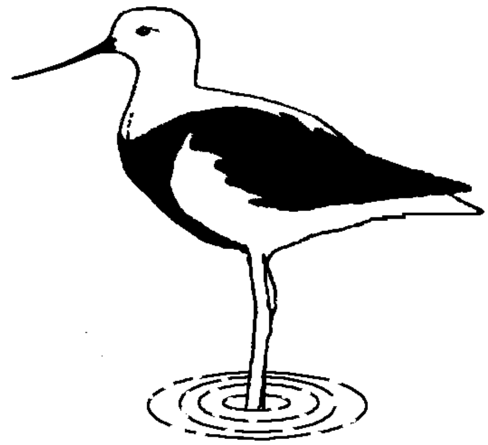
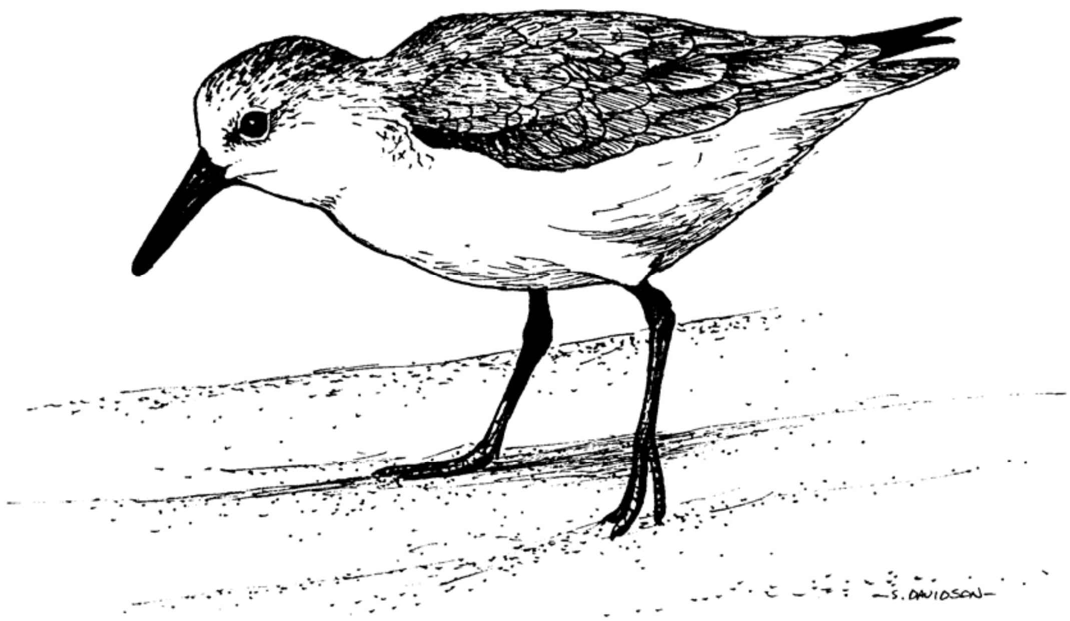
The Stilt



The Bulletin of the East Asian-Australasian Flyway



Australasian
Wader
Studies
Group

A special interest group of the
Royal Australasian Ornithologists Union

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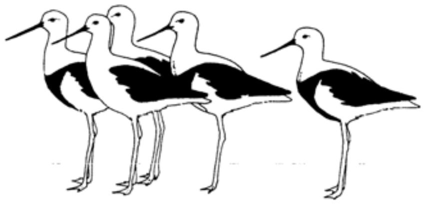

The Stilt

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OBJECTIVES OF THE AUSTRALASIAN WADERS STUDIES GROUP (AWSG) OF THE ROYAL AUSTRALASIAN ORNITHOLOGISTS UNION (RAOU):

1. To develop or assist with plans for wader research in Australasia in conjunction with other interested bodies.
2. To co-ordinate and encourage counting, banding, foraging studies and other scientific programmes involving amateur and professional skills.
3. To encourage and assist with the publication of results.
4. To maintain effective communication between wader enthusiasts within Australasia and with similar groups overseas.
5. To formulate and promote policies for the conservation and management of waders and their habitat.

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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 journal *The Stilt*, and the quarterly newsletter *The Tattler*. Please direct all membership enquiries to Jane Staley at RAOU HQ, 415 Riversdale Rd, East Hawthorn, 3122. Vic., AUSTRALIA. Ph: 03-9882 2622, fax: 03-9882 2677. Email: Membership@RAOU.COM.AU

Cover Illustration: Stephen Davidson

EDITORIAL

Welcome to the new-look *Stilt*. By now you should have noticed that there have been substantial changes in the production process. The aim of these changes is to increase the production quality, and the AWSG is fortunate to find itself in a position where it can afford to have *The Stilt* printed professionally. This was made possible in part by a grant from the Australian Nature Conservation Agency (via Wetlands International) to cover 100 international AWSG memberships. Previously 50 *Stilts* had been sent free to wader biologists throughout the Flyway who were unable to join the AWSG because of financial constraints. Wetlands International arranged for the funding of these *Stilts*, plus an extra 50 for distribution in the Flyway. *The Stilt* has thus truly become the bulletin of the East Asian-Australasian Flyway.

I would like to reflect on the foundations from which this edition has evolved. A special vote of thanks goes to those who have been involved in the production process in the past years. These include Jeff Campbell (retired Editor), Terry Barter (printing and collating) and Mick and Brenda Murlis (indexing, collating and postage). Their efforts have ensured that *The Stilt* has constantly improved in quality, and their labour has also allowed this most recent increase in production quality. Regular contributors have also been a great help.

There is another first for this *Stilt*. The first material on terns is presented. The decision to publish tern material was taken after an interesting discussion at the last AWSG Committee meeting. This decision was largely based on the fact wader studies groups, such as the AWSG, conduct considerable research on terns. The current editorial policy will be to present material on terns only where it has been generated by wader researchers on wader study group activities. Any other material will probably be directed to the *Australasian Seabird Group* (ASG), another special interest group of the RAOU.

Keep supporting your bulletin!

Michael Weston, ***Editor***

NEW AWSG COMMITTEE STRUCTURE

The new AWSG Committee structure, as proposed on the ballot paper sent out with the April *Stilt*, has been unanimously accepted by those members returning their ballot paper.

The AWSG committee for 1996-1998 will therefore be:

Chairperson	Mark Barter
Vice-Chair	Peter Driscoll
Secretary-Treasurer	Jeff Campbell
Research Coordinator	Roz Jessop
Editor	Michael Weston
Assistant Editor	Phil Straw
Conservation Officer	Sandra Harding
Liaison Officer	Hugo Phillipps
Committee Members	Ken Harris
	David Henderson
	Laurie Living
	Clive Minton
	Brenda Murlis
	Doug Watkins

The Committee has moved, at its last meeting, a vote of thanks to the retiring Secretary, Brenda Murlis, for her tireless work for the group over many years.

Many thanks also to David Henderson who has been a most efficient Treasurer since the group's inception.

Jeff Campbell, *Secretary-Treasurer*

POSITION VACANT

A volunteer with a PC compatible computer is required to type in contributions to *The Stilt* that cannot be submitted in computer format. Typically, most contributions are made on computer diskette and do not require typing. It is anticipated that only one or two short communications would need typing per volume, although occasional major papers might need typing. Any generous souls interested in helping out should contact the Editor.

COLOURED SHARP-TAILED SANDPIPERS - WHO DONE IT ?

Two colour painted or colour dyed Sharp-tailed Sandpipers were seen on 2nd February 1996 at Ballina in New South Wales. One had orange on both sides of the breast and on the belly. The other had pale blue on the lower back, rump and tertials. The Banding Office do not know who has coloured these birds. Does anyone know their origin?

Please contact Clive Minton, 165 Dalgetty Road, Beaumaris,Vic. 3193. Phone/Fax 03-9589 4901

WEIGHTS AND PRE-MIGRATORY MASS GAIN OF THE RED-NECKED STINT *Calidris ruficollis* IN VICTORIA, AUSTRALIA

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ABSTRACT
The weights of Red-necked Stints *Calidris ruficollis* at coastal non-breeding sites in Victoria, Australia, are described on the basis of birds captured for banding, mostly by cannon-netting. Adult Red-necked Stints are trans-equatorial migrants; they weigh about 28g on arrival in Victoria but their mass quickly recovers to levels of about 29 to 31 g which are maintained through most of the austral summer; weights decrease slightly and gradually in the first half of primary moult, and then gradually increase from about 29.0 g after a primary moult score of about 30 is reached. In March and April adults undergo rapid pre-migratory mass-gain, their weight increasing by about 0.35 g per day; the timing of the onset of pre-migratory mass-gain varies, some individuals beginning consistently earlier than others, but is independent of the size of the bird. The departure mass of adults is estimated at about 40 g, so they depart with sufficient fuel to fly directly to northern Australia; some individuals may be capable of reaching staging areas in Indonesia in one flight. In contrast, the weights of immatures do not increase in March and April; they remain in Australia, and undergo a varying amount of mass-gain during July and August in the austral winter; in at least some individuals the increase in weight may be to fuel local movements. The possibility of using growth-curve theory to estimate departure masses of adults is discussed. This approach to analysis was not possible in this study because average weights varied greatly from catch to catch, even in catches made on similar dates. Reasons for this variation are suggested and the need to maintain a detailed capture log is stressed.

INTRODUCTION

The Red-necked Stint *Calidris ruficollis* is the most abundant species of wader in Australia, occurring in a wide range of wetland habitats on the coast and inland. It breeds in foothill tundras of north-east Siberia in June and July, and migrates long distances to spend the non-breeding season in the tropics and temperate regions of south-east Asia and Australasia. Adults arrive in south-eastern Australia mainly between late August and early October; juveniles arrive later in October and November (Higgins & Davies 1996, Minton 1996). Adults begin moult into non-breeding plumage while on the way south or immediately after arrival, and complete this moult, including replacement of all flight feathers, during the austral summer. Between March and May adults begin their return migration; migration routes and timing are reviewed in Higgins & Davies (1996) and Minton (1996, this issue). In contrast, young stints remain in the non-breeding areas throughout their first austral winter and second austral summer, completing a moult into a plumage indistinguishable from adult non-breeding when they are about 14 to 16 months old and finally migrating north for the first time in March to May when they are about 20 months old.

Migratory lifestyles of this kind are associated with predictable and substantial seasonal changes in the body mass of waders. Most striking of these changes is the accumulation of stores (mainly fat) to fuel migration; waders increase weight rapidly immediately before departing on long flights in which the stores are consumed. The amount of pre-migratory mass-gain in waders can be used in flight range equations which predict how far waders can fly in a single migration step (e.g. Pennycuick 1975, Summers & Waltner 1978, Davidson 1984, Castro & Myers 1989). Migratory waders can also exhibit seasonal changes in weights related to the need to thermoregulate in very different climates in different parts of the world (e.g. Davidson *et al.* 1986) and to the effects of moult (e.g. OAG Munster 1975, Summers & Waltner 1978).

Small, gregarious, abundant and endearingly stupid, Red-necked Stints are relatively easy waders to catch and are by far the most widely banded wader in Australia (Baker *et al.* 1995). However, little has been published about their weights. The basic fact that Red-necked Stints undergo pre-migratory mass-gain was reported by Thomas & Dartnall (1970, 1971) for Tasmanian birds, and by Paton & Wykes (1978) for Victorian birds. Thomas & Dartnall (1971) also reported a decline in weights of adult Red-necked Stints during primary moult; all the weights published by Thomas & Dartnall were 9 g too light due to a processing error (Paton & Wykes 1978). A more substantial analysis of Tasmanian weights was published by Barter (1984) who also calculated potential flight range on the first leg of the northwards migration. The largest available Australian data sets on weights of Red-necked Stints (from Victoria and north-west Australia) have however remained untouched. This paper describes the weights of Red-necked Stints in Victoria, with emphasis on the seasonal changes that occur and particularly the mass gain of adults before departing on northwards migration.
The importance of good estimates of the departure mass of migrant waders to ecological and migration studies was noted by Barter (1996). He identified three basic ways of determining departure masses: working backwards from flight range equations, extrapolating estimated mass gain to known departure dates, and analysing mass data of birds identified as being about to

depart. He illustrated the third method for the Great Knot *Calidris tenuirostris* and Bar-tailed Godwit *Limosa lapponica*.

This paper started out with the notion of a fourth method, that the pre-migratory mass gain could be modelled using growth curve theory. This would preclude the need for possibly hard-to-get information on departure dates by estimating the asymptotic maximum mass assuming some functional model of mass gain. The method is explained in Appendix 1. Although this approach turned out not to be suitable for our data set on Red-necked Stints, we have hopes that it may be possible to use it in the future and we found the simulations explained in Appendix 1 helpful in interpreting some of the features of the data.

DATA AND METHODS

The Red-necked Stint data used were recorded from live birds very nearly all cannon-netted by the Victorian Wader Study Group (VWSG) at several locations on the central Victorian coast (see Figure 1) from 1978 to 1995. Of the 71,247 encounters (i.e. new birds and retraps) with Red-necked Stints, 18,304 birds were weighed and 10,072 had their wing length measured (all but 216 of which were also weighed). Most data were collected early in the project; 66% of all masses and 90% of all wing lengths were recorded on the 27% of all stints caught in the four seasons starting 1978/79. With very few exceptions, all birds were assigned to one of three age groups:

Age 1. Birds in their first year. They can be aged on plumage at all times (Higgins & Davies 1996). By convention and for convenience, all migratory waders in Australia are assumed to have the same birthday, 1 August; this of course underestimates their true calendar age.

Age 2. Birds in their second year. Young stints stay in Australia for some 16–18 months before making their first northward migration. They can be aged on primary moult until the end of November of their second calendar year, from which time they are indistinguishable from older birds (Higgins & Davies 1996).

Adults. Birds in their second year or older. In samples from September to November, it is possible that adults in the data set may have included some Age 2 birds, which can be difficult to distinguish from adults in some circumstances (e.g. when the light is poor or processors are hurried or inexperienced).

The sexes of Red-necked Stints differ slightly in mass. In a sample of December casualties sexed by dissection the average mass of adult females was 0.6 g heavier than in males - a slight but statistically significant difference (Higgins & Davies 1996). It is not possible to sex live Red-necked Stints on plumage characters; nor are the differences in linear measurements between the sexes substantial enough to permit statistical separation using univariate methods. We only had large samples of wing measurements to work with, so in all subsequent analyses, the sexes are necessarily combined. The effect of this is to slightly overestimate variances but given the

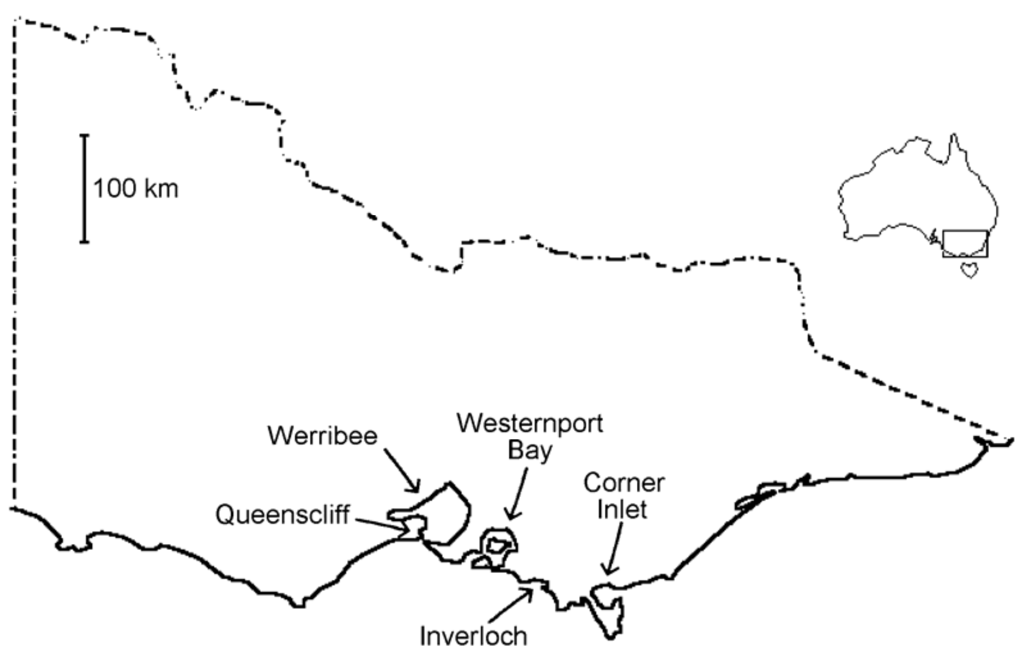

Figure 1 The main sites at which Red-necked Stints were captured by the VWSG in Victoria, 1978--1995. There were several catching sites within most of the wetland complexes indicated.

inherent scatter in weights of Red-necked Stints, we doubt that it affects any of our conclusions. Even in the unlikely event that sex ratios were skewed as much as is theoretically possible, the difference in average weights between an all-male and an all-female catch would be so slight that it would be difficult to detect.

Birds were weighed using spring balances and pre-weighed plastic weighing cones. There is something of a problem with these weights. Ideally we would like to know mass at the time of capture but this is not exactly what was measured because waders lose mass while being held for processing, the rate of mass loss being higher at higher ambient temperatures (see Castro *et al.* 1991 for review). The data could have been corrected for this effect if the relevant data (time of capture, time of processing, temperature) had been recorded but they were not. No capture log was maintained other than number of new birds and retraps by species. The effect of this mass loss on the data is to underestimate the true mean and overestimate its variance, these effects being stronger the longer the period between banding the first and the last bird.

