits used any of the numerous mudflats in the region during migration. This finding raises some very interesting questions about where are the key flyway stopover locations for these species and what are their preferred habitat and its conservation status ? Northern Sakhalin is used by migratory Great and Red Knots, as well as by Red-necked Stints and many passerines (predominately wagtails). Migration turn-over rates on northern Sakhalin Island appear to be less than two days for Great and Red Knots. I found that migratory Great Knot prefer tidal mudflats near saltwater with a high organic content and small white mussels. This is consistent with the results of previous studies in the region. However, most Great Knot sightings on Sakhalin Island were juveniles on migration and flocks included very few adults. These adults were likely to be non-breeding individuals. No significant migratory concentrations were found for this species. This suggests that Great Knots could either have an extended migration period over many weeks (Tomkovich 1997), or that the migration for the majority of these birds is still widely unknown. It is likely that the Sea of Okhotsk plays a crucial role for the migration of juvenile Great Knots. However, more research is needed on the flight paths of these migratory shorebird species in order to assure their conservation.

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SHOREBIRDS OF THE SELENGA RIVER DELTA, SOUTH-EASTERN RUSSIA

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The delta of the Selenga River is one of the important habitats for waterfowl, shorebirds, and other waterbirds in eastern Siberia and the most important one on the shore of Lake Baikal. Its upper reaches are covered by thickets dominated by willows *Salix* spp. The lower part has a large number of lakes and channels with extensive marshes of Reed *Phragmites australis* and other grasses, sedges *Carex* spp., Sea Sedge *Acorus calamus* and Broad-leaved Reedmace *Typha latifolia*. Much of it is flooded during periods of high water. The water level is lowest in April and May and highest in August and September.

Although the Selenga River delta has a relatively small area (540 km^2) and only half is favourable for waterbirds, it supports hundreds of thousands of migrating ducks and thousands of nesting ones. Between 14,000–30,000 gulls and terns, and many other birds like grebes *Podiceps* spp., Grey Heron *Ardea cinerea* occur there. Waders can be abundant, including globally rare species such as Asian Dowitcher *Limnodromus semipalmatus* (150–300 nesting individuals and up to 4500 birds in some periods). Apart from Asian Dowitcher, 13 wader species nesting here, and a total of 47 species have been recorded. Other rare nesting birds include two to five pairs of White-tailed Sea-eagle *Haliaeetus albicilla*, and a large population of Eastern Marsh Harrier *Circus spilonotus* (150–250 pairs, sometimes likely up to 300 pairs). Birds that nest in the northern Siberian tundra and forest-steppe and from north of west Siberia to Yakutia, pass through this region. As well, species with wintering areas from the Caspian Sea east to Japan and Australasia are migrating through the Selenga River delta. The delta has been a Ramsar site since being listed by the Russian government in 1994.

Several institutions have carried out ornithological research in the delta for a long time. From the 1970s, the Institute of Biology at Irkutsk State University has studied the ecology and monitoring for waterbirds, including waders. More than 40,000 birds have been ringed and more than 300 recoveries have been received. As a review of this bird study, a book titled "Birds of the Selenga delta: Faunal summary" (Fefelov *et al.* 2001) has recently been published. Scientists of the Baikalski State Nature Reserve (zapovednik) are working in the state refuge (zakaznik) "Kabanski", in the central sector of the delta. This reserve has an area 121 km^2. Biologists from the Institute of General and Experimental Biology SB RAS of Ulan-Ude work mainly in the north-eastern part of the delta, mainly on botany and bird parasitology.

The numbers and distribution of waterfowl vary greatly from year to year (normally up to 2–3 times), although these changes are less than in the steppe lakes of Siberia. The number of waterbirds depends on the water levels of the Selenga River and Lake Baikal. The populations show a multi-yearly cycle as the majority of species prefer to nest on lower, floodable islands of the delta. The number of nesting ducks and many shorebirds rise with the water height and decline when water levels are low. However, during periods of high water, floods are frequent and nesting success declines as many clutches are flooded. These changes in waterbird numbers are actually quite complicated. They depend on a combination of local conditions and the conditions in other parts of eastern Siberia. Consequently, areas of the highest density of nests and migrants change their locations within the delta from season to season. Long-term observation is required to understand the cycles. The number of waterfowl and waders that stage at the Selenga River delta increases when the water level rises annually. The delta is also important in extremely dry years, as the delta remains a wetland when the ponds and marshes of the adjacent steppe zone dry up.

The best examples of the degree of variability in the numbers of waders using the delta can be seen in the counts of Asian Dowitcher, Black-tailed Godwit *Limosa limosa melanuroides* and Marsh Sandpiper *Tringa stagnatilis*. The number of Asian Dowitcher is usually less than 300 birds, but in some periods, such as the early 1980s, several thousands nesting birds were present (Mel'nikov 1998). At the time, Black-tailed Godwit was also abundant, having a local density of over 1 pair.ha^{-1} and a total population of hundreds of birds. However, in years with high water level and in recent years of low water, the number of Black-tailed Godwit decreases by 10 – 20 times. The number of Marsh Sandpiper present is more stable and local density is 3 – 8 pair.ha^{-1} in favourable habitats. The total number of Marsh Sandpipers can reach thousands to tens of thousands of birds, but it has been less common during the recent dry years. Thus, Selenga delta is internationally significant for at least three wader species according to the 1% of Flyway population criteria. Eurasian Curlew *Numenius arquata orientalis* is a less abundant, but still common breeder, whose recent numbers has increased to between 80–160 pairs since the 1980s.

The number and diversity of wader species using the delta during stopovers is higher (35 species) and some regionally rare species such as Little Curlew *Numenius minutus*, Long-toed Stint *Calidris subminuta*, and Broad-billed Sandpiper *Limicola falcinellus* are present here. The abundant migratory species in the delta include Lesser Golden Plover *Pluvialis fulva*, Wood Sandpiper *Tringa glareola*, Common Snipe *Gallinago gallinago*, and Pintail Snipe *G. stenura*. These species can occur in their thousands at any time and tens of thousands during the overall migration, when species can form flocks of up to 600 birds.

In the Atlas of Key Sites for Anatidae in the East Asian Flyway (Miyabayashi & Mundkur 1999), the Selenga delta is internationally significant for migratory Eurasian Wigeon *Anas penelope*, Common Pochard *Aythya ferina*, and Tufted Duck *A. fuligula*. I must note that the numbers of these species were underestimated in this Atlas because of incorrect translation of our paper (Fefelov *et al.* 1999), and their real numbers are significantly larger. In seasons of maximum counts, the number of ducks roosting in the whole delta during the peak of autumn migration was ca 50,000–100,000 birds. The total number of ducks visiting the delta during migration is at least 2–3 times greater. There are at least five waterfowl species (Mallard *Anas platyrhynchos*, Northern Shoveler *A. clypeata*, Northern Pintail *A. acuta*, Teal *A. crecca*, and Common Goldeneye *Bucephala clangula*), to which the delta is internationally significant by the 1% of population criterion. However, the estimates of the total number of water birds, both breeding and migratory species, have been difficult to obtain. It needs more targeted research, possibly using new approaches such as satellite imagery.

The delta is an area of relatively high human impact with a wide range of activities including agriculture (grazing of cattle and horses, mowing), fishing, hunting and other types of recreation. With the high human impact come water pollutants from industrial and urban areas along the Selenga. After building the Irkutsk Hydroelectric Station and the rise in the water level of Lake Baikal in the 1960s, over 200 km^2 of the delta was flooded. This caused a corresponding reduction in the area of waterfowl habitat. Nevertheless, the delta remains of great importance for waterbirds.

Conservation of parts of the Selenga delta were proposed as early as the 1930s. At present, the only conservation are is the "Kabanski" refuge that has existed since1969. Some types of human activity are forbidden inside the refuge and these include hunting and agriculture. Being located in the centre of delta and being less affected by the disturbance of people, the refuge is important for nesting sea-eagles and for staging waterbirds during migrations. But it cannot protect nesting ducks and gulls as the areas where they concentrate in the delta change from year to year depending on the water levels. Nowadays, the most of their populations occur outside the refuge. More of the delta needs to be specially protected and the area should be at least twice as large as it is today,. It should be mentioned that the boundaries of the official Ramsar site have been restricted only to the extent of the refuge. Despite the doubtless importance of the entire delta as a single unified ecosystem. The last approach to expanding the independent zapovednik "Selenginskaya delta" based on the existing refuge was made in 1988. However, the reality is that any enlarged reserve is difficult to manage because of the large-scale human use of nature resources in the delta. These cannot be completely terminated in many cases without threatening the interests of the local human population. Therefore, the easiest way to preserve the waterbirds and representative parts of the whole ecosystem of the Selenga delta is to support and extend the existing refuge. Then, at the same time, carry out long-term monitoring studies to optimise the use of natural resources in the whole delta.

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NORTHWEST AUSTRALIA WADER AND TERN EXPEDITION FROM 1 AUGUST TO 1 NOVEMBER 1998

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INTRODUCTION

The NWA 1998 expedition was the longest of any visit to northwest Australia since expeditions commenced in 1981. It lasted 13 weeks and was designed to cover virtually the full period of arrival of adult and juvenile birds at the end of their southward migration. It was also the largest expedition in terms of the number of people taking part and in the total number of waders and terns caught.

OBJECTIVES

The specific objectives can be summarised at follows:

a. To catch, band, leg flag and process waders of as many species as possible at regular intervals throughout the period. Wherever possible, opportunities were taken to catch samples of less frequently captured species.
b. To make population counts of waders at all the locations visited. Most importantly to count at regular intervals the area of 80 Mile Beach with the highest wader numbers, and to make the first ever complete ground count of the whole length of 80 Mile Beach (in mid October).
c. To catch, early in the expedition, samples of immature waders that had remained in northwest Australia during the May/July period when fully adult birds were away at their northern hemisphere breeding grounds.
d. To obtain an initial estimate of the 1998 relative breeding success of each species by measuring the percentage of juvenile birds present in catches in late October.
e. To further expand tern studies in northwest Australia, particularly concentrating on Little Terns, Gull-billed Terns and Common Terns.

ITINERARY

The Expedition was based at three main locations during the thirteen-week period of fieldwork.