It was, of course, always recognised that holding the birds too long was not a good idea. The number of birds processed and the amount of processing was determined for each catch in the light of the numbers of birds (of all species) caught, the size and experience of the banding team, the weather, and the time of day. In general the first stints in a catch were weighed about 30–45 minutes after capture (after all birds had been extracted from the cannon-net and a processing station set up) and it was most unusual for a stint to be weighed more than four hours after capture. Measurements of mass loss for small numbers of Red-necked Stints captured on a cool day at Westernport Bay, 27 Dec. 1995, showed that they lost an average of 1.9 g in four hours (standard deviation 0.56, range 1.2–3.0g, n=12, M.A. Barter pers. comm.). That is, they lost about 1.7% of their body mass per hour, a result broadly consistent with the studies of Castro *et al*. (1991). It is a substantial enough loss of weight to encourage extreme caution when comparing average weights of Red-necked Stints in different catches; it suggests that differences of less than say *c.* 1.5 g might be caused solely by differences in procedures. This is inconvenient when looking for subtle weight variations caused by such things as differences between sites, sexes or age classes.

RESULTS

Figure 2 shows average weights plotted against date for all Red-necked Stint catches in which 30 or more birds were caught. Six features stand out from this figure:

- the confidence limits of means close together in time do not, in many cases, overlap as would be expected;
- an apparent similarity in masses of young birds and adults at most times of year;
- an apparent increase in average masses of young birds from June to August;
- weights in the arrival period appear similar to those during the middle of the Australian summer;
- a fairly steady reduction in weights of adults occurs between about October and January (age 2 birds and adults are in primary moult at this time, Higgins & Davies 1996);
- a rapid increase in average mass of adults from the end of February to the end of April.

The remainder of this paper discusses and expands upon these observations.

Apparent Differences In Average Weights For Catches Made Close Together In Time

Plots of average weights of Red-necked Stints against date are decidedly messy. As Figure 2 shows, the mean weights of catches made at almost exactly the same time of year often differ; in many cases they differ so much that even the 90% confidence limits do not overlap. Two possible explanations for this are that there are differences between locations and/or differences between years. Figures 3 and 4 show that neither explanation is likely to apply. These figures re-plot the means indicating location (Figure 3) or year of capture (Figure 4). The latter results apply only to the banding seasons in which substantial data were collected. It should be noted that these data do not rule out the possibility that there are slight differences between sites or between years, because there is clearly another factor (or factors) influencing average weights to such an extent that it (or they) could conceal the effect of subtler variations.

Our inability to correct for weight lost during handling may certainly have contributed to the above scatter, but it is unlikely to explain all of the variation of average weights. While it is true that a stint weighed at the end of a lengthy processing session will have lost more weight in the hand than a stint weighed immediately after capture, the average weight for a catch sample will depend on the average duration between capture and weighing; this does not vary so much between catches. We do not have systematic records of capture and weighing times of Victorian Red-necked Stints but our impression from extensive field experience is that for at least 90% of cannon-net catches of Red-necked Stints, the average time of weighing would be between one and two hours after capture. Variation in ambient temperatures might also affect the amount of weight lost during handling, but only when the weather is extremely hot (Castro *et al.* 1990). The VWSG has on occasion caught Red-necked Stints on very hot days but in general such weather conditions are uncommon in Victoria, especially in spring and winter when there is about as much scatter between average catch weights as there is in mid-summer. None of the above sources of variation seems sufficient to explain why the plot of means is so messy.

Why then are average weights of different catches of Red-necked Stints so varied at similar times of year? We suspect a large part of the variation might be related to mass loss that occurred before the birds were caught. Nearly all of the Red-necked Stint weights available were from birds cannon-netted at high-tide roosts. At high tide, they cannot feed (the feeding areas are flooded), and their attempts to roost are often disturbed by marauding predators or wader banders. They must lose weight through high tide as some tissue is metabolised for normal maintenance purposes (e.g. thermoregulation) and rather more if they have to expend energy in taking off and flying to avoid potential predators. They also lose weight through defecation, though it is likely that many Red-necked Stints captured at high tide have already digested or excreted much or all food remaining in their digestive tracts (most waders digest their food very quickly; Zwarts *et al.* 1990, Verkuil 1996). We have no direct information on how great the difference in average weights might be between (say) an undisturbed flock of stints that was caught on a rising tide, and a flock that had been disturbed many times before being captured a couple of hours after the tide began to ebb. Neither of the above situations would seem unusual to a Victorian wader bander; nor does it seem unlikely to us that the rate of energy expenditure (and therefore mass loss) of an active wild wader at high tide should at least equal that of a bird being held in a keeping cage for processing.

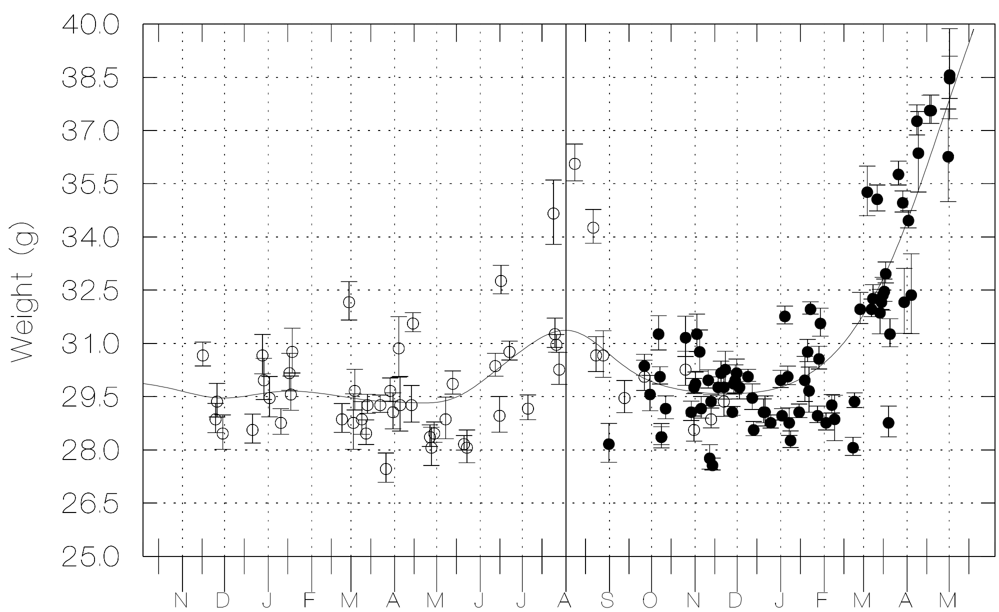

Figure 2. Seasonal variation in weights of Red-necked Stints; means and 90% confidence limits of the means are given for individual catches. Two years are represented on the X-axis. Birds in their first year (age 1) are shown to the left of the solid vertical line. Birds in their second or subsequent year are shown to the right of the solid vertical line; they fall into two age classes: Adults, and Age 2 (the latter are immature birds, which by convention are considered to have a birthday on 1 August, when they change from age 1 to age 2). These age categories are represented by different symbols: Age 1 and Age 2 = open circles; Adults = filled circles. Each data point is based on a sample of at least 30 birds; smaller samples were discarded from this graph. The curve through the graph was produced with the Distance Weighted Least Squares Smoothing option in SYSTAT and is presented only as a rough illustration of how means change through time; it has no real causal significance.

There are other factors that may have affected average weights recorded in catches of Red-necked Stints, probably to a lesser extent. It was not noticed until 1985 that some of the spring balances used for weighing birds had become unreliable, in some cases giving readings as much as 5% above the real value of what was weighed. The problem (which had probably only been marked for a short time) was apparently caused by rust thinning the springs within the balances; since then the springs have regularly been checked and replaced if necessary. It is impossible to assess exactly how this affected the data, but the effects appear to have been small given that there is no obvious difference between average weights before and after 1985, and that there was much unexplained scatter in average weights of catches made both before and after this time (see Figure 4). The tendency for Red-necked Stints to be caught in large catches which are weighed by several processing teams with different balances may have reduced the impact that a dodgy balance or two may have had on recorded weights. We are also unable to assess the potential effects of catches weighed on stormy days when strong winds make it difficult to get an accurate reading from spring balances and the weather may have interfered with feeding before high tide; such weather conditions are uncommon in Victoria. Further, "wet catches" were often made when stints at the leading edge of the net landed in the sea; areas of net containing wet stints were *always* pushed ashore within one or two minutes of firing and given that water typically pearls into drops and very quickly drops

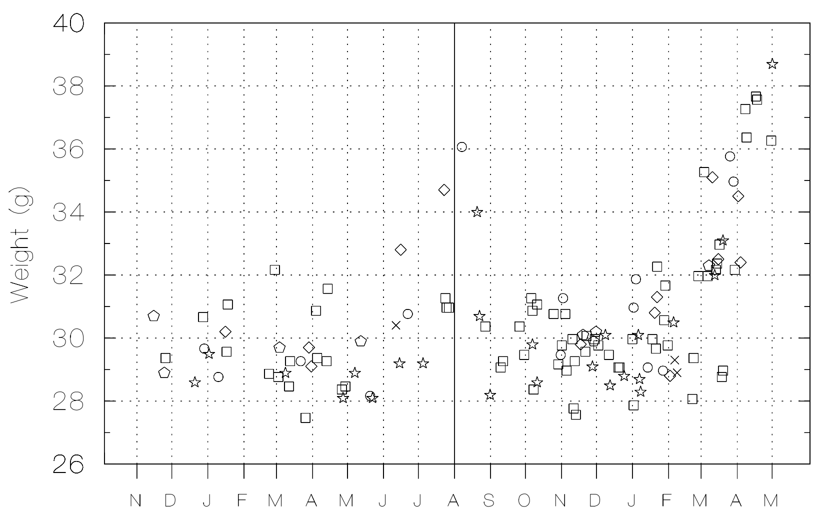

Figure 3. Weights of Red-necked Stints (as Figure 2) shown for different sites: □ Werribee; ◇ Queenscliff; ⚐ Westernport Bay; ⬠ Inverloch; O Corner Inlet; X Other sites.

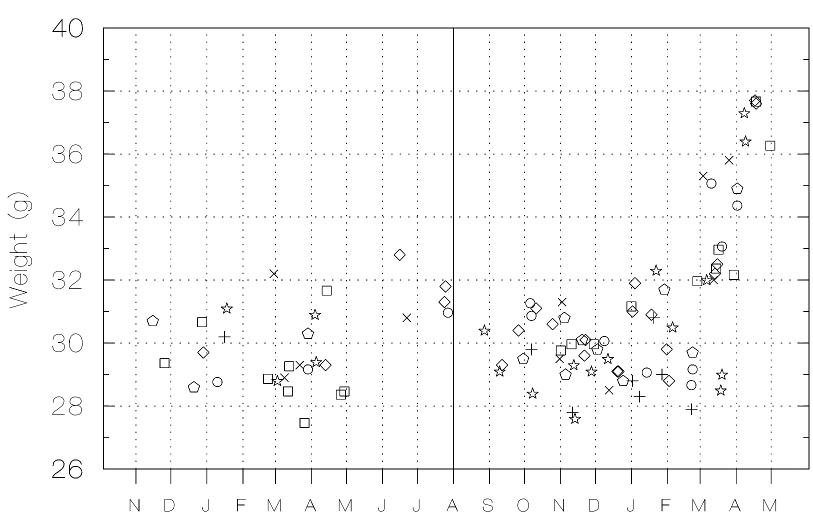

Figure 4. Weights of Red-necked Stints in different seasons: □ 1978/79; ◇ 1979/80; ⚐ 1980/81; ⬠ 1981/82; O 1982/83; X 1991/92; + 1993/94.

off stints as they stand in keeping cages, we doubt that they were waterlogged enough for average weights to be affected. Nevertheless we regret the absence of a capture log in which weather conditions and the number of wet stints in a catch were recorded.

Immatures Are Usually Slightly Lighter Than Adults

The unexplained differences in average weights between different catches made at similar dates make it difficult to detect subtle differences in the weights of immatures and adults at many times of year. One way to deal with the problem is to compare weights of immatures and adults that were caught in the same catch; provided the biases that influence average weights in different catches have much the same effect on all age categories, this approach should be robust. This is what has been done in Table 1. Not unexpectedly, this shows that immatures, which undergo no pre-migratory mass-gain, are always significantly lighter than adults from March to May. At other times, immatures were significantly lighter than adults in nearly half of the catches analysed, and not significantly different in the other catches. It seems that immatures are genuinely lighter than adults at these times, but not by very much.

Mid-winter Weight Increase of Immatures.

Two interpretations, not necessarily independent, could explain this observation. First, there could be a genuine increase in weights of immatures during the austral winter. Secondly, the result could be an artefact of the data arising from the small catches, low temperatures, short days, and rapid processing (for bander comfort) of mid-winter. These causes would tend to reduce the mass loss of birds whilst being held for processing. However, given that the VWSG almost never weighed and released the last bird of a catch more than 4 hours after capture, weight loss of stints in the hand would seldom exceed *c.* 2g. The weight increase in immature stints over winter appears to be greater than this: while differences in handling time may exaggerate the apparent mass increase during winter, they cannot alone explain it.

An interesting feature of the mid-winter weights (July and August) of immatures is that they appear to fall into two categories: (1) catches in which the average weights were between 29 and 31g (i.e. slightly higher than in immatures at other times of year but perhaps within the wide range of variation that results from scatter in average weights of catches); (2) catches in which the average weights were between 34 and 36g (i.e. much higher than in immatures at other times of year). Although relatively few catches of stints were made at this time of year, we have no reason to doubt this result. We have checked the original field data sheets and found no disturbing anomalies; in most of the catches (including all those of 'heavy' immatures) there were several processing teams, so the varying weights cannot be ascribed to an inaccurate spring balance or a systematic error in reading the weights by a single observer. The usual VWSG procedure of double-checking and then underlining individual weights that seemed unusual was followed and in some catches it was noticed that the stints caught seemed unexpectedly heavy, so particular care was taken to weigh them accurately.

Arrival weights

The amount of nutrient reserves consumed by waders before completing one leg of a migration may differ

Table 1. Comparisons of weights of immatures and adults. The rows are arranged so the youngest immatures are at the top of the table, the oldest at the bottom.Weights of immatures and adults, by month, are shown in the first two columns; they are presented in the format mean (standard deviation; sample size). The last three columns show the number of catches in which two-tailed T-tests showed immatures to be significantly slighter or heavier than adults ($P<0.05$). Only catches in which at least 10 immatures and 10 adults were captured have been included.

	Immature weights all catches: m (s.d.; n)	Adult weights all catches: m (s.d.; n)	Imms lighter	Imms heavier	Ages similar
Oct. (Age 1)	29.2 (2.11; 24-33; 49)	29.8 (2.15; 22-40; 1145)	0	0	2
Nov. (Age 1)	29.6 (2.54; 24-38; 421)	29.2 (2.04; 24-42; 2125)	4	0	5
Dec. (Age 1)	29.4 (2.39; 24-37; 265)	29.6 (2.24; 20-38; 2107)	3	0	3
Jan. (Age 1)	29.7 (2.40; 24-38; 370)	30.4 (2.34; 23-40; 1864)	2	0	6
Feb. (Age 1)	29.4 (2.70; 23-39; 196)	30.0 (3.02; 24-44; 948)	4	0	1
Mar. (Age 1)	29.1 (2.20; 20-38; 896)	33.2 (3.40; 22-50; 3135)	16	0	0
Apr. (Age 1)	29.9 (2.95; 22-41; 766)	37.5 (3.93; 24-51; 999)	8	0	0
May (Age 1)	28.9 (2.15; 22-36; 470)	33.0 (5.24; 24-43; 22)	1	0	0
Jun. (Age 1)	30.7 (2.28; 24-40; 443)	30.3 (4.43; 26-35; 4)	0	0	0
Jul. (Age 1)	30.9 (2.55; 20-42; 452)	30.0 (1.41; 29-32; 4)	0	0	0
Aug. (Age 2)	31.7 (3.32; 25-42; 300)	28.3 (2.25; 22-33; 58)	0	0	1
Sep. (Age 2)	29.8 (2.09; 25-37; 151)	30.0 (2.26; 24-40; 289)	0	1	3
Oct. (Age 2)	29.4 (2.03; 25-34; 247)	29.8 (2.15; 22-40; 1145)	1	0	4
Nov. (Age 2)	29.0 (1.68; 25-33; 216)	29.2 (2.04; 24-42; 2125)	3	0	3
Dec. (Age 2)	28.7 (2.15; 24-34; 60)	29.6 (2.24; 20-38; 2107)	1	0	0

between species and between different steps in the migration. For example, Red Knots *Calidris canutus* arrive on the breeding areas with substantial reserves that can apparently keep them alive for a week or two early in the breeding season when the tundra may still be snow-covered and food is scarce (Davidson & Wilson 1992). In contrast, other waders consume virtually all reserves and become extremely light on arrival (e.g. Great Knots and Bar-tailed Godwits staging in southern China on northwards migration, M.A. Barter pers. comm.). There is no clear evidence that Red-necked Stints are remarkably light or heavy on arrival in Victoria; average weights (and their standard deviations) early in the arrival period (in August and September for adults, October and November for immatures) hardly differ from those collected later in the summer (Figure 2, Table 1). The average weights of adults in August were the only ones that appeared anomalous, with the average weights about 1.7g lighter than in subsequent months. Figure 5 shows that this result cannot be ascribed to the sample including some birds that had ordinary weights and some that were very light. The distribution appears to be Normal, and catches made in December (when most or all adults have arrived in Victoria) appear to have much the same proportion of very heavy and very light birds. Our impression is that the arrival weights of Red-necked Stints are fairly stable and between 1g and 2g lighter than the usual summer weight, and further that they reach the usual summer weight very soon after arrival; this would explain why September weights are not markedly different from those collected later in season. It should be stressed though that our samples of arrival weights were rather small for adults, and in the case of immatures, too small for analysis.