Roebuck Bay, Broome (including Bush Point/Roebuck Plains)	41 days
80 Mile Beach/Anna Plains	33 days
Port Hedland Saltworks	7 days
Travel between locations	11 days
TOTAL	**92 days**

For three days, the expedition was based at Bush Point, in the southeast corner of Roebuck Bay and the first time an Expedition has overnighted there. Equipment was ferried in by hovercraft from Broome, while most team members walked in across the salt marshes from Thangoo Station, having travelled by 4WD to within about 3 km of base camp.

There were some "days off" in each location. Many members of the group used these for two, 2-day, boat trips to the Lacepede Islands, 100 km north of Broome. Short visits were also made into the SW Kimberleys.

PARTICIPANTS

A total of 127 people from 18 different countries participated.

Australia	59
U.K	34
Japan	9
New Zealand	5
Korea	3
China, Singapore, USA	2 (each)

Also one person from each of Vietnam, Malaysia, Taiwan, Canada, Indonesia, Argentina, South Africa, Netherlands and Belgium.

Participants ranged in age from 4 to 80. Nine were aged 15 or less. The average team size in the field at any one time was 30 people.

BANDING

Wader Catches

Wader catching was consistently successful throughout the thirteen weeks of fieldwork and all the principal objectives were met. A record total of 15,012 waders of 36 species were caught (Table. 1), averaging of over 1000 birds per week. Birds were caught at Roebuck Bay (8,040), 80 Mile Beach (6,193), and Port Hedland Saltworks (779).

The highlights of the wader banding program are detailed below:

- Great Knot (3,183) and Red-necked Stint (2,536) topped the species totals followed by nearly 2,000 each of Greater Sand Plover and Curlew Sandpiper and 1,474 Bar-tailed Godwits. The 935 Terek Sandpipers was also an excellent total, as was the 612 Red Knot considering that they are so well diffused amongst roosting flocks of other species.
- Of the less frequently caught species, large totals were obtained for Sanderling (393), Little Curlew (212), Black-tailed Godwit (212), Oriental Plover (157), Whimbrel (86), Broad-billed Sandpiper (71), Greenshank (46) and Eastern Curlew (42). Disappointments were Grey Plover (10), and Marsh Sandpiper (8).
- Particularly memorable catches included 118 Black-tailed Godwits at Broome on the 13 August followed by 84 Whimbrel there the next day, 41 Eastern Curlew on the 30 August (nearly doubling our previous grand total) and 98 Oriental Plover at 80 Mile Beach on 24 October.
- The visit to Bush Point from the 7 - 9 October was particularly targeted at Sanderling and Little Terns. Larger concentrations of both species roost there than at any other location in northwest Australia. A catch of 377 Sanderling on 8 October (at the time, the largest ever catch of Sanderling in Australia) and 289 Little Terns on 9 October made it a brilliantly successful visit.

Table 1. The total catches of each species of wader and tern during NWA 1998 Expedition from 1 August -1 November 1998.

Species	New	Retrap	Total
Great Knot	2881	302	3183
Red-necked Stint	2243	293	2536
Greater Sand Plover	1767	200	1967
Curlew Sandpiper	1648	274	1922
Bar-tailed Godwit	1284	190	1474
Terek Sandpiper	845	90	935
Red Knot	563	49	612
Grey-tailed Tattler	495	54	549
Sanderling	390	3	393
Sharp-tailed Sandpiper	235	5	240
Little Curlew	209	3	212
Black-tailed Godwit	208	4	212
Oriental Plover	157	0	157
Ruddy Turnstone	140	27	167
Red-capped Plover	82	2	84
Whimbrel	86	0	86
Broad-billed Sandpiper	69	2	71
Common Greenshank	46	0	46
Eastern Curlew	41	1	42
Black-winged Stilt	20	1	21
Lesser Sand Plover	19	7	26
Pied Oystercatcher	18	3	21
Grey Plover	9	1	10
Marsh Sandpiper	8	0	8
Common Sandpiper	6	0	6
Pacific Golden Plover	5	0	5
Asian Dowitcher	5	0	5
Black-fronted Plover	4	0	4
Long-toed Stint	4	0	4
Common Redshank	3	1	4
Australian Pratincole	3	0	3
Banded Stilt	2	0	2
Wood Sandpiper	2	0	2
Sooty Oystercatcher	1	0	1
Masked Lapwing	1	0	1
Red-necked Avocet	1	0	1
TOTAL (36 Species)	**13500**	**1512**	**15012**
Little Tern	345	14	359
Lesser Crested Tern	192	10	202
Gull-billed Tern	111	3	114
Whiskered Tern	59	1	60
Common Tern	9	1	30
Crested Tern	21	1	22
Caspian Tern	1	1	2
TOTAL (7 Species)	**758**	**31**	**789**

- These days, mist netting is responsible for only a very small portion of our wader catches. Port Hedland Saltworks is an ideal location for this technique and several mist net catches were made there, including 188 birds on the night of 17 - 18 September.
- Little Curlews have proved extremely difficult to catch ever since our initial superb catches (357 total) in late March/early April 1985. Four good catches at Broome Golf Course and Lake Eda (Roebuck Plains) in the second half of October/first November were thus most welcome, for a total of 212 birds.
- Cannon net catches in the range 100-400 are normally targeted in northwest Australia. Actual target levels are dependent on weather conditions and species content. Occasionally, larger catches are made – sometimes by design and sometimes as a result of misjudgment of the catch potential. A catch of 1,049 (544 Red-necked Stints) was made on Wader Beach at Broome on the 24 September. However, this had been preceded by the largest ever catch in northwest Australia – 2,042 (of 15 species, including 1001 Great Knot) that was made at Old Camp Site Beach at Broome on 29 August. Fortunately, a very large and experienced team was present. In this case, Clive Minton and Nick Branson had estimated a catch of about 1,000 when they made the decision to fire, but the net went out unexpectedly well.

Tern catching

A record 789 terns were caught during the expedition (Table. 1), including good samples of two of the three main target species (359 Little Tern, 114 Gull-billed Tern). Terns were caught at Roebuck Bay (662), 80 Mile Beach (166) and Port Hedland Saltworks (1).

Biometrics showed that two very distinct races of Gull-billed Terns were present - *macrotarsus* (Australian residents) and *affinis* (visitors from the northern hemisphere). Subsequent flag sightings and recoveries have also confirmed that many of the Little Terns were of northern hemisphere origin (Japan and Korea).

Retraps and controls

A total of 1512 retraps/controls of waders were made during the expedition. This equated to a 10% rate and is similar to other expeditions in recent years. Six birds carried bands from overseas - four from Hong Kong, one from Taiwan and one from Korea. Some old local retraps were also present in catches. Some birds were banded during the initial NW Australia expeditions in 1981 and 1982. These included a Black-winged Stilt and a Whiskered Tern that were each a minimum of 18 years old.

Percentage juveniles

The regular sampling of the wader populations over the thirteen-week period of the expedition enabled a clear pattern to be discerned of the arrival of adult birds (to join the immature birds that were already present) in August/September and later of the juvenile/first year birds (from late August in some species, but mostly in late September/October). The pattern suggested that not all juveniles had arrived by the end of October and therefore the percentage juvenile figures were only an indication, rather than a good measure, of the 1998 breeding success of each species. Nevertheless, it was apparent that Greater Sand Plover, Red-necked Stint, Little Curlew and Oriental Plover had all had very successful breeding seasons in 1998.

Other data

The majority of birds handled were also flagged. Biometric and moult data was collected on all less frequently caught species and on significant samples of other species. Nearly two hundred of the smaller waders were also dyed yellow on their underparts. This was confined to birds that were not in primary moult and potentially using the area as a staging post on their way to non-breeding areas elsewhere. While such birds rapidly disappeared, indicating that this supposition was probably correct, none were actually seen elsewhere (which was a disappointment).

Some additional experiments were carried out. The most important of these was the measurement of the rate of weight loss of waders after capture. It is necessary to determine this if one wishes to adjust measured weights of samples to take account of the actual period elapsed between capture and processing. Samples were collected from a number of species/age groups/locations/temperature conditions. The analysis of this data has now been published separately in Stilt. Weight loss in the first hour after capture is quite high (mainly due to defecation) but slows to 1-2 % per hour after that.

The opportunity was also taken to examine the accuracy of bill measurements on 94 Curlew Sandpipers that were captured twice during the expedition. Two different people measured most

birds. The difference in the mean bill lengths between capture and recapture was virtually zero, but on individual birds the difference was quite often up to 1mm, and occasionally more. Overall, the results were encouraging that data is generally not significantly biased.

Radio transmitters were deployed on waders in northwest Australia for the first time. They were applied to six Great Knot and Bar-tailed Godwits in Roebuck Bay. Day and night tracking over several weeks showed that there was considerable movement around the bay (with some birds even turning up at Bush Point). However, the predominant pattern was roosting on the northern beaches during daytime high tides, but roosting on the saltpans behind the mangroves at Crab Creek or on the sandy shores of the southern part of Cable Beach during night-time high tides.

COUNTS

80 Mile Beach

Three counts of the northernmost sections of 80 Mile Beach were carried out in August/September and the complete 220 km (from Cape Missiessy to Cape Keraudren) was counted on the 17 - 18 October. A summary of the results is attached (Tables. 2 & 3).

Some major conclusions drawn were:

- There was a steady build up in numbers throughout the period as migrants arrived from the north - firstly adults and then juveniles.
- A detailed analysis of the counts for each species showed that numbers declined in a few species after mid-September as birds passed through the area for non-breeding destinations in southern Australia (Red-necked Stint and Curlew Sandpiper in particular).
- The greatest concentrations of waders occur on the beach between 5 km and 55 km south of the Anna Plains beach road entrance (where base camp was located).
- Some species have their greatest concentrations much further south on 80 Mile Beach, especially Sanderling, Pied Oystercatcher, and Ruddy Turnstone. Therefore, previous estimates for these species based on extrapolations from counting in the northern section are not correct.
- Red Knot numbers (24,891) were well below the earlier estimates based on counts made in the early 1980s.
- The Oriental Plover count (57,619) is by far the highest ever and is above the previous estimate for the total population thought to occur in Australia. Conditions on the day of the count were ideal in that there had just been huge arrivals of adult *and* juvenile birds, and the extremely hot weather conditions meant that birds vacated their feeding grounds on the plains and came down to the cooler shoreline in the heat of the day.
- The full results of the 1998 counts are being integrated with the later NWA 2001 complete count for publication during 2003. The data has already been used in several conservation applications.