Mass Loss whilst Moulting

Weights of adult Red-necked Stints are plotted against primary moult-score in Figure 6 (moult scores were calculated using the standard method described in, for example, Marchant & Higgins 1990). It shows a gradual decrease in weights through the early stages of primary moult, with a fairly abrupt increase in average weights when primary moult scores reach about 30. Interestingly, it is at about this stage of primary moult when the rate of primary replacement in moulting Red-necked Stints decreases; in the early stages of primary moult up to four primaries are in growth concurrently in each wing, while in the later stages only 1 or 2 primaries grow concurrently and the secondaries begin to moult (Higgins & Davies 1996). This suggests that there is a real relationship between the weights of moulting Red-necked Stints and the size of the moult-induced gap in their wings; indeed, during the moulting period (approximately October to February), weights appear to be more closely related to primary moult-score than they are to calendar date (cf. Figure 2). Further analyses, beyond the scope of this paper, are required to test this idea.

Pre-Migratory Mass Gain of Adults

A prerequisite in answering questions about the amount of mass-gain in relation to body size is that the structural size of a bird can be described adequately with a linear

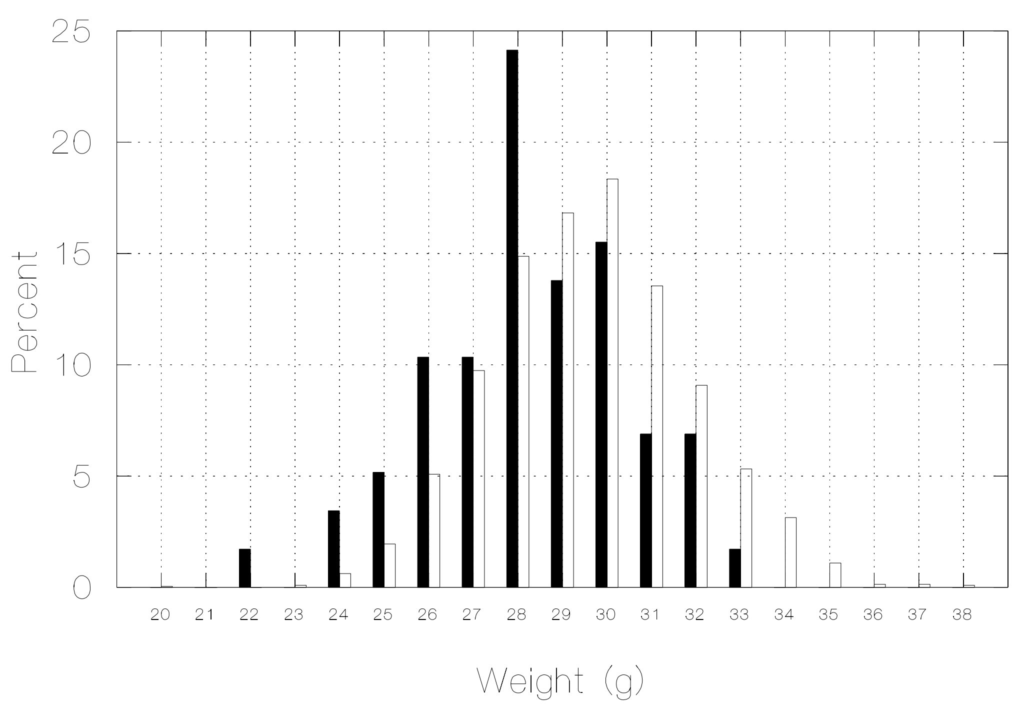

Figure 5. Histograms of weights of adult Red-necked Stints in Victoria in August (filled) and December (open).

measurement or combination of linear measurements. Wing length, the only measurement for which we had large samples, is significantly correlated with weight during the period when weights are fairly stable (in adults, Sept.-Nov., $r = 0.271$, $n = 1201$, $P < 5x10^{-6}$; in immatures, $r = 0.254$, $n = 2339$, $p < 5x10^{-6}$). It would therefore seem to be a reasonable index of structural size, though a stronger correlate would have been desirable. In Tables 2 and 3, it is shown that histograms of wing length are symmetrical through out the mass-gain period. This indicates that the timing of pre-migratory mass gain, and the timing of departure, are independent of the size of the bird. If this were not the case, and (say) bigger birds were the first to start mass-gain or the first to depart, the histograms in Tables 2 and 3 would be expected to be skewed.

If all birds started putting on mass at the same time, the plot of mean weights over time would be expected to indicate smooth growth, most likely conforming to one or other of the common growth curves (see Appendix 1). Figure 2 shows that it does not; the means in the pre-migratory period are much too scattered to form a neat curve like those illustrated in the Appendix 1. Indeed, Figure 2 suggests that the scatter between average weights in different catches may be greater in the period of pre-migratory mass-gain than it is at other times. This idea is explored further in Figure 7, which shows the difference in means between a catch of adults and the following catch. Although there is scatter at all times it appears to be more marked in February, March and April than in other months; in many cases during these months, the average weight in a catch was more than two grams heavier than in the following catch, even though birds were caught in the pre-migratory period when average weights should, in theory, increase in every catch. A number of potential biases that could cause the differences in average weights between catches made on similar dates were discussed earlier in this paper. We can see no reason why any of these should have a stronger effect during the period of pre-migratory mass gain than at other times.

Why then, is there increased scatter in average catch weights during the pre-migratory mass-gain period? We suspect it indicates a tendency for Red-necked Stints to bunch into groups of birds that are at similar stages of mass gain. If this does occur, one would expect the average weights of individual catches to vary most during the period of pre-migratory mass gain, since at this time there is a greater range of feasible weights in the population and average weights of different groups of stints are likely to be at their most divergent. It should be noted that if 'bunching' of Red-necked Stints does occur, its effects are likely to more apparent in some catches than in others, as cannon-netting often involves a varying amount of twinkling (flushing) birds into the catching area; this operation would tend to mix birds of different weights together to some extent. Mechanisms that could create bunching of Red-necked Stints at similar stages of mass-gain are suggested in the discussion.

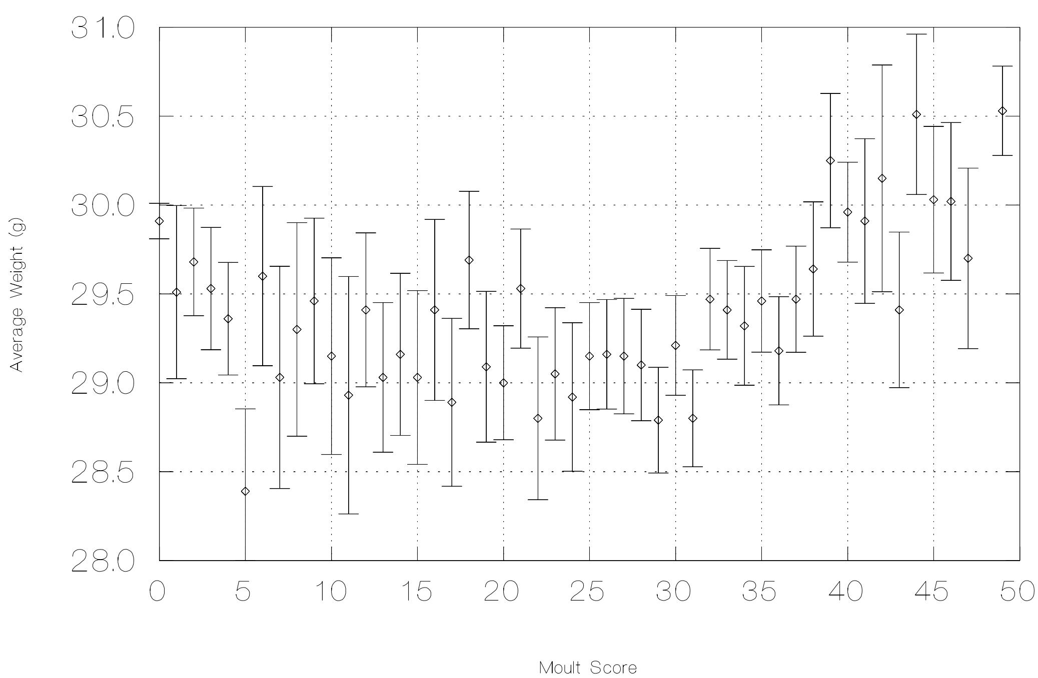

Figure 6. Weights of adult Red-necked Stints plotted against primary moult score. Means and their 90% confidence limits are shown.

We also examined changes in coefficients of variation during the pre-migratory mass-gain period to see if they offered information on bunching (Figure 8). Large samples are required for reasonable estimates of coefficient of variation - preferably greater than 300, according to our experiments with the cyberstints mentioned in Appendix 1 (data not presented). Ignoring the distractions of smaller samples, it seems that coefficients of variation increase continuously through the mass-gain period. This would be expected if stints were bunching and we were catching birds from mixed groups at different stages of weight gain (see Appendix 1). However, this observation could also be explained by other causes that we cannot rule out. For instance, if we caught some adults that failed to reach departure mass, this too would increase the coefficients of variation, and the effect would be expected to be stronger towards the end of the mass-gain period, as most adults have left by this time and those remaining would include a relatively high proportion of adults that failed to depart as they had not accumulated sufficient reserves. One thing that Figure 8 shows is that there is no indication that coefficients of variation decline to a level lower than that before pre-migratory mass-gain began. As coefficients of variation would be likely to decline if each bird put on exactly the same amount of weight before migrating (see Appendix 1), Figure 8 is consistent with the idea that the amount of weight a stint puts on before migrating is proportional to its size.

Average weights from different catches cannot be used to calculate the rate of mass gain.

An implication of the idea that bunching of stints into groups of birds of similar weight occurs during the mass-gain period is that whilst catches may be a random sample of the population of birds, and may indeed be representative of the increase in mass over time, the real world observations of mass gain are inconsistent with the simplistic assumptions required for the use of growth

Table 2. Summary statistics for mass gain period. Data are for birds both weighed and measured. Skewness: single undeline, significant between 1% and 5% (1 - tailed); double underline, significant at less than 1%.

Date	Number of Birds	Weight (g)					Wing Length (mm)				
		Mean	S.D.	Min	Max	Skewness	Mean	S.D.	Min	Max	Skewness
Feb 16	15	28.3	2.15	24	31	-0.312	107.0	4.88	96	115	-0.456
17	135	30.0	2.15	26	39	$\underline{\underline{1.262}}$	107.5	3.04	100	116	-0.152
21	80	32.8	3.03	26	44	$\underline{\underline{0.613}}$	106.7	3.60	98	117	$\underline{0.584}$
25	10	32.9	1.79	30	35	-0.088	108.5	3.41	103	116	0.683
Mar 1	244	32.1	2.67	27	44	$\underline{\underline{1.205}}$	108.3	2.75	100	116	-0.048
7	1	34.0	-	34	34	0.000	112.0	-	112	112	0.000
8	35	32.4	2.09	29	37	0.473	107.9	2.39	102	114	-0.160
9	93	32.4	2.77	27	39	0.222	107.3	2.63	101	114	0.001
10	120	32.9	2.52	27	41	0.120	108.6	2.81	100	115	-0.035
11	14	32.0	2.80	27	39	0.741	106.4	3.05	100	112	-0.240
12	22	34.6	3.54	30	42	$\underline{0.868}$	106.6	2.17	103	111	0.159
13	59	28.6	1.91	24	36	$\underline{\underline{1.070}}$	107.6	2.23	102	113	0.236
14	83	29.0	2.28	24	39	$\underline{\underline{0.927}}$	107.2	2.55	102	112	-0.230
15	19	27.6	1.46	26	31	0.766	108.2	2.30	103	112	-0.324
24	42	32.3	3.59	26	43	0.498	107.8	3.70	99	116	0.455
27	146	34.9	2.67	30	44	$\underline{\underline{0.887}}$	109.1	2.40	102	115	-0.219
Apr 2	162	37.5	3.29	24	47	$\underline{\underline{-0.608}}$	107.8	2.52	100	116	0.149
3	38	37.3	3.65	30	47	0.412	108.2	2.77	102	114	0.026
4	2	40.0	0.00	40	40	0.000	109.5	0.71	109	110	0.000
11	236	37.7	3.50	30	49	0.164	108.5	2.46	100	114	-0.232
12	288	37.7	3.96	28	51	$\underline{\underline{0.422}}$	108.3	2.62	100	116	-0.135
16	4	34.0	3.65	30	38	0.000	108.3	2.06	106	111	0.412
23	8	37.3	2.82	34	42	0.508	108.1	2.03	105	111	-0.179
24	36	36.3	4.76	26	46	-0.330	105.4	3.03	100	111	-0.082
25	8	35.4	3.42	30	41	0.208	107.1	2.36	102	110	-1.279
27	7	37.3	5.74	29	45	-0.017	108.4	2.15	105	111	-0.357

curve models. The model outlined in Appendix 1 for calculating departure mass and rate of mass gain requires representative and accurate average weights from different stages of the pre-migratory mass-gain period. These are not available from this data set on Red-necked Stints, as the average weight in each catch varies too much for reasons that we cannot adequately explain.

Table 3. Frequency histograms of weight and wing length by day.

	Mid-point of Weight (g) Interval													
	25	**27**	**29**	**31**	**33**	**35**	**37**	**39**	**41**	**43**	**45**	**47**	**49**	**51**
Feb 16	1	4	5	5	.	.	.	.	.	.	.	.	.	.
17	.	9	52	49	15	7	1	2	.	.	.	.	.	.
21	.	3	4	18	25	18	8	2	1	.	1	.	.	.
25	.	.	.	2	4	4	.	.	.	.	.	.	.	.
Mar 1	.	3	28	76	79	37	10	5	3	2	1	.	.	.
7	.	.	.	.	.	1	.	.	.	.	.	.	.	.
8	.	.	1	11	11	9	3	.	.	.	.	.	.	.
9	.	2	13	23	21	20	11	3	.	.	.	.	.	.
10	.	2	8	20	41	34	11	3	1	.	.	.	.	.
11	.	1	.	5	5	2	.	1	.	.	.	.	.	.
12	.	.	.	3	7	6	1	2	1	2	.	.	.	.
13	1	14	31	11	.	1	1	.	.	.	.	.	.	.
14	2	18	29	27	5	1	.	1	.	.	.	.	.	.
15	.	11	6	2	.	.	.	.	.	.	.	.	.	.
24	.	4	5	9	11	3	8	1	.	1	.	.	.	.
27	.	.	.	10	37	45	32	14	4	3	1	.	.	.
Apr 2	1	1	1	3	11	23	42	31	35	11	2	1	.	.
3	.	.	.	2	3	6	9	10	5	.	2	1	.	.
4	.	.	.	.	.	.	.	.	2	.	.	.	.	.
11	.	.	.	8	21	37	49	49	33	29	7	2	1	.
12	.	.	3	11	22	45	69	53	38	25	10	7	4	1
16	.	.	.	1	1	.	1	1	.	.	.	.	.	.
23	.	.	.	.	.	3	2	1	1	1	.	.	.	.
24	.	1	3	3	2	3	10	2	8	3	.	1	.	.
25	.	.	.	1	1	3	1	1	1	.	.	.	.	.
27	.	.	1	.	1	1	1	.	1	1	1	.	.	.

	Mid-point of Wing Length (mm) Interval																		
	<100	**100**	**101**	**102**	**103**	**104**	**105**	**106**	**107**	**108**	**109**	**110**	**111**	**112**	**113**	**114**	**115**	**116**	**117**
Feb 16	1	.	1	.	1	1	.	3	2	1	.	.	3	.	1	.	1	.	.
17	.	3	3	2	4	11	11	11	20	23	12	13	14	5	1	.	2	1	.
21	1	2	1	4	6	7	7	14	6	12	9	4	1	1	.	.	2	2	1
25	.	.	.	.	1	.	.	2	.	2	2	2	.	.	.	.	.	1	.
Mar 1	.	1	.	2	5	11	21	29	24	36	27	30	30	14	8	4	1	1	1
7	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.
8	.	.	.	1	.	1	4	6	1	4	11	4	2	.	.	1	.	.	.
9	.	.	1	3	3	5	10	13	16	13	10	7	6	5	.	1	.	.	.
10	.	1	.	.	2	5	7	13	19	15	10	19	7	13	5	2	2	.	.
11	.	1	.	.	1	2	1	2	2	1	3	.	.	1	.	.	.	.	.
12	.	.	.	.	2	1	5	4	1	5	2	1	1	.	.	.	.	.	.
13	.	.	.	1	.	4	4	9	10	12	12	1	2	2	2	.	.	.	.
14	.	.	.	4	3	8	10	5	9	20	8	8	6	2	.	.	.	.	.
15	.	.	.	.	1	.	1	2	2	6	1	2	3	1	.	.	.	.	.
24	1	.	.	1	1	4	3	6	4	8	3	4	1	2	.	.	1	3	.
27	.	.	.	1	2	1	5	12	12	24	18	34	13	11	10	2	1	.	.
Apr 2	.	1	.	.	3	10	21	15	25	22	20	27	11	4	.	1	.	2	.
3	.	.	.	2	.	.	2	7	6	3	7	4	2	3	.	2	.	.	.
4	.	.	.	.	.	.	.	.	.	.	1	1	.	.	.	.	.	.	.
11	.	1	.	2	.	10	16	17	31	38	36	39	16	17	12	1	.	.	.
12	.	1	1	6	3	7	22	31	42	36	40	45	23	20	7	2	1	1	.
16	.	.	.	.	.	.	.	1	.	2	.	.	1	.	.	.	.	.	.
23	.	.	.	.	.	.	1	1	1	1	2	1	1	.	.	.	.	.	.
24	.	2	3	3	1	4	4	6	4	4	.	4	1	.	.	.	.	.	.
25	.	.	.	1	.	.	.	1	1	4	.	1	.	.	.	.	.	.	.
27	.	.	.	.	.	.	1	.	2	.	1	2	1	.	.	.	.	.	.

What is the rate of pre-migratory mass-gain in adults?

We showed earlier (Figure 6) that weights of Victorian Red-necked Stints are lowest during the middle of primary moult. Mass increase during the latter half of primary moult is very slow. The average weight is lowest (29.00g) when primary moults scores are between 26 and 31; the average date at this time is 20 December. When the primary moult score is 49 (average date 16 February), the average weight is 30.53 g - an increase of only 1.53 g

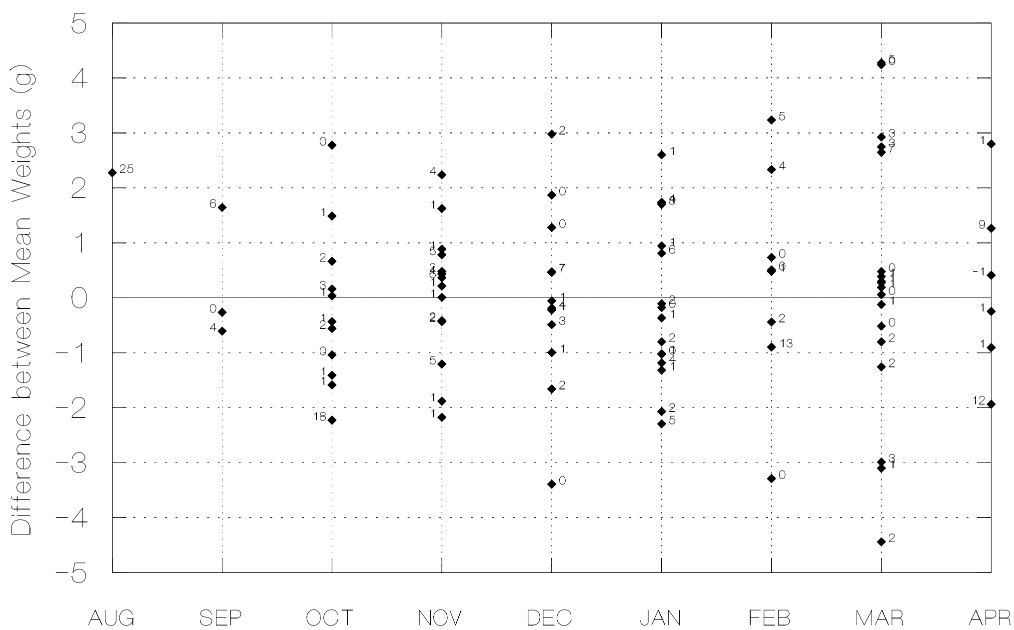

Figure 7. Differences between mean weights of adult Red-necked Stints in adjacent catches through the year. The difference in average weights between a catch and the following catch is plotted. The numbers next to each point show the number of days until the next catch. In this graph, all years were treated as the same, so for a catch made on (say) 1 March 1990, the following catch would have been treated as (say) a catch made on the 2 March 1982, rather than on the 3 March 1990.

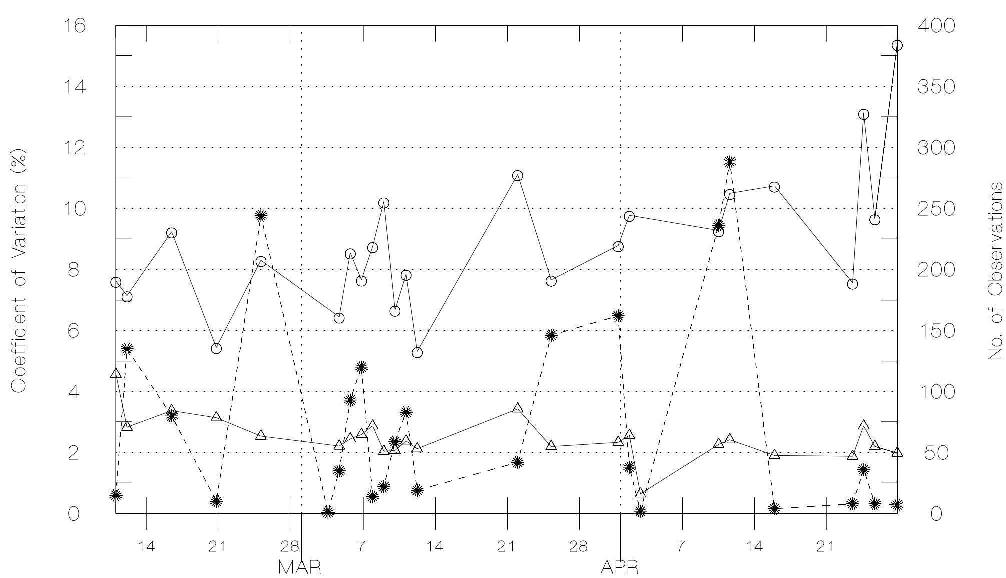

Figure 8. Coefficients of variation for weight and wing-length for each catch of adult Red-necked Stints made during the period of pre-migratory mass gain. O = weights; △ = Wing length; * = No. of observers.

in 58 days, or 0.026 g per day. If this rate of weight gain continued after moult was finished, adult Red-necked Stints would take some 400 days to reach departure mass. This is obviously not the case (e.g. Figure 2) so Red-necked Stints must increase their rate of mass-gain after primary moult is completed.

Does rapid mass-gain of adult Red-necked Stints begin as soon as primary moult is completed? This question was examined in Figure 9, which shows the differences in average weights, within catches, between birds that have and have not finished primary moult. For most of the austral summer, moulting birds are about 1g to 2 g lighter than those that have completed moult of primaries. However in mid-March (after 16 Mar.) the difference increases dramatically to at least 3g. This indicates that in at least some birds there is a delay between the conclusion of primary moult and the onset of rapid mass-gain; if this were not the case, the difference between average weights of moulting and non-moulting birds would increase gradually through time rather than abruptly.

As shown above, average weights in Red-necked Stints vary too much between catches in the pre-migratory period to be considered an accurate indication of the mean weight in the population at a given time. Accordingly the difference in average weights between one catch and another does not give a reliable indication of the rate of change in mass. An alternative approach to find the rate of mass-gain during the pre-migratory period is to use direct measurements of mass-gain from individual birds that were captured and weighed more than once during the mass-gain period. Other studies have found that weights of waders can decrease in the days following release, apparently due to the trauma of capture; in a study of Ruddy Turnstones *Arenaria interpres* it took about 25 days for the capture mass to be regained (Ens *et al*. 1990). Our samples of capture and recapture in the mass-gain period (March and April) are sufficiently large to indicate some mass loss following capture but insufficient to allow estimation of its size and generality. Any such mass loss would lead to systematic underestimation of the mass-gain rate. Accordingly, we performed separate analyses of weights of birds that were captured and recaptured in the same period of pre-migratory mass-gain ("same-season retraps") and of birds that were banded in one pre-migratory period and recaptured in another ("different-season retraps"); the latter should give a more reliable indication of the rate of mass-gain.

Any adults retrapped in a different season will have survived at least two trans-equatorial migrations since their last capture, an indication that their weight schedules have reverted to what is normal. A useful assumption in using different-season retraps to estimate rate of mass-gain is that individual birds time their pre-migratory mass-gain similarly in different years. If this is not the case, the average difference should between capture mass and recapture mass should not be affected, but the variance may become inconveniently large. This assumption is examined in Figure 10. It shows that there is a strong correlation between the weight of individual

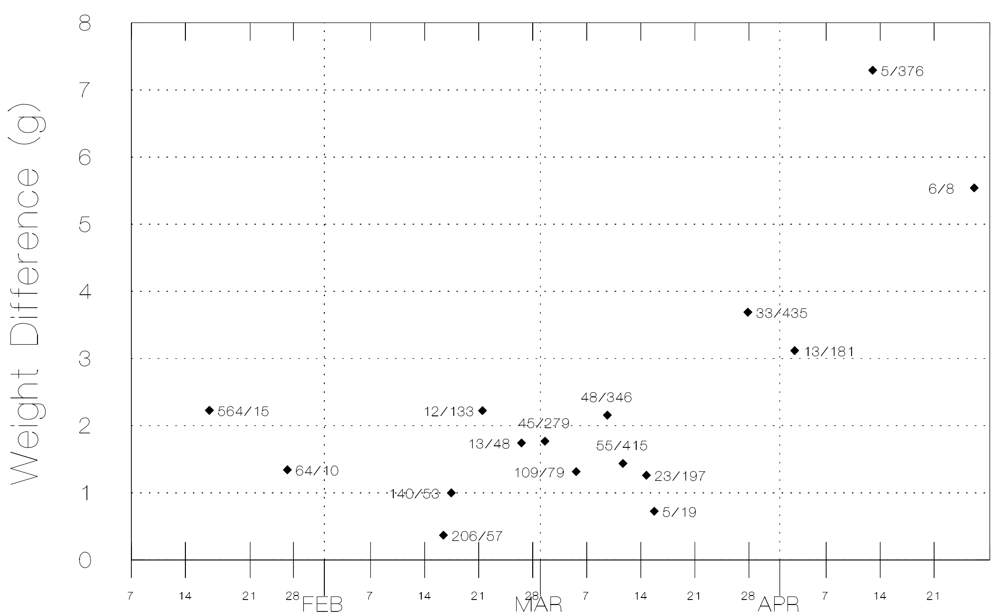

Figure 9. Differences in average weights, between birds that have finished their primary-moult, and those that are still in active primary moult. The mean difference in weight is shown by a solid square ■; the numbers beside these symbols = the number of birds still in active primary moult / the numbers of birds that had completed primary moult.

Red-necked Stints (relative to average weights in each sample) from one pre-migratory period to another; that is, a bird that begins rapid weight gain relatively early in one season is likely to do so in all seasons. Accordingly recaptures from different seasons should give a good indication of the rate of weight gain.

Figure 11 shows the changes in mass of recaptured adult Red-necked Stints. Earlier drafts of this figure, including data from all of March and April, showed a significant correlation in different-season retraps between mass change and the difference between days. However they resulted in a gradient (i.e. mass gain per day) that we considered improbably low; we attributed this to the sample including some birds that were not gaining mass at peak rate. This could be caused by birds being caught or recaptured before or after their period of mass-gain. If, as seems likely, the mass-gain of individual birds follows a growth curve (see Appendix 1), birds captured in very early stages or very late stages of mass-gain would not be increasing their mass at peak rate; they too would tend to lower the gradient in this figure. To get around this problem, we excluded birds that were captured at times when they may not have been at the peak rate of mass gain. The maximum rate of mass gain was calculated when only birds captured and recaptured in the period 13 March to 26 April were included (see Figure 11); shortening the period still further was unsatisfactory as the gradient became no higher and the samples became too small to be meaningful. A linear regression of the difference in weight against that of days gives a weight gain of 0.289 g/day with a constant term not significantly different from zero. A problem with the use of linear regression in this situation is that all data points are considered equally important even though they are not measured to the same accuracy. Weights were recorded to the nearest 1 g, the rounding implicit in this meaning that, even in the absence of any other source of error, each estimate of weight difference could be out by up to 1 g in either direction. This is a large effect when weight differences are small. Ens *et al.* (1990) avoided this problem by discarding data from different season-retraps when the interval between banding and recapture was less than six days, arguing that small random errors would be swamped by mass-gain when longer intervals between capture and recapture were used. Being reluctant to exclude any more data, we overcame the problem by estimating the rate of weight gain as the gradient of the total (over all data points) difference in weight by the total difference in days. This gives, on the data of Figure 11, a rate of weight gain of 0.352 g/day, about 1.2% of the average weight before pre-migratory mass-gain began. The rate of mass-gain, calculated on the same basis, in same-season retraps was -0.14 g (n=14). This

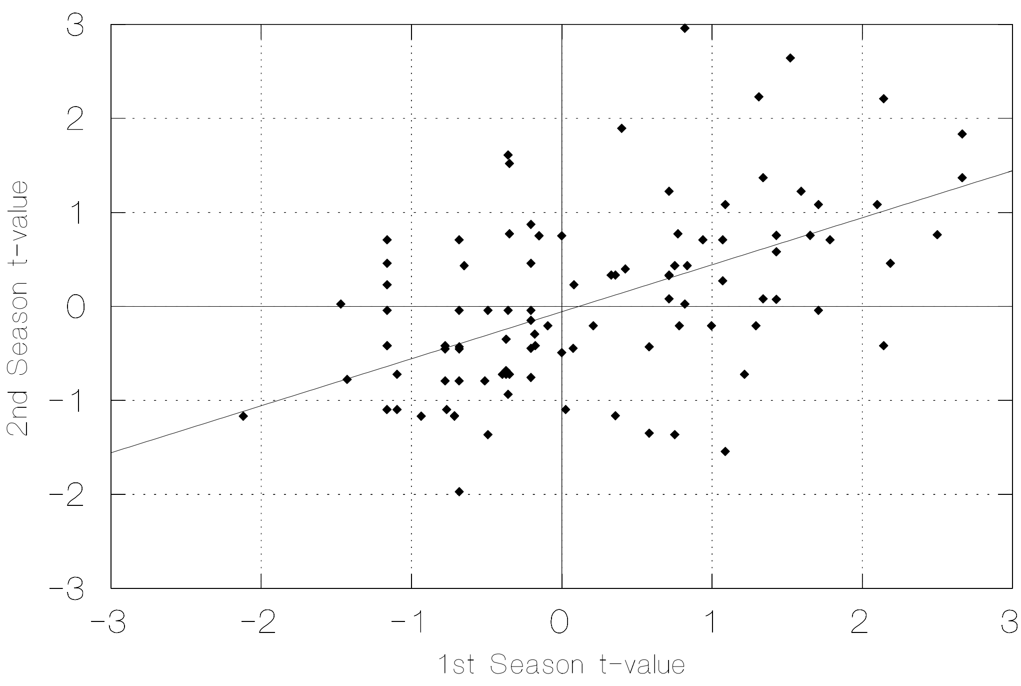

Figure 10. Weights of individual Red-necked Stints, relative to the average weight for particular days, in different seasons. This is expressed as t = (observed weights - mean weight for all birds captured on the same day) divided by (standard deviation for all birds captured on the same day). All data are from adults that were banded and recaptured in the period of pre-migratory mass-gain (March--April). For birds that were retrapped more than once in a single season, only the first encounter was used (to minimise any effects that earlier capture in the season may have had on mass). The correlation between the relative weights in different years is highly significant ($R = 0.534$; $n = 102$; $P < 0.000005$).

suggests that the weights of Red-necked Stints do decline after capture, probably not to the striking extent that was reported for Ruddy Turnstones in the study by Ens *et al*. (1990), but enough to suggest that analysis of data from different-season retraps is more appropriate.

The differences in weights between moulting and non-moulting birds, and the analyses of changes in weights of retraps, both suggested that Red-necked Stints do not attain the maximum rate of mass-gain until mid-March (16 Mar. and 13 Mar. respectively). It should be stressed that neither method gives a reliable indication of when the first birds begin mass-gain; they only give an indication of the date when mass-gain is sufficiently advanced to be readily detectable in a majority of birds. The real start of mass-gain is earlier; recoveries of adult Victorian Red-necked Stints on the south coast of China and in Taiwan on 31 March (Minton 1996) show that some birds must have started rapid mass-gain by mid-February (assuming about a month to attain departure mass in Victoria and at least two weeks to migrate so far north). The peak departure time for Red-necked Stints given by Minton (1996) of late March to mid-April would imply that most Victorian Red-necked Stints should begin rapid pre-migratory mass-gain in late February to mid-March; we do not consider this to be inconsistent with our results.

What is the Departure mass?

The apparent tendency of Red-necked Stints to be caught in sub-flocks at different stages of mass-gain is annoying, but not a total nuisance to the analyst. While it does preclude the possibility of modeling asymptotic departure masses, it does boost the chances of a team in the field making a cannon-net catch in which most or all birds caught are more-or-less at departure mass. This is a stroke of luck, as the only option remaining to us in estimating departure mass of Red-necked Stints is to calculate it from a catch of birds identified as being ready to depart.