Other locations

Wader counts were also undertaken at Bush Point, Port Hedland Saltworks, Roebuck Bay and the Lacepede Islands.

AVIAN-BORNE VIRUSES

Further blood samples were taken for analysis by the WA Department of Agriculture, assisted in the field by veterinary officers/microbiologists from Indonesia. Testing again showed an extremely low level of incidence of avian-borne diseases in the waders of northwest Australia.

CONCLUSION/RECOMMENDATIONS

The majority of the key objectives of this expedition were more than adequately achieved and it will probably go down in history as the most

Table 2. Wader and Tern counts at 80 Mile Beach during August – September 1998

Date	Section					
	Northernmost 70km		Northernmost 100km		Total length (220km)	
	Waders	Terns	Waders	Terns	Waders	Terns
5.8.98	31364	1836	-	-	-	-
19.8.98	63816	2073	64967	2965	-	-
14.9.98	207035	1381	225727	1770	-	-
17-18.9.98	367457	1522	414512	4487	465890	6520

Table 3. The species composition of a complete count of waders and terns at 80 Mile Beach on 17-18 Oct 1998.

Species	220km Totals
Pied Oystercatcher	653
Sooty Oystercatcher	3
Black-winged Stilt	1
Beach Thick-knee	1
Oriental Pratincole	1
Australian Pratincole	9
Pacific Golden Plover	24
Grey Plover	1,416
Red-capped Plover	2,512
Lesser Sand Plover	162
Greater Sand Plover	63,482
Oriental Plover	57,619
Black-tailed Godwit	22
Bar-tailed Godwit	110,290
Asiatic Dowitcher	1
Little Curlew	224
Whimbrel	185
Eastern Curlew	709
Grey-tailed Tattler	10,436
Redshank	5
Greenshank	1,738
Marsh Sandpiper	76
Terek Sandpiper	7,989
Red Knot	24,891
Great Knot	158,082
Red-necked Stint	16,766
Curlew Sandpiper	2,859
Sanderling	2,230
Broad-billed Sandpiper	21
Sharp-tailed Sandpiper	9
Common Sandpiper	3
Ruddy Turnstone	3,480
TOTAL WADERS	465,890
Silver Gull	1,008
Whiskered Tern	303
Caspian Tern	103
Gull-billed Tern	1,346
Common Tern	101
Little Tern	94
Crested Tern	556
Lesser Crested Tern	4,017
WADER TOTAL (32 Species)	465,890
TERN TOTAL (7 Tern Species)	6,520
GULL TOTAL (1 Species)	1,008
OVERALL TOTAL	473,418

successful and one of the most enjoyable, of the series of expeditions to northwest Australia.

One of the great benefits of such an expedition is the opportunity for people to meet and share their expertise with others. The huge number and diversity of participants of NWA 1998 greatly facilitated this interaction. Many valuable contacts were made between wader enthusiasts that will benefit wader studies around the world in the future. Northwest Australia and Broome Bird Observatory are now even more established on the world wader map.

Expeditions in the future are likely generally to be shorter in duration, with more limited numbers of participants. They will be targeted at specific gaps in our data, in order to reduce the burden of the organisation and to make them less costly overall.

ACKNOWLEDGMENTS

Many people/organisations assisted NWA 1998 to be so successful. We are particularly grateful to those landowners who allowed us to traverse their property and who assisted us in so many different ways. These include Anna Plains Station, the Cargill Saltworks at Port Hedland, Roebuck Plains Station, Broome Golf Club and Mandorah Station..

The staff at Broome Bird Observatory, the management committee and other individuals (especially Helen Macarthur and Mavis Russell) is specially thanked for making our stay at Broome so comfortable and enjoyable.

Various people in Broome and CALM in Perth very kindly loaned us trailers to carry equipment to/from 80 Mile Beach and Port Hedland, and they are greatly thanked. CALM also paid for the cost of hiring an aircraft to do an aerial count of the waders on 80 Mile Beach and also assisted in vehicle/fuel costs for the 80 Mile Beach complete ground count.

Myer Stores generously transported some of the heavy/bulky cannon netting equipment from Melbourne to Perth (and back again) free of charge. They have assisted expeditions in this way on every occasion since 1985.

Finally, an enormous thank you to every person who took part in the expedition and who input in so many ways to its enjoyment and success. It was especially helpful that a number of people participated in the full thirteen-week period. This core group greatly assisted the continuity and resulting efficiencies of the fieldwork operations. We hope to see many of you on NW Australia expeditions in the future.

NORTHWEST AUSTRALIA WADER AND TERN EXPEDITION FROM 15 MAY TO 3 JUNE 2000

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INTRODUCTION

This was the first expedition to northwest Australia timed to take place during the May to July period when adult breeding waders are away in the northern hemisphere. The populations to be studied at Roebuck Bay and 80 Mile Beach were therefore expected to be entirely immature non-breeding birds.

It was also the first of the planned "mini expeditions". These are smaller scale activities than most of the previous major wader expeditions and are designed to fill specific gaps in the northwest Australia data. With fewer participants and a shorter period in the field they are easier to organise and less costly.

PARTICIPANTS AND FIELDWORK SCHEDULE

The NWA 2000 Expedition ran for three weeks, from 13 May to 3 June 2000. Twelve people participated for the whole period (all from Australia) and various local wader enthusiasts also took part at different times. Eight days was spent at 80 Mile Beach (18 – 26 May) with the remainder of the time at Roebuck Bay, Broome, except for a two-day visit to the Lacepede Islands (27 – 29 May).

The unprecedented floods along the whole of the coastal plain considerably affected the visit to 80 Mile Beach. This resulting from an extremely wet January/April period that culminated in a major cyclone crossing the coast at the south end of Roebuck Bay just before Easter (in the third week of April). The normal road down to the beach from Anna Plains Station was under one metre of water (3km wide). A circuitous route, 35 km long instead of the normal 7 km, was made passable by Anna Plains Station to enable us to get to the beach. However this added two hours journey time for every beach visit. So for logistical reasons, we had to be based at Anna Plains Station rather than on the beach itself.

OBJECTIVES

The principal objectives of this expedition were:

(1) To catch, band, leg flag and fully process (weight/moult/other biometrics) the immature waders of a wide variety of species.
(2) To determine, by counting, the size of these non-breeding immature populations and determine the age structure of each species present.

RESULTS

Banding

A very satisfactory total catch of 1676 waders (1589 newly banded birds and 87 retraps) was made during the expedition. Samples of more than 50 birds were obtained for all the eight main study species (Table 1). Most surprising was a catch of a total of 412 Red Knot and perhaps most pleasing, a total of 12 Asian Dowitcher and 14 Whimbrel.

Eleven cannon net catches were made, six at Broome and five at 80 Mile Beach. However, 1270 birds were caught at Broome compared with 406 at 80 Mile Beach. There were two reasons for this imbalance. Firstly a very large catch of 710 birds was made at Wader Spit on Roebuck Bay on 31 May. Secondly, birds proved rather harder than normal to catch at 80 Mile Beach because of the much smaller numbers present on the very large area of shoreline. Also, at the slightest provocation (e.g. twinkling) many birds lifted off the shore of

Table 1. The total catches of each species of wader and tern during the NWA 2000 Wader Expedition from 15 May- 2 June 2000.

Waders	**New**	**Retrap**	**Total**	**First year birds**
Great Knot	433	47	480	276
Red Knot	394	18	412	320
Bar-tailed Godwit	153	14	167	98
Terek Sandpiper	140	3	143	142
Curlew Sandpiper	126	3	129	128
Red-necked Stint	109	0	109	104
Greater Sand Plover	91	0	91	91
Grey-tailed Tattler	59	0	59	58
Ruddy Turnstone	32	0	32	29
Pied Oystercatcher	16	2	18	2
Whimbrel	15	0	15	14
Asiatic Dowitcher	12	0	12	12
Eastern Curlew	5	0	5	3
Sanderling	4	0	4	4
TOTAL Waders	**1589**	**87**	**1676**	
Lesser Crested Tern	13	2	15	?
Crested Tern	1	0	1	0
Gull-billed Tern	1	0	1	1
TOTAL Terns	**15**	**2**	**17**	
TOTAL BIRDS (Waders + Terns)	**1604**	**89**	**1693**	

Location	**Waders**	**Terns**	**Catches**
Broome	1270	11	6
80 Mile Beach	406	6	6
TOTAL	**1676**	**17**	**12**

80 Mile Beach and went inland to roost at high tide on the extensive shallow floodwaters on the plains.

Flagging

All newly caught birds and retraps that were not already carrying flags were given a yellow flag on the right leg. The exception to this was first year Bar-tailed Godwit, Great Knot and Red Knot at Roebuck Bay, which were given a white colour band (and no yellow leg flag) to signify that they were birds hatched in the 1999 Arctic breeding season.

Retraps

The retrap rate, at close to 5%, was significantly lower than the usual 10-20% range for northwest Australia expeditions. The reason for this is that these populations of young birds have been exposed to banding activities for a much shorter period than adult birds. Nevertheless the 87 retraps contained a valuable number of known age individuals, which helped complement the biometric/plumage/moult data used to assess the ages of birds.

We now have conclusive proof that many two-year-old Bar-tailed Godwit, Great Knot and Red Knot do not go north to breed and that even some three-year-olds of these species may remain here (and therefore don't breed for the first time until four years of age).

Age structure

In seven species, almost every bird caught was a first year bird and just coming up to one year old (Table 1). In addition to the three species mentioned under retraps, many of the Eastern Curlew present were also older than first year. Surprisingly, only 7 % of the Whimbrels were second year (or older) birds. Nine percent of the Ruddy Turnstones appeared to be two-year-olds. Previously it was thought that all of these migrated northward at age two.

Biometrics

The most exciting and surprising discoveries of the expedition came from the weight/age data collected. Firstly, it was extremely obvious on our first perusal of the wader flocks at Roebuck Bay,

and later at 80 Mile Beach, that a great number of Red Knots were present at high tide roosts on the shore. A high proportion of these were in full breeding plumage. We were fortunately able to catch good samples of these and determine that there was indeed a high proportion of apparently fully adult birds present. To our surprise these were mostly very heavy birds with weights typical of birds about the depart on northward migration at the more normal time in late April (mean weight 150-160 g). Not surprisingly, these birds departed during the second and third weeks of May and many fewer adult full breeding plumage birds were left by the end of the month.