The nearest approach we have to such a catch was caught at Queenscliff on 26 April 1987; it was the latest large sample of adults available from the austral autumn. The histogram of weights from this catch, shown in Figure

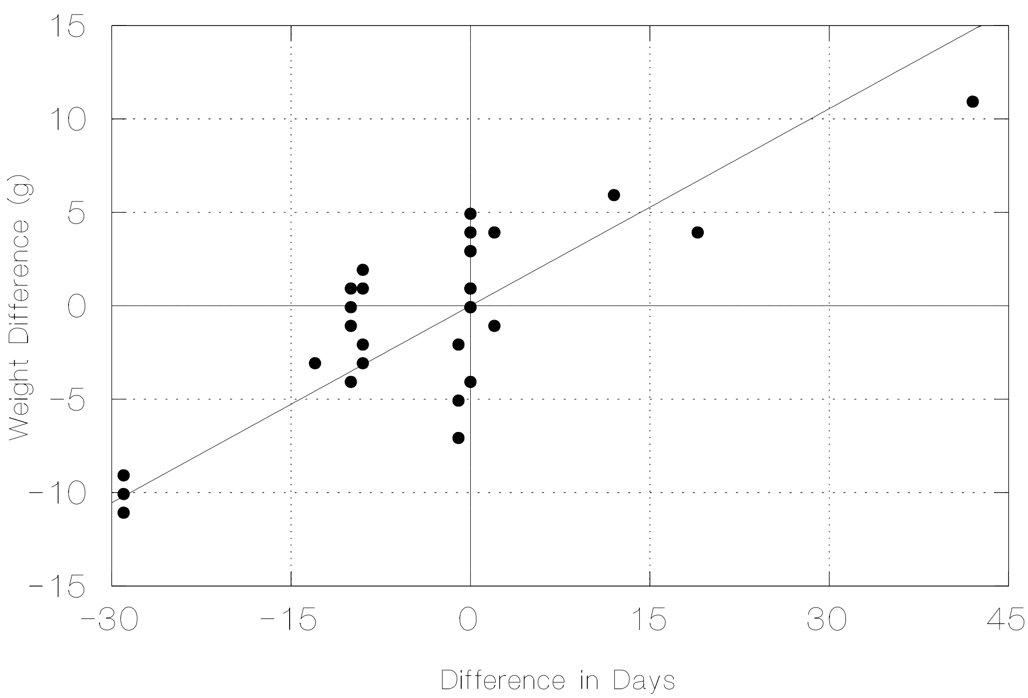

Figure 11. Mass changes of adult Red-necked Stints captured and retrapped between March and April of different departure seasons. For birds that were retrapped more than once in a single season, only the first encounter was used (to minimise any effects that earlier capture in the season may have had on mass). Encounters with Age 1 birds were excluded, so there was at least one pair of northwards and southwards migrations between each capture and recaptures. Data are only shown for the period 13 March -- 26 April; reasons for this are given in the text. The regression line shows the significant correlation between mass change and the difference in number of calendar days (not including year) between capture and recapture: intercept (weight difference for zero day difference) = 0.464 (s.e. = 2.972), gradient (grams per day) = 0.289 (s.e. = 0.041), $R^2 = 0.651$, n = 29, $P < 0.01$.

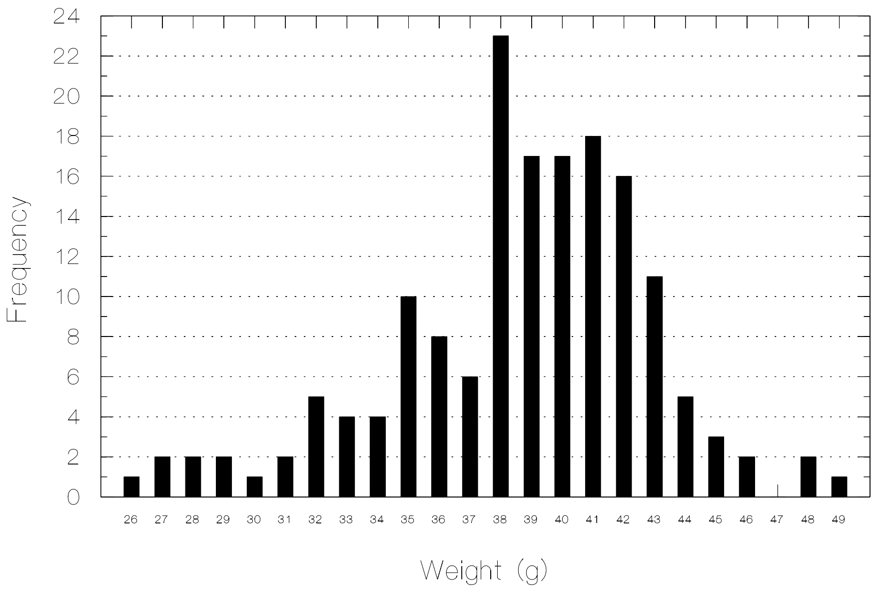

Figure 12. Histogram of weights of Red-necked Stints cannon-netted at Queenscliff, Victoria on 26 April 1987.

12, shows three peaks. One, of birds weighing between 26 and 30 g, consisted solely of all birds in the sample that were in active primary-moult. Exactly why these birds had such a delayed moult and weight-gain schedule is unclear but they had no chance of completing their northwards migration in time to breed; it is likely that they were among the very small proportion of adult Red-necked Stints that remain in Victoria through the winter (such birds make up only 0.008% of the austral-winter population of Red-necked Stints in Victoria, see Table 1). As they were atypical, they were excluded from subsequent analysis.

The remaining data can be considered to form two peaks, one with a mode of about 32–34 g and the other, presumably of birds at or near departure weight, with a mode of about 40g. The SHEBA suite of computer programs (Rogers 1995) can be used to separate two overlapping normal distributions; they are usually used to gain estimates of the size of each sex on the base of univariate linear measurements but they can used in this case too. Using HUMPS_UV and assuming coefficients of variation to be equal in birds gaining mass and those at departure mass, the following parameters were calculated: in birds forming the lower peak, mean = 33.98, standard deviation = 2.468, n = 23; in birds forming the higher peak (probably at departure mass), mean = 40.08, standard deviation = 2.912, n = 132. The estimated departure mass of 40g may be an underestimate, as it is possible that the higher peak in fact consists of two bunches of birds, of different average mass, that overlap considerably in weight; such distributions can look rather like a normal distribution when plotted on a histogram (see Rogers & Rogers 1995). Any underestimation of the mean of the higher peak in these circumstances is fortunately likely to be small (Rogers & Rogers 1995) so a departure mass of 40 g is probably a sensible estimate to use in flight range equations.

DISCUSSION

The mass of an individual bird is influenced by a number of factors. Lindström & Piersma (1993) divided these into several categories: structural size (the size of a bird as measured by linear dimensions independent of a birds nutritional status), nutrient stores (nutrients accumulated in anticipation of certain events, such as fuel for migration) and nutrient reserves (tissues which are needed for a functionally “normal life” but can be metabolized in the case of starvation). Although these categories are of theoretical use, they are not easy to identify, especially in studies for which no data on body composition are available. With our data, we can think of no satisfactory way of discovering the mass of the nutrient reserves. However the sum of the mass of structural size and nutrient reserves is probably very similar to the minimum average weights of Red-necked Stints in the middle of the non-breeding season. For convenience we have called this the base weight: the mass of a bird at a time when it is likely to be carrying minimal levels of nutrient stores.

In Victoria, the most satisfactory basis for an estimate of base weight is probably the average weight when moult scores are between 27 and 31 (see above). The average weight at this time, 29.00 g, hardly differs from that in several months of the non-breeding season (cf. Table 1), suggesting that sensible comparisons can be made with weights extracted from works in which data were presented in different ways. The base weights of Red-necked Stints in different areas are shown in Table 4 and appear to vary geographically. Lean weights of many other waders tend to be lower in areas with warmer climates, a trend that has been attributed to storage of most reserves in areas where the risks of finding insufficient food (e.g. in severe weather conditions) are highest (Davidson 1983). Base weights of Red-necked Stints follow this trend to some extent in that they appear to be lighter in warmer places. The correlation between base weights and temperature is not particularly neat though; for example, base weights in north-west Australia are closer to those of Red-necked Stints in temperate Victoria than to those in Malaysia or Thailand, although the latter two areas and north-west Australia all have a tropical climate. It seems likely that other factors are also involved in geographical variation in base weights of Red-necked Stints, but information from more sites is needed before we can guess what these might be.

Immature Victorian Red-necked Stints were slightly lighter than adults at most times of year, a trend shown in most studies of weights of waders (see, for example, the summaries of wader weights in Higgins & Davies 1996) and in the weights of Tasmanian Red-necked Stints (Barter 1984). The difference between the weights of immatures and adults was most marked in the pre-migratory period of adults; unlike adults in this period, immature Victorian Red-necked Stints underwent no detectable mass-gain. Tasmanian Red-necked Stints appear to differ in this respect; Barter (1984) found that immatures there gained a gram or two at the time that adults undergo rapid mass-gain. A similar increase in weights of immatures in about April has also been reported in Red Knots (Summers & Waltner 1978); suggestions to explain the phenomenon included: (1) it may be incipient pre-migratory fattening that only becomes fully developed in later years; (2) it may be early mid-winter fattening; (3) it may be related to younger birds being associated with adults that feed for longer or at a faster rate at this time. None of the above theories seems to explain why immature Red-necked Stints should put on weight in April in Tasmania but not Victoria.

Although they undergo no detectable mass-gain in the austral autumn, immature Victorian Red-necked Stints undoubtedly become heavier in July and August. Mid-winter mass increases in immatures that do not migrate north when a year old but remain in the non-breeding areas have also been reported in several South African waders: Curlew Sandpipers *Calidris ferruginea* (Elliott *et al.* 1976), Red Knots, Turnstones, Sanderlings *C. alba* and Terek Sandpipers *Xenus cinereus* (Summer & Waltner 1976). It has been suggested that this mass increase is analogous to the mid-winter mass-increase shown by many adults of those wader species that must endure cold winters because they spend the non-breeding season in the northern hemisphere: the extra tissue may provide increased heat production in cold weather, and could also act as a reserve to be drawn on should food become hard to obtain. These considerations may apply in Red-necked Stints but we are surprised that they should cause much change in mass given that the Victorian winter is relatively mild (in the coldest month, July, the mean daily minimum temperature in Melbourne is 5.7 ^{o}C, the maximum 9.5 ^{o}C, Lee 1982). Furthermore, they do not explain why the amount of mid-winter mass-gain of immature Red-necked Stints in July and August was slight in some catches (average weights *c*. 31g, cf. a base weight of 29 to 30 g at other times) and striking in others (average weights greater than 35g).

We think that at least some young Red-necked Stints disperse during the Victorian winter, looking for a nicer place to live while adults are in the northern hemisphere. Circumstantial evidence for this idea comes from field observations at Little River Mouth (near Werribee), where an influx of young stints to this important feeding area occurred in August 1989 and not earlier in the winter (B.A. Lane pers. comm.). Another indication that such movements must occur is that at some Victorian banding sites the proportion of immatures in the summer population is consistently higher than at others (VWSG, unpubl.) although the absolute numbers of stints at these sites have not changed dramatically. This situation could hardly be maintained unless some immatures changed sites between their first and second austral summers. It is possible that much of the mid-winter mass-gain observed in immatures is used as fuel for such movements - though it should be stressed that the potential flight ranges predicted by the weights in the heaviest catches are over 1,000 km, and there is no independent evidence that such long-distance movements occur. Possibly immature Red-necked Stints that change sites during their first austral winter put on more weight than is necessary because they have no idea how far they may have to move. There has been no detailed analysis of Red-necked Stint movements within Australia so this interpretation of the observed weight changes is rather speculative.

The departure mass (40g) we estimated for Victorian Red-necked Stints is not particularly high for a bird of their size, and is lower than the 41.6g estimated for Tasmanian birds (Barter 1984), which is in turn likely to be an underestimate as it was based on average weights of all birds captured in April. The relative body mass increase in the pre-migratory period of waders is greater in smaller species than in larger species (Zwarts *et al*. 1990), so the body mass increase in Victorian birds of about 38% is relatively low compared to comparative values reported in various small waders from the Banc d'Arguin, Mauritania: e.g. 43% in Little Stint *Calidris minuta*, 47% in Dunlin *C. alpina*, 39% in Sanderling and 40% in Curlew Sandpiper (data from Figure 9 of Zwarts *et al.* 1990).

Departure masses can be used in flight-range equations to calculate how far waders can fly in a given leg of migration. Zwarts *et al*. (1990) have stressed the many uncertainties that exist in calculating variables used in these equations: departure masses are difficult to estimate accurately; arrival masses are poorly known and recent studies of body composition suggest that the use of lean masses as a substitute is unsatisfactory; published data on flight speeds of waders are often contradictory and the flight speeds that occur in migration probably depend on the poorly known flight altitudes chosen by waders which enable them to find favourable wind conditions; estimates of energetic costs of flight come largely from studies of individual birds but waders usually migrate in flocks and formation flight may be more economical than flying alone; some of the pre-migratory mass-gain of waders is protein (which has a much lower energy content than fat), yet flight-range equations often assume that waders only use fat as fuel. With all these problems, flight range equations can only give a rough estimate how far a wader can go.

Bearing these problems in mind, we have tried several combinations of variables in the flight range equations ; the results are summarised in Table 5. They differ markedly according to the assumptions followed but in general predict a flight range between 2000 and 3000 km, sufficient to get Red-necked Stints from Victoria to staging areas around the Gulf of Carpentaria or elsewhere in northern Australia. This was also considered the likely destination of Red-necked Stints after migrating north from Tasmania (Barter 1984). Given that existing methods of calculating flight range are thought to give answers that are generally too low (Zwarts *et al*. 1990), it seems that Red-necked Stints probably make the journey to northern Australia rather comfortably and may arrive with fuel to spare. Indeed, the most liberal estimate of flight range (using the equation of Castro & Myers [1989], predicting a flight speed of 75 km/h and an arrival mass of 25 g) predicts a flight range of over 4000 km, which would be sufficient to take a Red-necked Stint to landfalls in Indonesia. A flight range of about 5700 km would be required to make the journey to sites in northern Borneo where a northwards passage has been recorded and Victorian birds have been retrapped (Higgins & Davies 1996).

The rate of pre-migratory mass gain in Victorian Red-necked Stints was estimated as 0.35 g per day in individual birds, or 1.2% of their Victorian base weight per day. This estimate is similar to that reported by Barter (1984) for Tasmanian Red-necked Stints of 0.9% of base weight per day (the rate in Tasmania was estimated from changes in average weights of the population and is thus likely to be a underestimate). Comparison with published reports of the rate of pre-migratory mass-gain in other species of wader (conveniently reviewed by Zwarts *et al*. 1990) indicates that this is a relatively leisurely rate of mass-gain; of 17 studies in which rate of mass-gain was reported for individual birds, 15 reported a faster rate, often between 2 and 5% of base weight per day. Interestingly, most of the slower rates of mass-gain have been reported from southerly non-breeding areas, while most of the faster rates of mass-gain were reported from non-breeding or staging areas much closer to the breeding grounds.

The mass of Red-necked Stints increases by about 9g to 10 g during the period of rapid mass gain; given that their maximum rate of mass-gain is about 0.3g per day, individual birds must need about a month to put this weight on. Elsewhere in this issue, Minton (1996) has proposed that Red-necked Stints perform their northward migration in about 5 stages. If it took about a month to prepare for each stage, a Red-necked Stint leaving Victoria in April could not arrive at the Siberian breeding grounds before September, just in time for the boreal winter. This clearly does not occur (they usually arrive at the breeding grounds in the first half of June), so Red-necked Stints must be capable of increasing the tempo as they migrate north.

How might they do this? One obvious possibility is that they have a higher rate of mass-gain when refueling at staging areas on northwards migration. No direct data are available on rates of mass-gain of Red-necked Stints at staging areas, but this idea would be consistent with the higher rates of mass-gain generally reported for waders at staging areas (Zwarts *et al*. 1990). When adult Red-necked Stints undergo pre-migratory mass-gain in Victoria, they are also performing a pre-breeding moult of nearly all body feathers (Higgins & Davies 1996). As most or all of this moult is completed by the time that they reach staging areas north of Australia, it is possible that energy previously used on pre-breeding moult can be diverted into refueling (see Piersma & Jukema 1993 for information on how this effect works in Bar-tailed Godwits).

Another possibility is that the arrival weights of Red-necked Stints vary at different stages of the migratory journey north. For example, a Red-necked Stint that left Victoria at 40 g and arrived in northern Australia weighing 30 g would only need to put on 5 g to migrate about the same distance again - provided it was prepared to arrive at the next staging area with an arrival weight of 25 g. It was shown above that the base weights of Red-necked Stints appear to vary geographically, so this idea may not be too implausible. It might explain why the heaviest Red-necked Stints weighed in tropical Asia are not nearly as heavy as the heaviest birds recorded in Victoria and Tasmania (Victorian maxima were shown in Table 1). In Malaysia, for example the heaviest Red-necked Stints weighed were 35 to 37 g (D.R. Wells, pers. comm.); in Hong Kong, most birds weighed in mid-May were less than 36 g, with a maximum of only 42 g (Melville 1981). The relatively low weights at the these Asian staging areas could also be explained if Red-necked Stints make short distance-flights as they travel along the coast of the Asian mainland.

The idea that adult Victorian Red-necked Stints are captured in subflocks at different stages of mass-gain is persuasive and has several interesting implications. To the best of our knowledge, this phenomenon has not been reported in waders before, though of course perfect bunching must have occurred by the moment of departure, when migrating waders typically set off in flocks of birds that are presumably all at departure mass. The behaviour of waders in the few hours preceding departure (reviewed by Piersma *et al*. 1990) generally appears like an adequate mechanism for waders to sort themselves into groups of birds that have and have not reached departure mass: small, vocalising flocks typically rise, wheel around the mudflats and resettle several times, with some birds joining them and others peeling off the flock and landing elsewhere, until the flock decides it is ready to go and heads into the distance in echelon or V-shaped formation. Red-necked Stints have been seen in such departure ceremonies in north-western Australia (Tulp *et al*. 1994, authors pers. obs.) but there are far fewer sightings than there are for larger species of wader in the same area. In Victoria, sightings of migratory departures of Red-necked Stints are very rare indeed (pers. obs., R.J. Swindley pers. comm., M.A. Barter pers comm.), though the lack of systematic efforts to observe migratory departures from Victoria may contribute to this. We agree with Zwarts & Piersma (1990) that migratory departures of small waders may be easier to overlook than those of larger and noisier species. Tulp *et al*. (1994) have also suggested that getting the flock composition exactly right for departure is more important for waders making very long flights than it is for birds, such as Red-necked Stint, that apparently plan to make shorter flights; Red-necked Stints may therefore have less need for impressive departure ceremonies. It is interesting to speculate that the tendency of Red-necked Stints to bunch into groups of birds at similar stages of weight gain in the days or weeks before departure might also reduce their need for elaborate departure ceremonies. This idea cannot be tested without further information on the efficiency of bunching in Red-necked Stints (and confirmation that it occurs); it would also be interesting to know if bunching occurs in other wader species. Most importantly, more observations of departures of Red-necked Stints ought to be made in Victoria, especially as the weight data presented in this paper do not pin down the departure time very precisely.

How might Red-necked Stints get divided into groups in which the birds are at different stages of mass-gain? One possibility is that some sorting occurs within high-tide roosts. A certain amount of jostling is often seen in flocks of Red-necked Stints at roosts but we have no idea if there if there is a systematic pattern to this that might result in heavy and light birds choosing different parts of the roost. Another possibility is that groups containing stints of different weights develop on the feeding grounds. Detailed radio-tracking studies of a similar American wader, the Western Sandpiper *Calidris mauri*, revealed strong site fidelity during the non-breeding period, both to feeding grounds and to roost sites (Warnock & Takekawa 1996). Red-necked Stints have been also observed defending discrete feeding territories (Peter 1996; B.A. Lane pers. comm.) and recoveries of banded birds indicate that they are typically site-faithful in Victoria (VWSG unpubl.), though whether their home range when roosting is as small as it is in Western Sandpipers has yet to be investigated. It is possible that birds from 'better' feeding grounds could weigh more than those from inferior feeding areas - perhaps because more food is available at the preferred sites, because the best feeding grounds are selected by stints that are better at exploiting them (such birds might be particularly healthy or experienced) or because of a combination of both considerations. If such segregation does occur it would probably be reflected to some extent at roosts as waders tend to roost at the nearest suitable site to their feeding grounds, and to fly to roosts and settle together in flocks. Mixing of groups of stints of differing average weights should be correlated with the amount of disturbance that occurs during high tide. The amount of disturbance of waders (both by twinklers and other threats) before a catch is something that cannon-netting teams can and should record systematically.

There is no obvious reason why the theory outlined above should only affect stints in the pre-migratory period. Indeed, it may help explain why there is so much scatter in average weights of stint catches taken at the same site at much the same time of year. How could theories about bunching be tested? Not for the first time in preparing this paper, we find ourselves regretting the absence of a capture log, maintained for each cannon-net catch, in which at least the following were recorded systematically: time and height of high tide, time of firing, amount of disturbance (both by twinklers and other potential predators), weather conditions and habitat in which the net was set. Moreover, a weight from an individual wader is much more useful to the analyst if time of weighing and at least one measurement is also recorded at the same time (Barter 1996); it would also be helpful to record who took weight readings and what balance they used. We do not think there is much point in weighing more Victorian Red-necked Stints unless these extra data are also recorded. If the extra data were to be recorded, we suspect that corrections could be made which would enable analysts to remove a lot of scatter from the data. It might then be possible to determine whether stints at different banding sites differ in weight, to develop more accurate estimates of departure mass of adults, to assess the importance or otherwise of bunching, to investigate the relationship between moult condition and weights and to describe the mid-winter mass-gain of immature stints in more detail.

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REFERENCES

Baker, G.B., E.B. Dettman, B.T. Scotney, L.J. Hardy & D.A.D. Drynan. 1995. Report on the Australian Bird and Bat Banding Scheme, 1984–1995. Australian Nature Conservation Agency, Canberra.

Barter, M. 1984. Weight variations of Red-necked Stint (*Calidris ruficollis*) whilst wintering in Tasmania. Occasional Stint 3, 69-80.

Barter, M. 1996. Ready! Steady! Go? A crucial decision for the long-distance migrant: a substantial challenge for the investigator. Stilt 28, 32-42.

Castro, G. & J.P. Myers 1989. Flight range estimates for shorebirds. Auk 106, 474-6.

Castro, G., Wunder, B.A., & F.L. Knopf 1991. Temperature-dependent loss of mass by shorebirds following capture. J. Field Ornithol. 62(3): 314-18.

Davidson, N.C. 1983. Formulae for estimating the lean weights and fat reserves of live shorebirds. Ringing & Migration 4, 159-66.

Davidson, N.C. 1984. How valid are flight range estimates for waders? Ringing and Migration 5, 49-64.

Davidson, N.C. & J.R. Wilson. 1992. The migration system of European-wintering Knots *Calidris canutus islandica*. Wader Study Group Bull. 64, Suppl.: 39-51.

Davidson, N.C., J.D. Uttley & P.R. Evans. 1986. Geographic variation in the lean mass of Dunlins wintering in Britain. Ardea 74, 191-8.

Elliott, C.C.H., M. Waltner, L.G. Underhill, J.S. Pringle & W.J.A. Dick. 1976. The migration system of the Curlew Sandpiper *Calidris ferruginea* in Africa. Ostrich 47, 191-213.

Ens, B.J., P. Duiven, C.J. Smit. & T.M. van Spanje. 1990. Spring migration of Turnstones from the Banc D'Arguin in Mauritania. Ardea 78, 301-314.

Higgins, P.J. & S.J.J.F. Davies (Eds). 1996. Handbook of Australasian, New Zealand and Antarctic Birds. Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.

Lee, D.M. 1984. Climate. Pp 26-31 in Duncan, J.S. (Ed.) Atlas of Victoria. Victorian Government; Melbourne.

Lindström, Ä. & T. Piersma (1993). Mass changes in migrating birds: the evidence of fat and protein storage re-examined. Ibis 135, 70-78.

Marchant, S. & P.J. Higgins (Co-ordinators) 1990. Handbook of Australasian, New Zealand and Antarctic Birds. Volume 1: Ratites to Ducks. Oxford University Press, Melbourne.

Melville, D.S. 1981. Spring measurements, weights and plumage states of *Calidris ruficollis* and *C. ferruginea* in Hong Kong. Wader Study Group Bulletin 33, 18-21.

Minton, C.D.T. 1996. The migration of the Red-necked Stint. Stilt 29: this issue.

OAG Munster. 1975. Zug, Mauser und biometrie der Bekassine (*Gallinago gallinago*) in den Rieselfeldern Munster. J. Orn. Lpz. 116, 455–487.

Paton, D.C. & B.J. Wykes. 1978. Re-appraisal of moult of Red-necked Stints in southern Australia. Emu 78, 54--60.

Pennycuick, C.J. 1975. Mechanics of Flight. Pp 1–75 in Avian Biology, vol. 5. (D.S. Farner & JR. King Eds). Academic Press, New York.

Peter, J.M. 1996. Intraspecific Conflicts between foraging Red-necked Stints. Stilt 28, 46.

Piersma, T. & J. Jukema. 1993. Red breasts as honest signals of migratory quality in a long-distance migrant, the Bar-tailed Godwit. Condor 95, 163-77.

Piersma, T., L. Zwarts & J.H. Bruggemann. 1990. Behavioural aspects of the departure of waders before long-distance flights: flocking, vocalisations, flight paths and diurnal timing. Ardea 78, 157-84.

Ricklefs, R.E. 1967. A graphical method of fitting equations to growth curves. Ecology 48, 978-83.

Rogers, D.I. & K.G. Rogers. 1995. Commentary: estimating sexes of honeyeaters from head-bill measurements. Corella 19, 12-17.

Rogers, K.G. 1995. SHEBA: Computer programs for sexing birds on measurements using univariate data. Corella 19, 25-34.

Summers, R.W. & M. Waltner 1978. Seasonal variations in the mass of waders in southern Africa with special reference to migration. Ostrich 50, 21-37.

Thomas, D.G. & A.J. Dartnall. 1970. Pre-migratory deposition of fat in the Red-necked Stint. Emu 70, 87.

Thomas, D.G. & A.J. Dartnall. 1971. Moult of the Red-necked Stint. Emu 71, 49-53.

Tulp, I., S. McChesney & P. de Goeij. 1994. Migratory departures of waders from North-western Australia: behaviour, timing and possible migration routes. Ardea 82, 201-21.

Verkuil, Y. 1996. Stomach-pumping of waders does not necessarily provide more information on diet than faecal analysis. Wader Study Group Bull. 79, 60-63.

Warnock, S.E. & J.Y. Takekawa. 1996. Wintering site fidelity and movement patterns of Western Sandpipers Calidris mauri in the San Francisco Bay estuary. Ibis 138, 160-67.

Zwarts, L. & T. Piersma. 1990. How important is the Banc d'Arguin, Mauritania, as a temporary staging area for waders in spring? Ardea 78, 113-21.

Zwarts, L., B.J. Ens, M. Kersten & T. Piersma. 1990. Moult, mass and flight range of waders ready to take off for long-distance migrations. Ardea 78, 339-64.

APPENDIX 1: SIMULATING THE PRE-MIGRATORY MASS-GAIN PERIOD

Calculating the departure masses of waders is a messy affair. Even at peak departure times, a wader catch will include an unknown proportion of waders at various stages of mass-gain, perhaps some birds that have yet to begin fattening up, and hopefully, an unknown proportion of birds that have reached departure mass and are ready to go. Working out what stages of mass-gain are included in captured samples is difficult, not least because those birds at the magic departure mass have an inconvenient tendency to depart, thus becoming unavailable for capture.

With all this confusion, it might help to know what the data from a perfectly-sampled population should look like. One way to work this out is to use a population for which the answers are already known. With the aid of a computer it is possible to invent such a population of hypothetical birds, "cyberstints", and to simulate how their weight might change over time, particularly over the mass gain period. We examined masses from three such simulated populations of stints; the simple rules used to perform the simulations are summarised below in Table A1.

The parameters given in Rules 1 to 3 are not wholly dissimilar to those estimated for live Red-necked Stints in this paper. Some assumption is necessary about how much weight is gained; two are looked at, one admittedly implausible. Choice of start day is arbitrary; no calendar significance is implied. Whether or not Red-necked Stints loiter at the non-breeding grounds after reaching departure weights is not known but we suspect that some loitering probably occurs so that stints can depart in the evening, in favourable weather conditions, together with other stints. The main reason for including rule 6 was that we wanted to sample some cyberstints at departure weights, before they migrated and left our imaginary population. We arbitrarily set the number of cyberstints in the population (before mass-gain began) at 10,000. Results are summarised for all birds present.

Typical results from simulation 1 are shown in Figure A, which shows the frequencies of weights from selected days of the simulated mass-gain period. From the graph we can see that: (1) The modes/means (the peaks of the different curves) increase through most of the mass-gain period; (2) The number of birds (represented by the area under each histogram) decreases towards the end of the period when the first cyberstints depart; (3) the standard deviation (the scatter around the mean) increases in the mass-gain period; (4) the skewness (i.e. the assymetricality) of each sample may increase during the mass-gain period but there is very little in it and every sample looks more-or-less normally distributed; (5) towards the end of the departure period, there is little change in the average weights. The number of cyberstints decreases quickly though, with the result that there is some scatter in the estimates of some parameters that are only precisely calculated with very large samples (e.g. coefficients of variation and skewness).

Figure B shows how the coefficients of variation (standard deviation expressed as percentage of the mean) change over time in the simulations. In simulation 1, coefficients of variation are stable before mass-gain begins, and rise to a peak when nearly all birds in various stages of mass-gain; they decrease as birds begin to reach departure mass. When all birds have reached departure mass, the coefficients of variation should in theory be the same as they were in catches made before any mass-gain began. However in our simulation the estimates of the final coefficients of variation are rather imprecise, as many cyberstints had departed; the variances were accordingly calculated from smaller samples, with, for example, fewer than 500 cyberstints in the last two data points. Simulation 2, where the weight gain is the same for all birds, shows a much more rapid and prolonged reduction in coefficient of variation, which eventually becomes smaller than it was before mass-gain began. Simulation 3, where there are two groups of birds present with different start dates, shows a bigger and more sustained increase in the coefficient of variation.

Table A1: Rules used in simulations.

RULES	Simulation 1	Simulation 2	Simulation 3
1. Starting mass (& S.D.)	30 (2)	30 (2)	30 (2)
2. Weight gain per day	0.25	0.25	0.25
3. Average departure weight	37.5	37.5	37.5
4. Weight gain assumption	Proportional to lean mass	Constant for all birds	Proportional to lean mass
5. Average start day (& S.D.)	10 (7)	10 (7)	10 (7) in 50% of birds 15 (7) in 50% of birds
6. Days loitering (& S.D.)	1 (0)	1 (0)	1 (0)

Figure C shows how the average weight changes over time. The curves for simulations 1 and 2 are necessarily identical because the "average" bird behaves the same in both these simulations. The general form of these curves, an S-shaped curve tapering to an asymptote as departure mass is attained, suggests that they could be described very neatly using one of three standard growth curve equations (Logit, Gompertz and Von Bertalanffy) which are frequently used to describe various biological growth processes (Ricklefs 1967). It would obviously be nice to apply a growth-curve equation to the pre-migratory mass-gain period of waders, as the curves would give precise descriptions of important parameters such as the departure mass, departure date and the starting date of mass-gain. The paper describes why this elegant approach is, sadly, inappropriate for our data set on real Red-necked Stints.

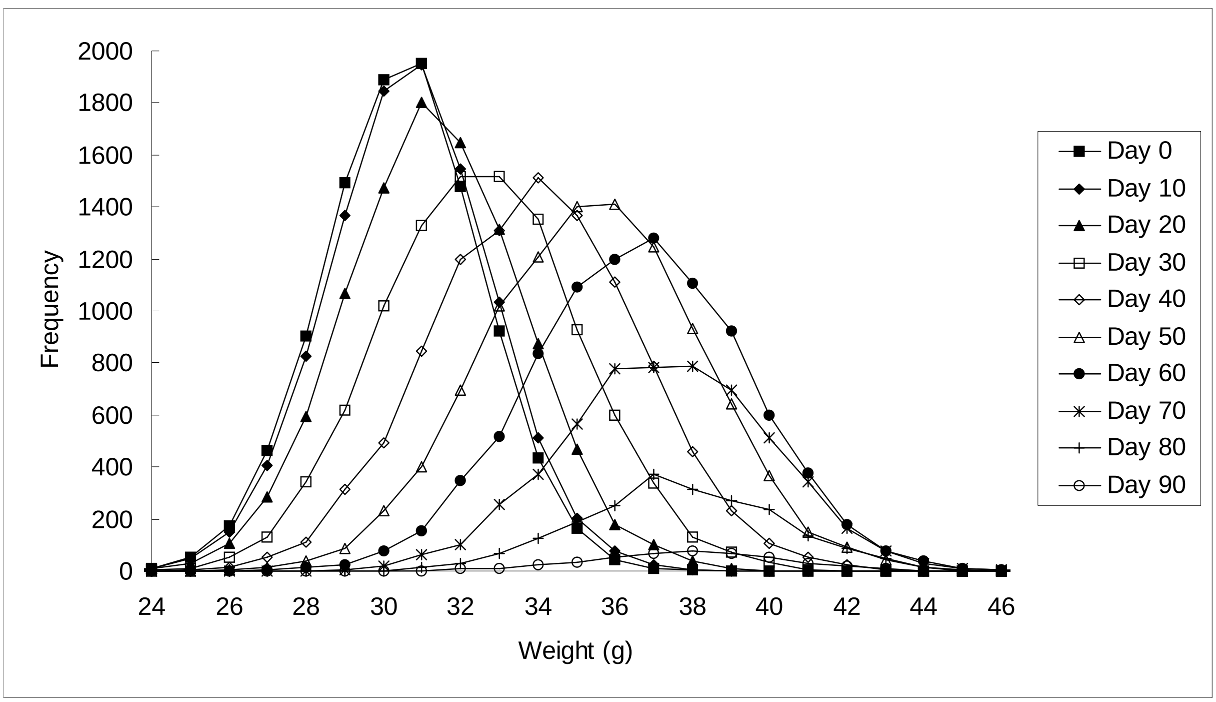

Figure A. The frequencies of weights from selected days of the simulated mass-gain period.

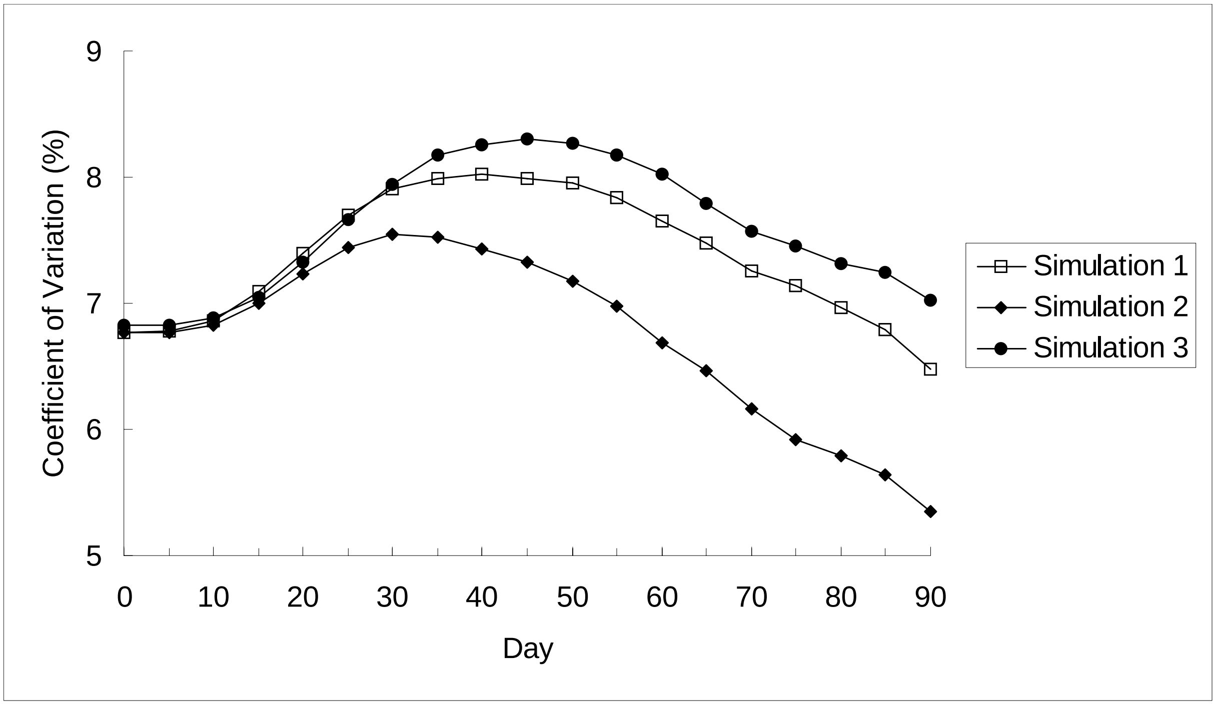

Figure B. Coefficients of variation (standard deviation expressed as percentage of the mean) change over time in the simulations.