One can only speculate that these birds had had their departure preparations interrupted by the late April cyclone. It nevertheless seems amazing that they should still accumulating fat deposits and then migrating as late as mid May. They would have had no chance of getting all the way to the breeding grounds in time to breed in June 2000.

Another unexpected behaviour was found in a significant proportion (around 30%) of first year Terek Sandpipers and Greater Sand Plovers. These birds had accumulated fat deposits to give them weights approaching those of pre-migratory adults in April. Again sampling at the end of May/early June showed that these birds had departed. This is the first time evidence has been obtained of the northward departure of one-year-old birds from any species except those few where all first year birds normally depart (Sharp-tailed Sandpiper, Pacific Golden Plover, Oriental Plover, Little Curlew and Oriental Pratincole). Its particularly surprising that they should be putting on weight and making this northward movement well after the normal northward migration season.

We were extremely lucky to obtain absolute proof that these birds were moving out of Australia when one of these heavy May first year Terek Sandpipers was reported from the Philippines in August!

It is not clear why only two species were involved in this activity. It is also not clear why only a proportion of the population undertook this partial northward migration. Maybe it was the fittest birds that were involved and that this first year excursion made them better prepared for their first full migration back to the breeding grounds the following year.

Waterbirds

The vast number of waterbirds present, and mostly breeding, on the floodwaters around Anna Plains were one of the visual highlights of the expedition. Assessment of the numbers of birds breeding locally and the recording of many nest contents were carried out. In addition a two hour helicopter survey of the waterbirds on the floodwaters between Anna Plains and Mandorah Stations was carried out. This data has been submitted to CALM, Perth, for incorporation into a major paper on waterbirds occurring in northwest Australia in the 1999/2001 floods.

A few highlights might be worth mentioning:

a. There were tens of thousands of nesting Black-winged Stilts and Whiskered Terns.
b. There were over 1000 Pelican nests and many hundred nests of egrets and herons (Cattle and Intermediate Egrets, Pacific and Nankeen Night Herons).
c. Many thousands of pairs of Straw-necked Ibises were nesting. Many Glossy Ibis were present, but did not appear to be breeding.
d. Thousands of pairs of Hoary-headed Grebes were nesting together with small numbers of Australian Grebes.
e. Vast hoards of ducks were present and breeding, including thousands of both species of Whistling Ducks. The water was also deep enough for Hardheads to be quite common.
f. There were several colonies of around 100 pairs of Gull-billed Terns nesting on small islands. One that was visited had newly hatched chicks, most of which were being fed on skinks. These were at least the same length as the young chicks. One chick had TWO skink tails protruding from its mouth!
g. Red-kneed Dotterel were nesting in small, loose colonies on low islands in the floodwaters. Most nests were placed at the base of small 0.5 to 1.5 m high bushes (apparently a normal nesting position).

A helicopter visit to the flooded clay pans on Roebuck Plains, behind Crab Creek was made for the high tide period on the 3 June. This is the first time this ephemeral lagoon area, inaccessible by ground/vehicle/boat, had been visited, despite the area being extensively used by waders for roosting. Although this was the "off" season, 21,528 waders came to roost in the lagoons. The results of this have since been published in Stilt.

Lacepede Islands

This visit coincided with the peak breeding activity of Brown Boobies (20,000+ pairs West and Centre Island, with eggs and young chicks) and Lesser Frigatebirds (2500 nests, mostly with eggs and small chicks). Wader numbers were quite low, with Ruddy Turnstones predominating. No Roseate Terns were present.

ACKNOWLEDGMENTS

Grateful thanks are due to everyone who helped achieve, directly or indirectly, the valuable results that came out of this NWA 2000 expedition. John Stoate at Anna Plains Station is especially thanked, not only for house accommodation, but also for enabling us to get to 80 Mile Beach along a specially prepared route circumventing the floodwaters. The staff at Broome Bird Observatory and all the local Broome wader enthusiasts who participated in activities are also thanked. Humphrey Sitters again kindly made his vehicle available and Heather Gibbs provided a most valuable service by computerising some of our data, facilitating some preliminary analyses while we were still in the field. Most of all those team members who put in so much time and physical effort are especially thanked.

THE FUTURE

Small expeditions to NWA, to supplement the effort of the local wader banding team and to fill in gaps in the data collection, are clearly a successful way of operating in the future. They are likely to become an important component in the NWA study program. Another expedition to study the immature birds remaining behind when the adults have gone north to breed is required, preferably in the second half of June/early July, to complement the data obtained on this expedition.

NORTHWEST AUSTRALIA WADER AND TERN EXPEDITION FROM 30 DECEMBER 2000 TO 30 JANUARY 2001

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INTRODUCTION

The AWSG has been banding and counting waders and collecting associated biometric and moult data in NW Australia since August 1981. This has been via a series of large and small expeditions supplemented, since 1992, by regular catches by Broome Bird Observatory Staff and others resident in the Broome area.

Most of the data collected has been in the March/April northward departure period and in the August/October period when birds arrive back from the northern hemisphere breeding grounds. Little data has been generated in the December/January/February period and thus there was a major gap in knowledge, especially of moult/weight data. Although at that time of year, the local climate is hot and humid, with thunderstorms and potential cyclones, it was felt that a small expedition should be mounted to try and fill the gap in knowledge. This was particularly important for moult, as the lack of data was preventing an accurate estimation of the duration of primary moult for most species.

PARTICIPANTS AND FIELDWORK SCHEDULE

A team of eleven participants, nine from Australia and two from the United Kingdom were present on the expedition from 30 December 2000 to 20 January 2001. A number of Broome residents supplemented this visiting team extensively during this three-week period.

When the team was at Roebuck Bay, Broome, it was based at the Broome Bird Observatory. During the eight day visit to 80 Mile Beach (7 - 15 January) the team was based at Anna Plains Station (in and camping around a small house kindly loaned by the owners of Anna Plains), rather than on the normal beach campsite which was considered potentially too risky for extended occupation (and too uncomfortable!) at that time of year.

OBJECTIVES

The specific objectives of the NWA 2000/2001 expedition were:

a. To catch at least 50 birds of as wide a range of species as possible from Broome and 80 Mile Beach (Anna Plains), in order to collect moult and weight data.
b. To obtain an indication of the breeding success of each wader species in the 2000 breeding season by measuring the proportion of first year birds caught in the catches.
c. To catch samples of species which are only present in NW Australia during the December-February period (especially Oriental Pratincole).

RESULTS

Banding

Wader banding was carried out on all days except those with unsuitable tides (6 -7 and 19 January). A total of 19 cannon net catches and two (small) mist net catches were made. Cannon net catch sizes ranged from 13 to 220 birds, averaging 100. This is rather smaller than usual, but was deliberate because of the hotter climate (33 - 41° C) at this time of year and smaller team size (11-17 people) than normal.

A total of 1779 waders was caught (1614 newly banded and 165 retraps), of 23 species, with almost equal numbers being caught at Broome and 80 Mile Beach (Table 1). Fifteen terns (1 retrap) and 127 Silver Gulls (2 retraps) were also caught.

The target minimum sample size of 50 birds was met for all the eight main study species (Table 1). One of the special target species, Oriental Pratincole, almost reached this level too (47). Smaller, but useful, samples of a number of other less frequently captured species were also caught and the only failures were on Little Curlew and Oriental Plover (nil) and Black-tailed Godwit (4).

However, it could have been a lot better, and very nearly was! Because of the huge amounts of water still lying on the grasslands at Anna Plains there were vast numbers of Oriental Pratincoles present (estimates vary between 20-50,000). They proved much less easy to concentrate into net catching areas than had been envisaged. On the one occasion, when over 100 birds had been twinkled into the catching area, the birds spooked and flew away when we tried to move the twinkler out of the firing line! Little Curlew were also a disappointment because, after finding them coming to roost at dusk in patches of long grass in rather bare general areas, we found that their roost

Table 1. The numbers caught of each species of wader during cannot and mist netting in NWA from 31 December 2000 - 18 January 2001. (* Of these, 882 at Broome, 897 at 80 Mile Beach). In addition, 3 Australian Grebe, 2 Green Pygmy Geese and 2 Grey Teal were caught during the expedition.

Species	Totals			Juveniles	
	New	Retrap	Total	No.	%
Pied Oystercatcher	15	1	16	6	37.5
Sooty Oystercatcher	12	2	14	0	0.0
Grey Plover	3	0	3	0	0.0
Greater Sand Plover	171	32	203	46	22.7
Lesser Sand Plover	1	1	2	1	50.0
Red-capped Plover	19	0	19	9	47.4
Black-fronted Dotterel	4	0	4	0	0.0
Ruddy Turnstone	5	1	6	0	0.0
Eastern Curlew	15	0	15	1	6.7
Grey-tailed Tattler	233	12	245	46	18.8
Common Greenshank	18	0	18	2	11.1
Common Redshank	0	1	1	0	0.0
Marsh Sandpiper	2	0	2	0	0.0
Terek Sandpiper	77	15	92	6	6.5
Black-tailed Godwit	4	0	4	0	0.0
Bar-tailed Godwit	222	39	261	14	5.4
Red Knot	48	7	55	6	10.9
Great Knot	535	29	564	107	19.0
Sharp-tailed Sandpiper	11	0	11	4	36.4
Red-necked Stint	92	19	111	17	15.3
Curlew Sandpiper	78	6	84	10	11.9
Sanderling	2	0	2	1	50.0
Oriental Pratincole	47	0	47	3	6.3
SUBTOTAL	**1614**	**165**	**1779***	**299**	
Whiskered Tern	4	0	4	0	
Gull-billed Tern	8	1	9	0	
Little Tern	2	0	2	0	
Silver Gull	125	2	127	0	
SUBTOTAL	**139**	**3**	**142**	**0**	
TOTAL	**1753**	**168**	**1921**	**299**	

location was not as constant from one night to the next as we had assumed. We never got to first base with Oriental Plover as most had already dispersed to areas well inland and numbers present were very small.