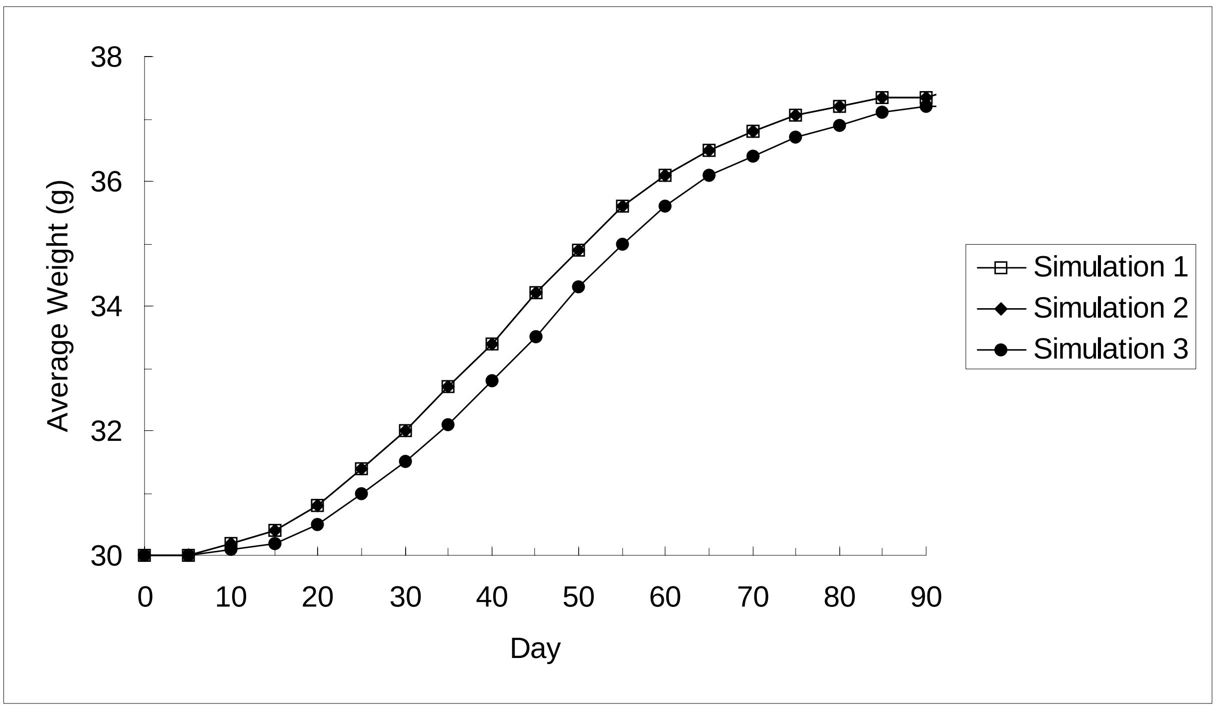

Figure C. Average weight changes over time.

THE MIGRATION OF THE RED-NECKED STINT *Calidris ruficollis*

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ABSTRACT
The paper analyses all available banding recoveries and colour leg-flag sightings of Red-necked Stints marked in the East Asian-Australasian Flyway up to mid-1996. Migration routes and stopover regions for birds on both northward and southward migrations are postulated. There appears to be some difference between the two routes, and also between the routes and ultimate breeding destinations of Red-necked Stints from the two sides of the Australian continent. For all populations key areas are the Chinese coast on northward migration and Japan on southward migration. No Red-necked Stint less than two years old has been reported migrating northwards from Australia, but there is evidence of some northward migration by one year old birds from the population which spends the non-breeding season in southern Asia. Band recovery reporting rates are low, but colour leg-flag sighting rates are much higher, emphasising the value of this supplementary marking technique. Suggestions are made concerning the most desirable areas for expanded marking and flag searching effort in the future.

INTRODUCTION

The Red-necked Stint *Calidris ruficollis* is the most numerous and widespread migrant wader in the East Asian-Australasian Flyway with an estimated population of 471,000 (Watkins 1993). Approximately 75% of the population spends the non-breeding season in Australia. Birds breed in Northern Siberia in June and July. Adults mainly reach Australia in September and do not depart until April. Passage through Asia is predominantly in April/May and August/September (Higgins & Davies 1996).

The Red-necked Stint is by far the most widely banded wader in Australia (Baker *et al*. 1995) and probably in the Flyway. Sufficient banding recoveries and sightings of colour leg flagged birds have now accrued for an initial analysis to be made. This is particularly relevant in the light of the recent Australian initiative, at the Ramsar Convention meeting in Brisbane in March 1996, for the designation of a network of shorebird reserves throughout the East Asian-Australasian Flyway (Ramsar 1996). Reports of marked birds help delineate migration routes and locations used for 'stopovers' during migration.

This analysis therefore concentrates on inter-country movements of Red-necked Stints within the Flyway. Movements within Australia will be analysed elsewhere. Weight changes associated with migration of Victorian Red-necked Stints are described elsewhere in this issue (Rogers *et al.* 1996).

METHODS AND RESULTS

All available recoveries showing movements of Red-necked Stints banded or colour marked anywhere in the Flyway were used in this analysis. Most data emanated from Australian marked birds, partly because the majority of banding has been carried out there but also because comprehensive information from some overseas sources has not yet become available.

The analysis of recoveries of birds individually identifiable by their numbered metal bands and reported through the Australian Bird and Bat Banding Scheme office (or their overseas counterparts) was conducted separately from the analysis of sightings of birds with generic colour leg flag codes, which indicate only the region (but not the date) of banding. This is because these two modes of recovery are potentially subject to different influences, which could affect the pattern of reports.

Banding

Available information on the number of Red-necked Stints banded in the various countries of the Flyway is given in Table 1.

In addition, small numbers (maximum low hundreds, but generally less than a hundred) are known to have been banded in Malaysia, Russia, the Philippines and Korea. It is probable also that the Taiwan figure is now much higher.

The Migratory Animal Pathology Survey (MAPS) programme was an extensive US funded Asia-wide banding programme which took place much earlier than most other wader banding in the Flyway. The majority of the Red-necked Stints banded in this programme were caught in the Philippines

The Australian banding of Red-necked Stints has been unevenly distributed across the continent, being concentrated in the south-east (Victoria and Tasmania)

Table 1. Banding totals of Red-necked Stints. Sources were Baker *et al.* (1995), Kashiwagi (1995), Chuang (1992), D.S. Melville (pers. comm.) and McClure (1974).

Country	Period	Total Banded
Australia	1953 - 95	69757
Japan	1961 - 94	3961
Taiwan	1986 - 89	866
Hong Kong	1975 - 94	212
MAPS	1962 - 71	15613

and north-west, as shown in the Table 2. The number of local retraps is included as a measure of the intensity of banding in each area and also, in part, as an indication of the level of turnover in each population due to through migration.

The figures for Australia overall are estimates based on information published by the Australian Scheme to mid 1995 (Baker *et al.* 1995), corrected for omissions and updated to mid-1996.

Leg-flagging

The use of a single coloured DARVIC plastic leg flag to indicate geographical area of banding commenced in Victoria in January 1990 and in NW Australia in August 1992. Japan has also experimented with leg-flagging since 1992 and progressively extended its use, with the main effort being 708 Red-necked Stints leg-flagged (blue) in Hokkaido to May 1996 (K.Ozaki pers. comm.).

Totals leg-flagged in Victoria and NW Australia so far are given in the Table 3.

There has been an unexpectedly high level of reports of leg-flagged birds sighted away from their banding location and this has generated much additional valuable data on migration routes and stopover sites. A comparison between banding recovery rates and flag-sighting report rates is given later.

Recoveries

This analysis is mainly concerned with the migrations of Red-necked Stints once they leave Australian shores and with other inter-country movements.

So far there have been 44 overseas recoveries of Red-necked Stints banded in Australia. In addition there have been seven Red-necked Stints captured in Australia which had been banded overseas (controls). Details of these are given in the Table 4.

The region of Australia in which these birds were banded or controlled largely reflects the level of banding effort. Details are given Table 5.

Apart from the controls in Australia, included above, there have been few recoveries of Red-necked Stints banded in other countries. The only ones which have been located are Russian birds in Japan and China, a Japanese bird in China and a Taiwan bird to the Philippines (P. Tomkovich pers. comm., Chuang 1992, Mundkur 1993, Kashiwagi 1995) and these are detailed below. The extensive MAPS banding efforts do not seem to have produced any between-country recoveries (McClure 1974).

In addition to the above, two Russian banded birds were recovered after moving some distance within Russia. Banded as chicks at Uelen (see Table 6) in late June and early July 1979, they were recovered on the east side of the Kamchatka Peninsula in the third week of August, some 1500 and 1900 km south-west (P. Tomkovich, pers. comm.).

Flag sightings

There have been 84 overseas reports of Red-necked Stints leg-flagged in Victoria, and 14 for birds from north west Australia, up to 30/6/96. Details are given in Table 7.

Every sighting of a flagged bird has been included in the totals in Table 7. This means that at well-watched locations (eg. Hong Kong) a bird which stays for a number of days may be counted a number of times. Similarly an extended stay by a flagged bird (eg. in New Zealand) may result in multiple reports of the same bird, over a period of months or even in succeeding years. Thus the above table over-estimates the number of individual birds which have occurred at some locations.

Table 2. Capture locations of Red-necked Stints in Australia

Principal locations	Period	Banded	Retrapped	Total caught
Victoria	1975 to 30/6/96*	56567	16820 (30%)	73387
NW Australia	1981 to 30/6/96*	7415	787 (11%)	8202
Tasmania	1979 to 30/6/96**	4569	2205 (48%)	6774
Australian Total (estimated)	1953 to 30/6/96	c.75,000	c.20,000	c.95,000

* Minton 1996, Minton *et al*. 1996

** mostly November 1979 to December 1986 (A. Fletcher, pers. comm.)

Table 3. Leg flag totals for Red-necked Stint. Sources were Minton (1996) and Minton *et al.* (1996).

Country/region	Flag colour	Period	Total birds
Australia-Victoria	Orange	Jan 1990-30/6/96	10439
NW Australia	Yellow	August 1992-30/6/96	2876

Table 4. Overseas recoveries of banded Red-necked Stints in relation to Australia. Source data are from the Australian Bird and Bat Banding Scheme database as at 30 June 1996 (E.B. Dettman, pers. comm.)

Country of recovery or origin	Overseas recoveries of Australian birds	Controls in Australia of birds banded overseas
China	17	-
Russia	12	2
Vietnam	5	-
Indonesia	4	-
Japan	2	2
Taiwan	1	1
Hong Kong	1	2
Thailand	1	-
Malaysia	1	-
Totals	44	7

Table 7. Overseas sightings of Red-necked Stints leg-flagged in Australia.

	Flagged in Victoria	Flagged in NW Australia
Hong Kong	35	8
Japan	13	5
New Zealand	13	-
Russia	11	1
Taiwan	5	-
Vietnam	2	-
Brunei	2	-
Thailand	2	-
Indonesia	1	-
Totals	84	14

Table 5. Region of Australia where Red-necked Stints which have moved overseas were banded/controlled

Region	Number banded or controlled
Victoria	26
West Australia	12(north west 7, Perth 5)
Tasmania	7
NSW	3
South Australia	3
Total	51

Table 6. Red-necked Stint recoveries in the East Asian-Australasian Flyway which do not involve Australia. For each bird, the first line refers to the banding details and the second line to recovery information.

Band no	Date	Age/status	Location	Coordinates
Moskwa	11.6.80	pullus	Uelen, Chukotka Peninsula, Russia	66°09'N 178°56'W
S-925602	0.5.84	killed (hunter)	Shanghai, China	30°25'N 121°51'E
Moskwa	25.5.90	adult	Zapadnaja, Kamchatka, Russia	55°50'N 156° 02'E
XA4-42946	23.5.93	recaptured	Komuke, Hokkaido, Japan	44°16'N 143°29'E
Japan	29.8.91	juvenile	Nemuro, Hokkaido, Japan	43°17'N 145°26'E
2D-77082	28.4.92	killed (hunter)	Shanghai, China	30°25'N 121°51'E
Taiwan	15.10.88	?	Szu-tsao, Taiwan	22°58'N 120°10'E
A 00675	0.12.89	?	Polangui Albay, Philippines	?

Four Red-necked Stints colour leg-flagged (blue) in Hokkaido, northern Japan, have been reported in Australia. Three were in October/November, but at widely separate locations: Broome (Western Australia), Darwin (Northern Territory) and Brisbane (Queensland). The fourth was seen in late April near Mackay on the central Queensland coast. A juvenile Red-necked Stint leg-flagged in Hokkaido in late August/early September 1994 was reported in Taiwan on 6 November of the same year.

Recovery and flag sighting rates

The overseas recovery rate of Red-necked Stints banded in Australia up to the present time is 0.06% (44 recoveries from *c.*75,000 birds banded) ie. 1 overseas recovery for every 1700 birds banded. This rate will increase somewhat in the future as many banded birds are still alive (retraps of birds up to 17 years old have been made). However the ultimate rate is likely to be below 0.1%, indicating the large amount of banding effort required to generate migration route information.

It is interesting that the 'overseas' recovery rate of Little Stints *Calidris minutus* banded in southern Africa is of a similar magnitude to that of Red-necked Stints banded in Australia. The rate was 0.07% (11 long distance recoveries from 16,704 birds banded) ie. 1 inter-country recovery for every 1500 birds banded (L. Underhill pers. comm.).

Overseas recovery rates for waders banded in western Europe are typically an order of magnitude higher. For instance the Wash Wader Ringing Group (the largest British Wader banding group) has experienced a 0.65% recovery rate on 111,988 Dunlin *Calidris alpina* banded up to the end of 1994 (Evans 1995). There are several factors which can account for this difference in recovery rates. In Europe:

(a) there are much shorter distances to travel to other countries.
(b) there is a more literate, aware population and a largely uniform script.
(c) areas frequented by waders are generally more accessible.
(d) there is an extensive network of banders.

For Canada recovery reporting rates were more akin to Europe than Australia or southern Africa. The rate for Semi-palmated Sandpipers *Calidris pusilla* was 0.36% (109 banding recoveries from *c*.30,000 birds banded). The sighting report rate for yellow colour-dyed birds away from their James Bay marking site was a massive 6.1% - interestingly around 17 times higher than the band recovery rate (Morrison & Gratto 1979, Morrison 1984, see below).

The overseas sighting report rate for Red-necked Stints colour leg-flagged in Australia is significantly higher than the banding recovery rate. Eighty four overseas sightings from 10,439 birds flagged in Victoria corresponds to a rate of 0.8% - 13 times the national banding recovery rate. For north west Australia the overseas sighting rate is 0.5% - 8 times the national banding recovery rate. On a directly comparable basis (recoveries and flag sightings of Victorian banded birds only) the ratio of flag sighting rate to recovery reporting rate for birds marked and reported in the period 1990-95 was 17 (Minton *et al*. 1996).

The introduction of colour leg flagging programmes has thus greatly enhanced the rate of data generation on migration routes and stop over sites. The lack of a specific banding date and location is almost immaterial in this regard given that so far most of the birds have been marked in Australia in the extensive non-breeding season and at the terminus of their migration. Furthermore the regions identified by the different colour codes are small in relation to the total migratory pathway.

ANALYSIS OF RECOVERIES AND FLAG SIGHTINGS

The overseas location of all recoveries of Red-necked Stints banded in Australia is plotted in Figure 1 together with the origin of overseas banded birds subsequently controlled in Australia. Records relating to birds from the south-eastern part of Australia (Victoria, Tasmania, New South Wales and South Australia) are grouped together and are shown separately from those of birds from Western Australia (north western Australia and the Perth area). Fortunately the latter are not significantly contaminated with birds on passage through north west Australia from non-breeding grounds in south-eastern Australia. All except one of the overseas recoveries emanating from north west Australia relate to birds which, on the basis of date and/or active primary moult, can be ascribed to the population which spends the non-breeding season there.

Of the 51 Australian recoveries and controls, 25 relate to birds on northward migration through Asia, seven have occurred in the breeding season, 14 correspond to the period of southward migration, 1 was in December and four were at unknown dates.

On northward migration all but one of the recoveries of birds from south-eastern Australia were along the Vietnam and Chinese coasts (including Hong Kong). Recovery dates in the southern part of this area tended to be earlier than in the northern part (see later).

A feature of the recovery pattern is the paucity of records (only one) from the islands of southern Asia: Indonesia, Papua New Guinea, Borneo and the Philippines. Overall the recoveries suggest a staged migration with the birds initially stopping off in Vietnam/southern China, after leaving northern Australia, and then migrating up the Chinese coast to northern China.

There are only two recoveries of Red-necked Stints from Western Australia on northward migration, but it may be significant that one of these was on Sakhalin Island, off the eastern Siberian coast - much further to the north-east than any bird from south-eastern Australia.