Nine Gull-billed Terns was a useful small addition to our data on this species, where both the race from the northern hemisphere (*affinis*) and from the Australian breeding population (*macrotarsus*) should have been present. The Silver Gull banding was the commencement of a Broome Bird Observatory project to study the movements of birds along the northwest Australian coastline to/from Roebuck Bay.

Flagging
All newly banded waders and terns were yellow flagged (including the Silver Gulls) and any unflagged retraps were also flagged.

Retraps
Nine percent of the waders caught already carried bands, mostly from previous expeditions or local banding activities. This is a rather lower retrap rate than usually experienced in NWA catches. Nevertheless, the 165 retraps provided a useful pool of known age birds to assist in the moult studies.

Percentage juveniles
All birds proved relatively straightforward to age, using a combination of moult and plumage characteristics. Most adult birds were still in non-breeding plumage, except for a few of the Greater Sand Plovers and Red Knot that were already showing the first traces (up to 25%) of breeding plumage, following completion of their annual primary moult.

The proportion of first year birds in samples caught varied quite markedly between species (Table 1). It would appear that the breeding season in Siberia in 2000 was most successful for Greater Sand Plover (23% first year birds), Great Knot (19%) and Grey-tailed Tattler (19%). It was also reasonable for Red-necked Stint (15%), Curlew Sandpiper (11%) and Red Knot (11%). However, Terek Sandpiper (6%) and Bar-tailed Godwit (5%) appeared to have fared poorly.

Some local breeding species- Pied Oystercatcher (37%) and Red-capped Plover (47%)- had also bred well. Given the generally favourable conditions in northern and inland Australia after heavy rainfall in early 2000, it is not surprising that many Red-capped Plover juveniles were recorded. The lack of any young birds in the small sample of Sooty Oystercatchers is somewhat baffling, especially as it is so markedly different from that of Pied Oystercatchers.

Moult
Excellent primary moult data was collected for many species. Adults of most species were in the latter stages of moult and some individuals had already completed their primary moult. Many first year birds were also showing primary moult, a few quite advanced, but other individuals had not commenced any moult yet.

The most unexpected information was the presence of a second wave of moult occurring in some second year birds of several species. This took the form of a recently fully moulted bird commencing replacing some of the innermost primaries even though these were still relatively good in appearance. Presumably those second year birds that had done a partial moult in their first year and had completed this early in their second year had the time available to again replace the innermost feathers. They would thus be able to commence their first northward migration with their flight feathers in the best possible condition.

Biometrics
Standard biometric data was collected on most birds handled, thus augmenting considerably our data collection for this period in the middle of the non-breeding season. The most interesting feature was that some weight gain had already commenced in birds that had completed their primary moult. This may have been partly because energy was no longer required for this moult process but it could also have been part of the deliberate build up of pre-migratory fat deposits for northward departure in March/April. More data is needed on this but it seems possible that pre-migratory weight gains are spread over a long period before the first leg of northward migration. Subsequently, time does not allow this at migratory stopovers where weight gain needs to be extremely rapid.

Counts
No formal wader or waterbird counts were conducted during this expedition. The regular annual "summer" wader counts normally take place in late January/early February. [From late 2001 onwards, the "summer" counts have been

rescheduled to take place in November/early December, before the wet season]. Estimates were made of numbers of waterbirds still remaining on the floodwaters around Anna Plains Stations. The most noticeable feature was that the prolific breeding activity that had been recorded in May/June 2000 seemed to have completely ceased.

ACKNOWLEDGMENTS

Considerable thanks are due to everyone who took part in the expedition, or who assisted in a variety of ways. Humphrey Sitters is particularly thanked for making his 4WD vehicle available. Broome Bird Observatory staff and management committee are thanked for allowing us to be based there when in Broome and for much assistance in fieldwork. John Stoate was extremely generous in allowing us to use one of the houses at Anna Plains Station as our base when we were working at 80 Mile Beach. He's also greatly thanked for allowing us to roam over Anna Plains Station looking at and counting the vast number of waterbirds still present there as well as to catch Oriental Pratincoles (and to attempt to catch Little Curlew!).

THE FUTURE

This was the second of the "small" wader expeditions that need to be mounted to fill gaps in our data from northwest Australia. It confirmed the experience of the May/June 2000 Expedition that the most valuable data could be gained by a small team operating for a limited period, provided data collection targets were clear and practical. Future small expeditions will be planned, in addition to periodic larger operations.

NORTHWEST AUSTRALIA WADER AND TERN EXPEDITION 15 SEPTEMBER TO 17 NOVEMBER 2001

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INTRODUCTION

This was the 20th special visit to band and count waders and terns in N.W. Australia since the first expedition took place in late August/early September 1981.

Previous expeditions have taken place in

January	1
March/April	9
May	1
August/November	8

The NWA 2001 expedition was timed to cover the main arrival period of juvenile waders in N.W. Australia and to permit a November count of 80 Mile Beach.

OBJECTIVES

The principle objectives of this expedition were

Counts

To undertake the second-ever complete ground count of 80 Mile Beach. This was scheduled for November, to provide a comparison with the first count in October 1998.

Banding

1. To obtain good catches of the main wader species in the region in order to increase the information on migration routes from subsequent flag sightings and recoveries.
2. To determine a measure of the breeding success of each species in the 2001 arctic summer by recording the percentage of juveniles in the populations in the latter part of the expedition.
3. To obtain as many recaptures as possible of birds banded in previous years to facilitate survival rate calculations.
4. To especially target the less frequently caught wader species whenever opportunities were available.
5. To expand further the studies of terns, especially Roseate Terns on the Lacepede Islands.

Itinerary

The fieldwork programme covered Roebuck Bay (Broome), 80 Mile Beach (Anna Plains), Port Hedland Saltworks, and the Lacepede Islands (100 km N of Broome). Two days were also devoted to Symposia (in Broome). The detailed itinerary was drawn up, as usual, in the light of the optimum tide and moon conditions for each location.

Roebuck Bay, Broome (including 3 at Bush Point)	20 days
80 Mile Beach	20 days
Port Hedland Saltworks	5 days
Lacepede Islands	2 days
Birds Australia/AWSG Symposiums	2 days
Travel between locations	7 days
Days off/Rest days	7 days
Total	**63 days**

"Days off" became interpreted as "days off the beach" and "rest days" as "days like the rest"! Opportunities to catch inland species such as Little Curlew were taken on such days. And at 80 Mile Beach, it was discovered that it was possible to catch on the beach north of the campsite even on the lowest of neap tides. This reduced the number of days when no formal activity occurred to two!

Participants

A total of 48 people from 10 different countries participated.

Australia	20
UK	17
Russia, Taiwan, New Zealand	2 (each)
Japan, India, Canada, Germany, & The Netherlands	1 (each)

Of these, 11 individuals were present throughout the nine-week period providing a stable core team and leading to operational efficiencies. These figures do not include Broome-based personnel –

members of the North West Wader Study Group – who also took part extensively.

Finances

The expedition broke even and all costs balanced income (see below). The majority of costs were covered by participants' input of $20 per day for food and overheads, $150 per week for transport, $20 towards the Bush Point hovercraft costs, $15 for each symposium, $450 towards the Lacepedes boat costs, and $20 towards the cost of the "last supper".

Symposia

These were symposia held in Broome on 25 September and 28 October and were initiated as an AWSG contribution to the RAOU/Birds Australia Centenary Celebrations. They provided a forum for expedition members to make rather more formal presentations than those that have occurred in the evenings at Broome Bird Observatory and 80 Mile Beach during past expeditions. They were also open to members of the public. About 45 people attended each. Symposium. Speakers from 7 countries made a total of 24 presentations. While the main theme was waders, papers were also given on seabirds, terns and tides.

COUNTS

80 Mile Beach

The whole of the 220 km length of 80 Mile Beach was counted on 12-13 November. This required six teams, three based at Anna Plains and three at the Wallal Downs campsite (the only public access point). Four of these teams were led by the same person as in the October 1998 count and counted the same sections of coast, thus reducing the potential variation in results associated with different counters.

The overall totals of 472,000 waders (Table 1) and 6,300 terns were remarkably similar to the 1998 totals (466,000 waders and 7,500 terns). A significant potential increase had been considered possible as the later date in November 2001 allowed for the main arrivals of juveniles to have occurred.

A pleasing feature of the results was the close similarity of numbers and distributions of many species in the two years. This was true in both abundant species (e.g. Greater Sand Plover 64,584 in 2001 vs. 63,482 in 1998) and in less common species (e.g. Pied Oystercatcher 694 vs. 653, Grey Plover 1,585 vs. 1,416, Whimbrel 148 vs. 185).

The most marked differences between the two years were: -

a. Increases of 40% in Grey-tailed Tattlers (14,647 from 10,436) and 23% in Terek Sandpipers (9,820 from 7,989).

   These larger numbers of both species were noticeable throughout the period of the expedition with both occurring more frequently than usual as major components of catches on 80 Mile Beach.

b. An increase of 43% in Red-necked Stints (24,005 from 16,766). This is a national trend

INCOME	
	$
Contributions from participants	58,853
Contributions from CALM, AQIS, and David Seay (donation)	1,674
	60,527
EXPENDITURE	
Vehicles	17,920
Food	15,650
Boat to Lacepedes	10,164
Fuel	6,675
Equipment	6,283
Hovercraft to Bush Point	2,000
Miscellaneous	1,931
	60,623

Net loss $96.

Table 1. Counts of all waders on 80 Mile Beach in October 1998 and November 2001 and cover complete length from Cape Missiessy to Cape Keraudren (220km).

Species	17-18 Oct 98	12-13 Nov 01	Maximum
Great Knot	158,082	169,044	169,044
Bar-Tailed Godwit	110,290	97,403	110,290
Greater Sand Plover	63,482	64,584	64,584
Oriental Plover	57,619	41,278	57,619
Red Knot	24,891	29,679	29,679
Red-necked Stint	16,766	24,005	24,005
Grey Tailed Tattler	10,436	14,647	14,647
Terek Sandpiper	7,989	9,820	9,820
Curlew Sandpiper	2,859	7,984	7,984
Ruddy Turnstone	3,480	1,649	3,480
Sanderling	2,230	3,219	3,219
Red-capped Plover	2,512	3,077	3,077
Greenshank	1,738	2,432	2,432
Grey Plover	1,416	1,585	1,585
Eastern Curlew	709	552	709
Pied Oystercatcher	653	694	694
Little Curlew	224	215	224
Sharp-tailed Sandpiper	9	193	193
Whimbrel	185	148	185
Marsh Sandpiper	76	171	171
Lesser Sand Plover	162	0	162
Pacific Golden Plover	24	12	24
Black-Tailed Godwit	22	7	22
Sooty Oystercatcher	3	13	13
Broad-billed Sandpiper	12	3	12
Australian Pratincole	9	1	9
Redshank	5	0	5
Common Sandpiper	3	2	3
Black-fronted Dotterel	0	1	1
Black-winged Stilt	1	0	1
Beach Thick-knee	1	0	1
Oriental Pratincole	1	0	1
Asiatic Dowitcher	1	0	1
Total Waders	465,890	472,418	503,896

resulting from recent good breeding seasons.

c. An increase of 19% in Red Knot (29,679 from 24,891). Significant numbers were located just to the north of Anna Plains camp site in 2001, where few were present in 1998.

d. Increases of 180% in Curlew Sandpipers (7,984 from 2,859) and 44% in Sanderling (3,219 from 2,230). This apparent welcome trend in Curlew Sandpiper numbers as this species is showing long term declines nationally. However, the count should be interpreted with caution as it is a notoriously difficult species to count accurately in the huge flocks of large and medium sized waders on 80 Mile Beach. The Sanderling were again mostly in the Mandorah area and at another location only 15 km from the southern end of 80 Mile Beach.

e. Greenshank (2,432 from 1,738, +40%) and Marsh Sandpiper (171 from 76, +125%) numbers were also up. As with some of the other increases detected a proportion of the change may be due to the presence of more juveniles in November 2001 than in October 1998.

f. Against the trend was an apparent decrease of 12% (97,403 vs. 110,290) in Bar-tailed Godwits. The general impression during banding operations was that a larger decline than this had occurred. It was also felt that Great Knot numbers might be down but this was not supported by the count (169,044 vs. 158,082, +7%).

g. The largest decline was in Oriental Plover numbers (41,278 vs. 57,619, -28%). This was expected as the 1998 count coincided with the peak arrival of adult and juvenile birds, some of which would have dispersed inland by November. Also in 1998 there were hot conditions, which were conducive to birds leaving the plains, where they feed, to roost on the cooler beach in the middle of the day. Although in 2001 similar conditions prevailed, the relatively early timing of the counts (7am to 11am) meant that some birds that visited the beach later may not have been counted.

As in previous counts the greatest concentrations of waders overall were in the sector 5 – 55 km south of the Anna Plains beach road (the campsite). Each 5 km section in this region held more than 10,000 waders, with the peak of 136,392 being in the 35 – 40 km section.

As in 1998, the greatest concentrations of a few species occurred outside this sector, in the southern half of 80 Mile Beach. Such species included Pied Oystercatcher (which also breed extensively from Wallal southwards), Sanderling, Ruddy Turnstone, and Grey Plover.

The northern 70 km of 80 Mile Beach was also counted on 29 September. The 163,678 waders counted was a little lower that might have been expected, based on a count of 209,602 on 14 September 1998. The later count of this same section, on 12-13 November 2001, was 405,686 waders.

Bush Point

A total of 63,979 waders were counted at the high tide roost at Bush Point on 18 September. This is the largest single high tide roost in the East-Asian Australasian Flyway with over 100,000 birds at its peak in October/November. Top species this year were 22,000 Greater Sand Plover, 20,000 Bar-tailed Godwits, and 15,000 Great Knot. A total of 993 terns were also present including 800 Little Terns (where from?).

Port Hedland Saltworks

The numbers of waders using the saltworks at Port Hedland has reduced markedly in recent years. This is largely due to changes in operating procedures with higher water levels in the intake and evaporation ponds leading to a reduction in feeding areas. There have also been negative changes in the tidal areas outside the bank of the salt lagoons with a major new creek forming and draining previously wet areas.

Two counts were conducted, on 14 and 19 October, and the combined results are appended (Table 2). The past specialties of the area – Broad-billed Sandpiper (thousands), Lesser Sand Plovers (hundreds) and Asiatic Dowitchers (100-120) are much reduced.

A small compensation was a record flock of 53 Red-necked Phalaropes. The Port Hedland Saltworks is the only place in Australia where this species regularly occurs. Numbers are usually less than 15.

A total of 125 species of birds (including passerines) were recorded in the Port Hedland Saltworks during the six days the Expedition was based there. The owners, Rio Tinto, submitted this list as part of a worldwide competition, which generated funds for Birdlife International.

Lacepede Islands

A complete count of waders and terns on West Island and Middle Island was carried out at high tide on 7 October, together with the usual seabird census. Wader numbers (2,400) were similar to previous counts with Ruddy Turnstone (600) predominating, closely followed by Grey-tailed Tattlers (500).

The night time roost of 25,000 Roseate Terns was again the outstanding feature. Most Roseate Terns

Table 2. Counts at Port Hedland Saltworks October 2001.

Species	14 Oct 01	19 Oct 01	Max Count
Pied Oystercatcher	8	4	8
Masked Lapwing	0	0	0
Grey Plover	6	2	6
Pacific Golden Plover	8	4	8
Red-kneed Dotterel	0	0	0
Lesser Sand Plover	26	24	26
Greater Sand Plover	104	12	104
Oriental Plover	8	264	264
Red-capped Plover	177	151	177
Black-winged Stilt	26	9	26
Banded Stilt	55	0	55
Red-necked Avocet	63	5	63
Ruddy Turnstone	74	25	74
Eastern Curlew	19	31	31
Whimbrel	6	5	6
Little Curlew	0	0	0
Wood Sandpiper	1	0	1
Grey-tailed Tattler	44	17	44
Common Sandpiper	21	2	21
Greenshank	134	16	134
Marsh Sandpiper	80	191	191
Terek Sandpiper	8	0	8
Asiatic Dowitcher	53	12	53
Black-tailed Godwit	11	0	11
Bar-tailed Godwit	80	438	438
Red Knot	0	0	0
Great Knot	200	0	200
Sharp-tailed Sandpiper	225	159	225
Red-necked Stint	1,797	1,454	1,797
Curlew Sandpiper	1,302	2,320	2,320
Sanderling	6	0	6
Broad-billed Sandpiper	300	38	300
Red-necked Phalarope	53	70	70
WADER TOTALS 33 Species	4,895	5,253	6,667
Silver Gull	240	234	240
Whiskered Tern	73	50	73
White-winged Black Tern	1	4	4
Gull-billed Tern	52	0	52
Caspian Tern	49	29	49
Common Tern	2	1	2
Little Tern	57	8	57
Crested Tern	0	0	0
Lesser Crested Tern	2	0	2
TERN TOTALS 8 Species	236	92	239

departed the island in the first hour or two of daylight and did not return until 4 – 5 pm. The main night time roosts were in the bay and on the shores of the south and southwest of West Island. However, up to 2,500 roosted at the top of the muddy creek in the centre of West Island in a small mid-morning post-first-fishing gathering and it was here that 401 were cannon netted on 8 October.

BANDING

Wader Catches

A total of 8477 waders were caught during the nine week expedition (Table 3). They were made in 41 cannon net and 5 mist net catches. Top species were Great Knot (1853), Red-necked Stint (1452), Greater Sand Plover (1182) and Grey-tailed Tattler (1011). This was the largest catch of Tattlers by any of the wader expeditions to northwest Australia, and was nearly twice the number caught in 1998 (549) during a thirteen week expedition that caught nearly twice as many birds (15,012). This catch information tallies with the visual impression and count data which suggested that Grey-tailed Tattlers were much more numerous than normal, particularly at 80 Mile Beach.

One of the specific objectives of the expedition was to obtain samples of less frequently caught species. We caught 291 Little Curlew, 44 Marsh Sandpipers and 22 Red-necked Phalaropes and these were the best examples of success in this area. Only one Red-necked Phalarope had previously been banded in Australia, and that was on an AWSG expedition in November 1983. The catch of 22 at Port Hedland Saltworks was the culmination of several days of nerve-racking attempts, which also included an abortive net fire when an electrical fault caused one cannon, of a two cannon net, not to go off. Eventually, a posse of Red-necked Phalaropes swam in close enough to the rocky shoreline (which they had often done) right in front of the cannon net and a surprisingly easy catch was made.

The record catch of 44 Marsh Sandpipers was also made at Port Hedland Saltworks, again mostly by cannon netting. The Little Curlew catch total was the highest since our first ever catching of this species in 1985. After many years of trying, we finally worked out a combination of characteristics that, together, appear to enable the majority of birds caught in the October/November period to be aged correctly.

Table 3. Wader catches in NW Australia from 16 September to 16 November 2001.

Species	New	Retrap	Total
Pied Oystercatcher	5	2	7
Lesser Sand Plover	11	1	12
Greater Sand Plover	1058	124	1182
Oriental Plover	11	0	11
Red-capped Plover	21	0	21
Black-winged Stilt	1	0	1
Ruddy Turnstone	38	3	41
Eastern Curlew	32	3	35
Whimbrel	46	2	48
Little Curlew	276	15	291
Grey-tailed Tattler	924	87	1011
Common Sandpiper	2	0	2
Greenshank	6	0	6
Marsh Sandpiper	44	0	44
Terek Sandpiper	547	44	591
Asian Dowitcher	9	0	9
Black-tailed Godwit	88	8	96
Bar-tailed Godwit	619	115	734
Red Knot	336	35	371
Great Knot	1608	245	1853
Sharp-tailed Sandpiper	14	0	14
Red-necked Stint	1330	122	1452
Curlew Sandpiper	417	40	457
Sanderling	128	6	134
Broad-billed Sandpiper	31	0	31
Red-necked Phalarope	22	0	22
Oriental Pratincole	1	0	1
TOTAL	7625	852	8477

Other less frequently caught species where worthwhile totals were obtained included Black-tailed Godwits (96), Whimbrel (48), Eastern Curlew (35) and Asian Dowitcher (9). "Failures" were Oriental Plover (11), Greenshank (6) and Grey Plover (nil).

One new development was the catching of Sanderling at a new site, Coconut Well, some 10 km north of Cable Beach. This partially made up for the inability to catch Sanderling at Bush Point, our only previously good Sanderling site. This was because the late April 2000 cyclone had completely removed the high offshore sandbank on which they used to roost in good numbers.

As usual, most birds were caught on the shores of 80 Mile Beach and Roebuck Bay, Broome (Table 4). Sampling was well spread at 80 Mile Beach with all the catches being at slightly different locations between 1km north of the campsite and 31km south of the campsite. The 15 cannon net catches had the excellent average of 302 birds per catch. Catches to the north of the campsite have not been made in the past. It was discovered on this visit that even the lowest of neap tides still pushed the birds off the mud onto the sandy beach. Thus, in contrast to Roebuck Bay at Broome and most other wader locations around the world, high tide cannon net catches of waders can be made at 80 Mile Beach throughout the lunar/tidal cycle. Hence, "rest days"/ "days off" at 80 Mile Beach are a thing of the past!

Tern Catches

Terns have in recent years become a formally integrated part of NWA expeditions. In 2001, the specific targets were Roseate Terns at the Lacapede Islands and Gull-billed Terns.

Of the 682 terns caught (Table 5), 401 were in a single catch of Roseate Terns at the Lacepede Islands on 8 October. This was the largest every catch of Roseate Terns made in Australia, and probably in the world. Biometric and moult data indicated that they were from a different population than those caught at Swain Reefs, at the southern end of the Great Barrier Reef, Queensland, in July 1999 to 2001 (the Lacapedes birds were much smaller). The primary moult was also too advanced for birds that might have come from breeding grounds in the northern hemisphere. Such birds are now (January 2002 data) known to be present on the Great Barrier Reef in large numbers in the Austral summer. It is probable that the Roseate Terns on the Lacepedes were from breeding grounds on offshore islands in the Northern Territory and the north-eastern part of Western Australia. Hopefully future recoveries and flag sightings will resolve this question.

As well, 56 Little Terns and 38 Gull-billed Terns added significantly to our previous totals for these species. Data (biometrics and/or flag sightings/recoveries) have already demonstrated that significant parts of the population of both these species in northwest Australia are visitors from breeding grounds in the northern hemisphere.

Retraps and controls

A total of 852 wader retraps/controls were made during the Expedition (and 39 terns). This represents a retrap rate of 10% of the waders caught. This rate varied markedly between locations, because of the relative amounts of catching which had taken place at each in the past (Table 5). Thus, at places like Broome, where catching takes place regularly throughout the year every year (in addition to expeditions), the retrap rate was a remarkable 22.9 %. At 80 Mile Beach,

Table 4. Locations of waders caught in NW Australia from 16 September - 16 November 2001.

Location	New	Retraps	Retraps as % of total	Total
Broome	2545	584	22.9	3129
80 Mile Beach	4207	239	5.7	4446
Port Hedland	278	5	1.8	283
Anna Plains	21	0	0.0	21
Lake Eda	266	15	5.6	281
Coconut Well	176	5	2.8	181
Bush Point	132	4	3.0	136
TOTAL	7625	852	10.1	8477

Table 5. Tern catches in NW Australia from 16 September to 16 November 2001.

Species	New	Retrap	Total
Silver Gull	0	4	4
White-winged Black Tern	1	0	1
Gull-billed Tern	36	2	38
Caspian Tern	8	1	9
Common Tern	18	0	18
Roseate Tern	401	0	401
Little Tern	49	7	56
Crested Tern	10	2	12
Lesser Crested Tern	120	23	143
TOTAL	643	39	682

where catching only takes place during expeditions, and where the total population is much larger, the retrap rate was 5.7 %. At both locations combined, Bar-tailed Godwit (16%) and Great Knot (13%) were the two species with the highest recapture rates.

Of the retraps, 144 were birds banded during the expedition and retrapped later in the expedition. These provided particularly valuable data on the start/progression of the primary moult in individual birds, and also of weight changes following migration and during the earlier stages of the annual moult.

The other retraps will be especially valuable in facilitating survival rate calculations for a number of species. Further illustration of the age to which some individual waders may live were shown by retraps of Grey-tailed Tattlers, Great Knot and Bar-tailed Godwit, which were now more than 20 years old.

Very few of the birds captured had been banded elsewhere in the flyway. This is a reflection of the relatively small amount of wader banding currently carried out in the East Asian/Australasian Flyway, and also that the expedition did not commence until the 16th September, by which time many of the small waders on route to Victoria would have passed through northwest Australia. Highlight of the controls was a Korean-banded Great Knot. There was also a Sanderling and a Ruddy Turnstone from South Australia and a Red-necked Stint from Victoria.

We also caught two Great Knot, three Red Knot and two Red-necked Stints at 80 Mile Beach that had previously been banded at Broome. Surprisingly, there were no retraps of birds that had moved in the opposite direction. In general, most waders in northwest Australia are faithful to particular sites and interchange between the 80 Mile Beach/Roebuck Bay populations is small.

Flagging and Colour Banding

Putting a yellow leg flag on all birds captured in NWA has become a high priority in recent years when the considerable enhancement of reporting rates of flagged birds became clear (approximately 10 times recovery rates for NWA birds). When flagging was first commenced in northwest Australia in August 1992, only about half the birds captured had flags put on them. Now, in handling captured birds, flagging is elevated to top priority after the basic banding/ageing process, being placed ahead of the collection of more biometric data on all the most frequently caught species.

Thus almost all the newly caught waders and terns, and any previously unflagged retraps, were flagged during the NWA 2001 Expedition. The total number of waders yellow leg flagged in northwest Australia to the end of December 2001 is 48,843.

Birds carrying colour flags from elsewhere, mostly Victoria (orange) and South Australia (orange over yellow), were regularly observed throughout the expedition at Roebuck Bay, 80 Mile Beach and Port Hedland Saltworks. Twenty-one birds of five different species were involved.

The study to try and determine the age of first breeding of Bar-tailed Godwit, Great Knot and Red Knot, was continued in 2001. All juvenile birds of these three species captured at Broome were given a red colour band on the tarsus (to signify hatched in 2001) in lieu of a yellow leg flag. Examination of the non-breeding birds that remain at Broome in the May-July period then enables the ages of

banded birds in those flocks to be determined visually, because of the different colour band put on for each yearly cohort. Danny Rogers, Adrian Boyle, Chris Hassell and the wardens of the Broome Bird Observatory principally carry out this visual observation work. It is already showing that in most birds, return to the breeding grounds does not occur until their third year, and in some cases, not until the fourth year or later.

Percentage Juveniles

A key long-term component of the NWA wader study programme is the annual monitoring of breeding success, measured by the percentage of juvenile birds in the banding catch samples made outside the migration seasons.

For northwest Australia, the majority of adult and juvenile birds that spend the non-breeding season there, arrive by the end of October (there are exceptions for a few species, like Oriental Pratincole) and no northward emigration of significance occurs (except for Eastern Curlew in early March) until after the 20 March. Although there is a wide window of opportunity (4 ½ months) to obtain data, it is still not easy to acquire it for the full range of species, given the limited (human) resources normally available in Broome for fieldwork. Thus expeditions taking place in this period can valuably supplement "percentage juvenile" data collected by the local wader banding team (NWA Wader Group).

Examination of the data collected during the NWA 2001 Expedition showed that there was little change in the proportion of juveniles in catches of each species after 20 October. Thus data for the four-week period 20 October to 16 November was used for the breeding success assessment (Table 6). This data has already been utilised in various publications (Arctic Birds Newsletter and the October 2002 edition of Stilt) but is reproduced again in this report.

Overall, most of the wader populations in northwest Australia seem to have had a reasonably successful breeding season outcome in 2001 (10 - 20% juveniles). The principal exceptions were:

1. Little Curlew, which, with 36% juveniles, appeared to have had a brilliant breeding season. There are however suggestions from previous years' catches that the proportion of young birds in catches made in the Broome/Roebuck Plains area during October/November are often high. This needs further investigation. It may be that there is a marked segregation of juvenile birds to this area or those habitats at that time of year.
2. Red Knot (5.4%), Great Knot (5.2%) and Sanderling (4.3%) which all appeared to have poor breeding seasons in 2001. Red Knot breeding success is notoriously variable from year to year and this situation also occurs to some extent in Sanderling. But Great Knot seem to have had a series of poor breeding years recently, and this may be a cause for some concern, especially considering their major migratory stopover site on the west coast of South Korea will be lost by 2003 due to reclamation.

Moult

Excellent data on the primary moult of all the main study species was obtained through to the end of the expedition in mid-November. Previously, very little primary moult data was available beyond the first few days of November.

Another new finding was that the primary moult of juvenile (first year) birds may start in some individual Terek Sandpipers and Greater Sand Plovers before the end of October. Also, a "6" moult was detected commencing in late October/early November in some second year birds. These are birds that had already completed a primary moult late in their first year or early in their second year and were recommencing at least a partial further moult from the innermost primary. This is not dissimilar to some moult patterns commonly found in terns. New feathers from this moult are given a moult score of 6 for recording purposes, to distinguish them from normal newly grown primaries (5s).

Biometrics

Full biometric data was collected on all birds caught of the less frequently handled wader and tern species and on all juvenile birds. Selected other biometric data was also collected on other species, especially weight data.

AVIAN-BORNE VIRUSES

John Curran, Veterinary Officer for the Ministry of Agriculture in Broome, again joined the Expedition and collected 147 blood samples from a wide variety of species (11). Subsequent testing for avian borne diseases came up with only one positive

Table 6. Proportion of first year birds in wader catches in NW Australia from 20 Oct – 16 Nov 2001. * Includes catches of 9 birds on 24th Nov and 20 on 1st Dec.

Species	Number of catches		Total birds caught	Number of first year birds	% first year
	Large >50	Small <50			
Greater Sand Plover	9	4	943	123	13
Red-necked Stint	4	8	840	140	17
Great Knot	6	7	634	33	5.2
Grey-tailed Tattler	5	8	506	85	17
Terek Sandpiper	3	8	380	45	12
Bar-tailed Godwit	2	10	332	50	15
Little Curlew*	2	4	315	112	36
Curlew Sandpiper	1	10	230	44	19
Red Knot	2	8	221	12	5.4
Sanderling	1	6	115	5	4.3
Whimbrel	-	2	44	5	11
Eastern Curlew	-	2	33	0	0
Black-tailed Godwit	-	1	32	0	0
Broad-billed Sandpiper	-	5	19	7	(37)
Ruddy Turnstone	-	7	16	0	(0)

result- on an Oriental Plover. This may be significant in that most of these diseases are transmitted by mosquitos and the Oriental Plover is the species, largely feeding on the plains, which is most likely to come into contact with mosquitos. More extensive sampling of Oriental Plovers for diseases will be an objective for the blood sampling on future expeditions. Testing in previous years has shown that the level of avian-borne viruses in waders in generally extremely low.

ACKNOWLEDGMENTS

This section could become almost as long as the rest of the report! So many people have assisted the Expedition in so many ways that it would be difficult to mention each individually. Can we therefore please thank everyone involved collectively, specifically:

1. Landowners who have permitted us to operate on or traverse their properties (Anna Plains Station, the Dampier Saltworks of Rio Tinto at Port Hedland, Roebuck Plains Station (Lake Eda), Mandorah Station and other stations further south bordering 80 Mile Beach).
2. Broome Bird Observatory- the wardens, other staff and the Management Committee- for having the Expedition based there during the period it was in Broome.
3. Those who provided their personal vehicles for use by the Expedition for extensive periods- Humphrey Sitters, Ros Jessop/Pete Collins, Maureen Christie, Clive Minton, Ken Gosbell, Ken Mills, and various persons from the NWA Wader Group in Broome.
4. Those who provided financial assistance (David Seay) and loaned equipment (e.g. trailers by BBO, Broome Shire and John Curran).
5. The authorities in Environment Australia and CALM who gave permission for bird banding, etc.
6. All participants in the Expedition, especially those who took on extra responsibilities such as Dick Veitch (computerisation of field data), Pete Collins and Maureen Christie (equipment logistics) Helen Macarthur and Julie Deleyev (food/catering), and Doris Graham (leg flag manufacture). The Expedition could not have succeeded without the enormous effort put in over a prolonged period by everyone.

THE FUTURE

A summary of wader catching results over the 1981-2001 period of studies in northwest Australia is given in Tables. 7-10. Overall 83,969 waders, of 43 species, have been caught, including 7,259 retraps/controls. Eleven species have had more than 1000 birds caught- top species being Great Knot (15,975) and Red-necked Stint (13,240). Sixty percent have been caught at Roebuck Bay (Broome) and 30% at 80 Mile Beach. Eighty-eight percent have been caught during formal AWSG

expeditions but a valuable 9,958 waders have been caught by Broome Bird Observatory staff and visitors and by wader enthusiasts residing in Broome (now Northwest Australia Wader Group).

Wader studies in northwest Australia are of a long-term nature and will continue indefinitely into the future. The emphasis of each expedition will continue to change. From an initial prime target of finding out about the origins and migrations and further destinations of waders visiting northwest Australia, the contributions to population monitoring deriving from banding, reproductive rate and survival rate data are now becoming the highest priority. The longer the continuation of the collection of such data the better the quality of the survival rate information that can be derived. Furthermore, the longer the data series on "percentage juveniles", the easier it will be to separate out long-term trends from short-term variations in breeding success.

The pattern of local banders sampling the wader and tern populations at Roebuck Bay at regular intervals throughout the year will continue with periodic support of special wader expeditions. The timing of these will vary. Some will be geared to generate data where there are still gaps, e.g. in moult/weight data in the second half of January/February (end of primary moult, start of pre-migratory weight gain) and in June/July (non breeding populations). Other expeditions may be timed to ensure that sufficient sampling of populations occurs in the November to mid-March period in order to adequately measure reproductive success.

No firm dates have yet been set for future expeditions. But the "gap periods" mentioned above are the most likely targets. Possible dates are therefore June/July 2003 and Jan/Feb 2004. Expeditions are likely to be of three or four weeks duration, rather than the longer period of many past expeditions.

Table 7. The total number of each wader species caught in North-west Australia from 1981-2001.

Species	Newly Banded	Retraps/Controls	Total
Pied Oystercatcher	160	12	172
Sooty Oystercatcher	40	2	42
Masked Lapwing	38	-	38
Grey Plover	213	6	219
Pacific Golden Plover	14	-	14
Red-kneed Dotterel	180	18	198
Lesser Sand Plover	406	97	503
Greater Sand Plover	8420	1020	9440
Oriental Plover	305	-	305
Red-capped Plover	710	26	736
Black-fronted Plover	65	2	67
Black-winged Stilt	263	3	266
Banded Stilt	92	-	92
Red-necked Avocet	132	1	133
Ruddy Turnstone	1416	259	1675
Eastern Curlew	140	5	145
Whimbrel	238	3	241
Little Curlew	980	24	1004
Wood Sandpiper	28	3	31
Grey-tailed Tattler	5063	607	5670
Common Sandpiper	24	-	24
Common Greenshank	136	-	136
Common Redshank	6	1	7
Marsh Sandpiper	142	1	143
Terek Sandpiper	5214	547	5761
Pin-tailed Snipe	1	-	1
Swinhoe's Snipe	1	-	1
Asian Dowitcher	94	4	98
Black-tailed Godwit	533	16	549
Bar-tailed Godwit	9067	881	9948
Red Knot	4639	358	4997
Great Knot	14755	1220	15975
Sharp-tailed Sandpiper	930	14	944
Pectoral Sandpiper	2	1	3
Little Stint	1	-	1
Red-necked Stint	11933	1307	13240
Long-toed Stint	44	4	48
Curlew Sandpiper	8316	737	9053
Sanderling	585	9	594
Broad-billed Sandpiper	1217	70	1287
Red-necked Phalarope	23	-	23
Australian Pratincole	7	-	7
Oriental Pratincole	138	-	138
TOTAL	76710	7259	83969

Table 8. The most commonly caught wader species captured in NW Australia from 1981-2001.

Species	New	Retraps	Retrap Rate (%)	Total
Great Knot	14755	1220	7.6	15975
Red-necked Stint	11933	1307	9.9	13240
Bar-tailed Godwit	9067	881	8.8	9948
Greater Sand Plover	8420	1020	10.8	9440
Curlew Sandpiper	8316	737	8.1	9053
Terek Sandpiper	5214	547	9.5	5761
Grey-tailed Tattler	5063	607	10.7	5670
Red Knot	4639	358	7.2	4997
Ruddy Turnstone	1416	259	15.5	1675
Broad-billed Sandpiper	1217	70	5.4	1287
Little Curlew	980	24	2.4	1004

Table 9. Locations of catching sites of waders caught in NW Australia from 1981-2001.

Location	Number caught
Roebuck Bay, Broome	50525
80 Mile Beach	25475
Port Hedland Saltworks	5757
Roebuck Plains	1518
Anna Plains	654
Derby Sewage Farm	85
TOTAL	84014

Table 10. Sources of waders banded in NW Australia 1981-2001.

Source	Count
AWSG NW Australia Expeditions (1981-2001)	73926
Broome Bird Observatory/NW Wader Study Group (1991-2001)	9958
Doug Watkins (at Derby 1993-1994)	85
TOTAL	83969

BOOK REVIEW

Barter, M.A. 2002. Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series 9, International Wader Studies 12, Canberra, Australia. 104 p. ISBN 90-5882-009-2

This book is undertaken and supported by individuals who went way beyond the horizon and came back with fame and appreciation; they just followed the birds. The East Asian Australasian Flyway (EAAF) is gigantic. It not only includes tongue-breaking location names, this flyway also connects the Australian and Asian wintering grounds with the breeding grounds in the Russian Arctic and even Alaska. Many of the huge mudflats with its shorebirds are still unknown and await investigation. Australia and its well-known shorebird enthusiasts ('shorebird-aholics') present the powerful 'engine' to further such investigations of shorebirds along the EAAF. Besides its unique and endemic birds, this flyway also offers great opportunities to evaluate findings from flyways elsewhere in the world. The author summarizes efficiently in 9 chapters over 10 years of fieldwork in the Yellow Sea. This region supports over 36 shorebird species and is a key location within the EAAF during the migration and non-breeding seasons. Each of the 36 species is well described in the Species Accounts, which provide the international audience with official flyway estimates, important coastal regions of occurrences and many other details such as counting results for the migration seasons and literature references. In addition, a description (e.g. area, coordinates, protection status and threats) is given for 27 of the most important shorebird migration sites in the Yellow Sea. Two chapters are devoted to shorebird threats, and conservation of shorebirds and their habitat. This topic cannot be emphasized strongly enough since the Yellow Sea harbours not only a high biodiversity but also globally threatened species such as the Spotted Greenshank (*Tringa guttifer*) and Spoon-billed Sandpiper (*Eurynorhynchus pygmeus*), besides the near-threatened species like Eastern Curlew (*Numenius madagascarensis*) and Asian Dowitcher (*Limnodromus semipalmatus*). For six of the shorebird species, the Yellow Sea region carries almost the whole breeding population of the flyway during northward migration.

The text of this technical publication is written very well and efficiently, and the tables and black-and-white maps serve their purpose nicely. Summaries in Korean and Chinese are also provided. One should keep in mind that 12 major Asian rivers drain into the Yellow Sea providing plenty of mudflats and estuaries to survey. Therefore, the publication raises the issue of how to survey migratory shorebirds efficiently in quantitative terms and over such a large area? This book provides some of the answers. Birds need habitat, and the author outlines well which conservation policies work best to protect and conserve (migratory) shorebirds in the Yellow Sea region. Of interest is the progressive coastal ecoregion approach presented in Chapter 7, which allows characterising shorebird habitat in conjunction with a variety of other multidisciplinary habitat data.

Although, China, North and South Korea are presently not well known for their efforts to conserve shorebirds and their habitat, this publication will help to improve the current situation. The dynamic author is congratulated for his tremendous effort providing the international community with such a splendid book on shorebird conservation and crucial baseline data for the EAAF.

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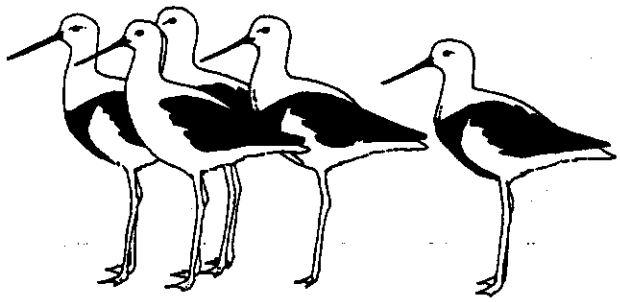
Deadlines:

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



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