The possibility of different preferred breeding areas for Red-necked Stints from opposite sides of the Australian continent has some further support from the breeding season recoveries, even though these are limited. Two birds from south-eastern Australia have been recovered on, or close to, the western part of the Red-necked Stint's discontinuous breeding range whilst a bird controlled in Perth had been banded in the most easterly breeding area. Furthermore two additional birds, from Victoria, were recovered in central Siberia apparently on a direct overland route from the northern Chinese coast to the western part of the breeding range. The recovery near Shanghai, in April, of a bird banded as a chick in the north-eastern part of the breeding range further suggests that the two breeding groups share a common staging area on the central Chinese coast on northward migration.

The recovery pattern on southward migration is markedly different from the northward route for birds from south-eastern Australia. Eight of the 11 recoveries are in central or south-eastern Siberia (5) or Japan (3). There are no recoveries in China (but one in Taiwan). There was also a recovery on the north coast of Indonesia. Not surprisingly the more northern recoveries were mainly in late July and August, with the more southerly ones in late August and September. However one of the recoveries near Vladivostok in south-east Siberia could have been as late as October (reported Sept/Oct), though it is possible

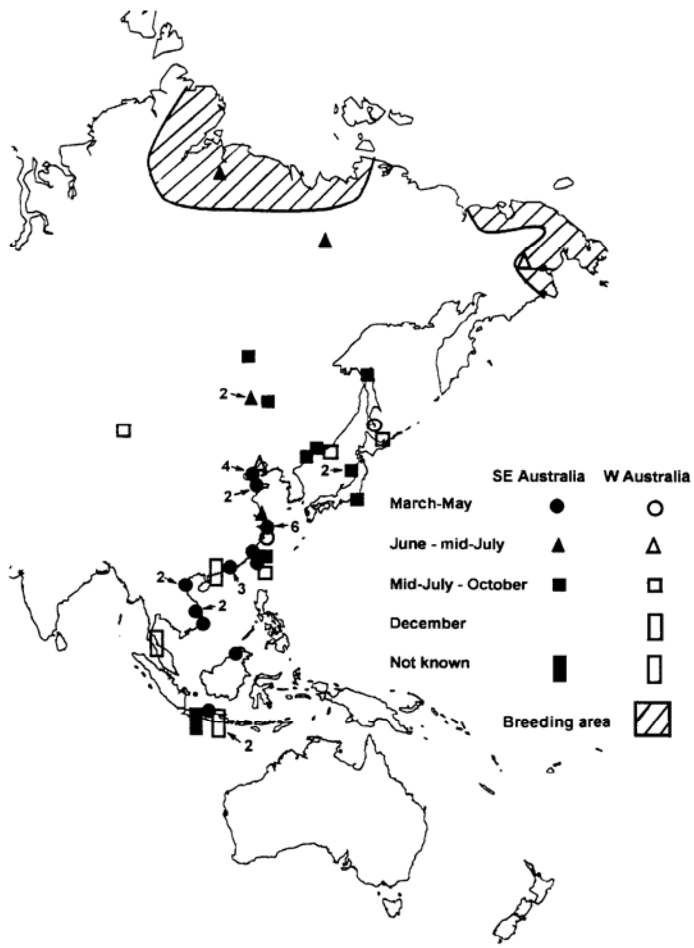

Figure 1. The location of Australian recoveries and controls of Red-necked Stints. Season of recovery, or original banding in the case of birds later controlled in Australia, is also indicated. March to May covers the period of northward migration; June to mid-July is when most birds should be on or close to their breeding areas; and mid-July to October covers the period of southward migration.

there was an error in the reporting date.

The overall pattern suggests that birds from south-eastern Australia take a more easterly migration route on southward migration than the route followed on northward migration. The south-east coasts of Siberia and Japan seem to be key staging areas. This tallies well with Japanese count data which shows Red-necked Stints to be much more numerous on southward migration than on northward migration (Shigeta 1995). There is little information on the route taken thereafter, but there is a suggestion that stopovers in the south-east Asian islands, such as Indonesia, may be more frequent than during the northward migration.

There is insufficient information on the southward migration of birds from Western Australia to indicate whether there are any differences from the northward migration or from birds from south-eastern Australia. There is however one record of a juvenile banded well to the west in central Siberia (at 51°N 95'E) in early September which was recaptured at Broome in north west Australia the following April.

There is one further unusual record of a west Australian bird which was apparently recovered on 22 December at Guandong (22°N 111'E) in southern China. This report, which was initially received via Radio Australia, was subsequently followed up by the Australian Banding Office and the date appears to be genuine. If this is the case then this individual had taken the unusual step of markedly changing its non-breeding area between years. Small numbers of Red-necked Stints are reported to spend the non-breeding season as far north as southern China (and even southern Japan).

There is further banding evidence of some Red-necked Stints spending the non-breeding season at locations in Asia. The Red-necked Stint which moved from Taiwan (banded late October) to the Philippines was recovered in December. As this was over a year after banding the bird was certainly an adult at the time of recovery and therefore could not have been a late lingering juvenile still on southward migration. More interesting still was a bird banded as a juvenile, in late August in northern Japan, which was recovered near Shanghai in China at the end of April the following year. As this bird was then less than a year old it is unlikely that it had travelled as far south as Australia (see later).

Figure 2 shows the overseas sighting locations of Red-necked Stints colour-flagged in Victoria and north west Australia, again distinguished from each other and by season.

Of the 98 overseas flag sightings 60 were of birds on northward migration, 11 were in the breeding season and only 14 were on southward migration. A further 13 records relate to birds which had moved on from Australia to New Zealand for the non-breeding season.

The pattern of reports of flagged birds in general follows the recovery pattern of banded birds, though with one marked difference (China). It also tends to support the migration routes and stopover regions postulated in the recoveries analysis.

There are no sightings of flagged Red-necked Stints on the mainland Chinese coast on northward migration (or, for that matter, southward migration) whereas it is the main location of banding recoveries. This must be a function of the lack of observers as there are 42 sightings from the well-watched Mai-Po Marshes in Hong Kong and even five sightings in Taiwan. There are also sightings from further south, in Vietnam, Brunei and Thailand. There seems to be an equal tendency for Red-necked Stints from south-east Australia and north-west Australia to pass through Hong Kong with flag reporting rates being similar (0.32% and 0.28% respectively).

A further indication that there may be a greater tendency for west Australian Red-necked Stints to migrate to the most easterly breeding grounds and the south-eastern Australia birds to go to the western breeding grounds, is that four out of the six sightings in Japan in April/May were from north west Australia. Furthermore ten of the 11 sightings, all in early June 1996, at the Daursky Nature Reserve in southern Siberia were of Victorian flagged birds apparently heading for the western breeding areas.

Whilst there may be some tendency for different preferred breeding areas for birds from the two sides of the Australian continent there is probably not a clear cut division. Two sightings (referring to one bird) on north Sakhalin in late May, of a bird from Victoria, could relate to a bird heading for either part of the breeding area, though the eastern part is the more likely target destination will be analysed separately.

Twelve of the 14 flagged birds seen on southward migration were reported from Japan. This supports the earlier contention of a more easterly migration route of birds on southward migration. Birds from both sides of the Australian continent were involved. Furthermore the four Australian sightings of Red-necked Stints flagged on migration in Japan were also spread right across the northern half of the continent, again indicating that Japan is a key stopover region for Red-necked Stints from all over Australia during southward migration.

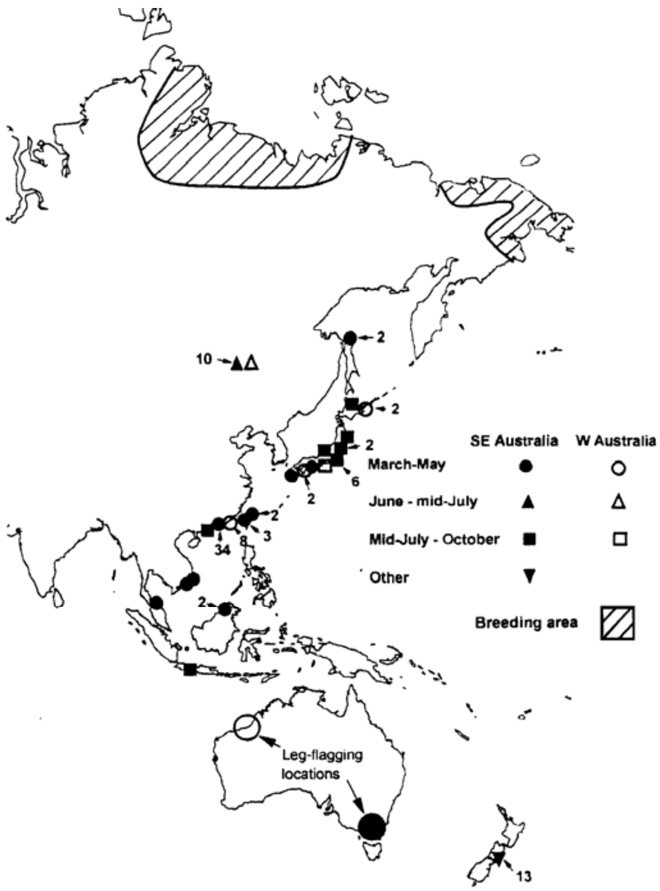

Figure 2. The location of sightings of Australian leg-flagged Red-necked Stints. Season sighting is also indicated. March to May covers the period of northward migration; June to mid-July is when most birds should be on or close to their breeding areas; and mid-July to October covers the period of southward migration.

With only one sighting in Hong Kong it does appear that the Chinese coast is used very much less as a stopover region for Red-necked Stints on southward migration than on northward migration. It would not be possible for a small wader such as the Red-necked Stint to make an 8000 km flight from Japan to the northern Australia coast. Stopover sites between Japan and the northern Australia coast on southward migration thus remain a mystery at the moment. It is probable that many birds are using the southern Asia island countries, from the Philippines to Indonesia, as refuelling sites but that lack of bird banders, bird watchers, or a human population likely to read and report details of a band inscribed in English, is causing the lack of reports.

The New Zealand records were all at Lake Ellesmere, near Christchurch, and are known to relate to at least two individuals, with the reports spread over a five year period. The sightings occurred between October and February, with one sighting (possibly a first year bird) in April. Red-necked Stints are not numerous in New Zealand but clearly some of those which do reach there pass through Victoria on migration.

Timing

More specific information on the timing of migration and in particular on the rate of movement of the population through the Flyway can be gained from an examination of banding recovery and flag reporting dates. Only the recoveries where specific finding dates are recorded were used in this part of the analysis.

Northward Migration

For birds from south-eastern Australia on northward migration the median recovery and flag sighting dates are given in Table 8.

Four banding recoveries were reported in March - two in Vietnam, one in south China and one near Shanghai - but as no specific dates were given for three of the records, there must be some doubt of their veracity. However the one on the south Chinese coast (at 26°N) and two leg-flag sightings in Taiwan on 31 March appear to be correct and indicate that a few individuals may already be quite far north before the end of March. There is clearly a wide span for the timing of the Red-necked

Stint northward migration, typified by the 13 April to 22 May range of the 34 sightings of south-eastern Australian Red-necked Stints in Hong Kong. It is notable that the bird which was caught in Hong Kong on the late date of 23 May was a second year bird, on its first northward migration. In many species of wader there is a tendency for older birds to migrate first, ahead of the younger birds, especially those migrating back to the breeding grounds for the first time(cf. Barter & Minton 1987).

There are fewer records from Western Australia and these are detailed in Table 9..

It would appear that birds from north-west Australia may reach the Hong Kong area on average a week or more ahead of birds from south-eastern Australia. At other locations there are insufficient records yet to make further comparisons.

Breeding season

The timing of birds reaching the breeding grounds would appear to be quite variable. A banded bird was reported at 72°N - near the north-western part of the breeding grounds - as early as 1 June. Another was at 63°N, just to the south of the breeding grounds, on 14 June. In contrast there were eleven leg-flag sightings and two recoveries in southern Siberia at only 50°N between 5 and 12 June. These were however all in 1996 when there was a very late spring in most of Siberia (P. Tomkovich, pers. comm).

The breeding grounds are probably normally reached in the first two weeks of June. The bird banded on the Chukotka Peninsula in the north-eastern part of the breeding range was actually caught at the nest on 17 June.

Two banding recoveries in China, of birds from Australia, in June (one on 15 June and one undated) could relate to stragglers still on northward migration. However they might also be incorrectly reported dates.

Southward migration

For the analysis of southward migration dates records relating to the whole of Australia have been considered together because there are too few for more detailed analysis (Table 10).

As with northward migration there is a wide spread of dates for passage through each area. The median dates are probably a good estimate only for Japan, but even there actual dates ranged from 26 July (northern Japan) to 19 September. Two of the southern Siberian dates were in late July but others extended to 10 September (with one possibly later - reported as September/October). The 24 October date for the recovery in Indonesia was getting rather late for an adult still to be returning to south-eastern Australia.

There is little banding evidence on the timing of the first

Table 8. Median recovery and flag sighting dates for south-east Australian birds on northward migration. Sample sizes are given in brackets. * a late (27 May) record in southern Thailand was excluded.

Area of Recovery/Sighting	Median Recovery Date	Median Flag Sighting Date
Vietnam, Sabah, Brunei, Thailand	25 April (4)	1 May (4) *
Hong Kong, southern China coast	12 May (4)	1 May (34)
Taiwan, central China coast, (Shanghai)	12 May (5)	17 May (5)
Northern Chinese coast	16 May (2)	--
Japan (south)	--	12 May (2)
Russia (Sakhalin)	--	23 May (2)

Table 9. Median recovery and flag sighting dates for Western Australian birds on northward migration.

Area of Recovery/Sighting	Median Recovery Date	Median Flag Sighting Date
Hong Kong	--	23 April (8)
Shanghai	17 April (1)	--
Japan (south)	--	13 May (2)
Japan (north)	--	27 May (2)
Russia (Sakhalin)	25 May (2)	--

Table 10. Median recovery and flag sighting dates for Australian birds on southward migration.

Area of Recovery/Sighting	Median Recovery Date	Median Flag Sighting Date
Southern Siberia	3 Sept. (6)	--
Japan	20 Aug (4)	19 Aug. (2)
Taiwan/Hong Kong	26 Aug. (2)	30 Aug. (1)
Indonesia	24 Oct. (1)	27 Aug. (1)

southward migration of juveniles. However two birds banded as chicks in the north-eastern breeding area had travelled as far as the east side of the Kamchatka Peninsula by the third week of August. They were thus nicely placed one step away from northern Japan where the peak juvenile passage is in late August/early September (Y. Shigeta, pers. comm.).

Age of first northward migration

No Red-necked Stint banded in Australia has been recovered overseas until it was almost two years old. This suggests that Red-necked Stints do not migrate northwards to breed until they are aged two. It also indicates that any shorter movements of birds in their first year, once they have reached their ultimate destination, in Australia, at the end of their initial juvenile migration, are limited.

Deferment of first breeding until the age of (at least) two is the norm for many of the species of migratory wader in Australia (AWSG/VWSG data). In the case of the Red-necked Stint no one year old birds show any sign of significant weight gains at the time that older birds are laying down premigratory fat deposits, in March and April. Most first year birds also remain in non-breeding plumage, although a few eventually gain a smattering of breeding plumage. Most non-breeding flocks in the May to July period in Australia are composed entirely of Red-necked Stints which can be positively identified as first year birds. It thus seems that a return to the breeding grounds at age two is the norm for almost all Red-necked Stints which visit Australia.

A consequence of the above is that all recoveries relating to Australia in this analysis refer to birds which were adults at the time of being reported outside Australia. Furthermore all except one of the birds subsequently controlled in Australia were banded as adults. Thus migration timings and routes refer only to adult birds. The exception was the Red-necked Stint banded as a juvenile on 7 September in southern central Siberia (51°N 95°E), well to the west of all other banded or flagged birds. The southward migration of juveniles is often more dispersed and takes place later than that of adults in most species of wader.

There is some evidence that a few of the Red-necked Stints which spend the non-breeding season in southern Asia (as opposed to Australia) may undertake significant northward migration when only a year old. The Japanese banded bird subsequently recovered at Shanghai, already mentioned, is one example of this. Also a small number of first year birds, identified by plumage and/or by existing bands, have been captured during the period of northward migration in late April/early May in the Obitsu Estuary, central Japan (Y. Shigeta, pers. comm.). In the light of current knowledge it is also clear that three out of 140 Red-necked Stints caught in Hong-Kong in April and May in the period 1977-80 were also first year birds. It is not clear whether such precocious birds proceed all the way to the breeding grounds and if they do, whether they actually breed. It is well established that there is a greater tendency for migrant waders which spend the non-breeding season in the northern hemisphere to migrate (and breed) when only one year old. Presumably the extra migratory distance to be covered by waders spending the non-breeding season in the southern hemisphere is an inhibiting factor.

Mode of recovery and potential biases.

The pattern of banding recoveries and leg-flag sightings is subject to a number of factors which will influence the quality of information generated on the migration of Red-necked Stints through different parts of the Flyway. These potential biases in the data need to be taken into account in drawing conclusions on migration routes and stopover regions.

Most bias factors centre on the varied activities of humans. Of the 44 banding recoveries, 38 were of birds killed deliberately by humans. Most were reported by hunters or were of bands obtained from hunters. This was especially true for recoveries in China, but also occurred in Indonesia, Russia and Vietnam. Scientists also killed, for museum purposes, a number of the birds reported from Russia. In contrast none of the birds reported in Japan was killed.

Live recaptures of birds by other banders (5) was the other main source of banding recoveries, and of course all seven controls were similarly live recaptures by banders. These therefore were inevitably confined to countries in the Flyway with significant wader banding activities (Japan, Hong Kong and Taiwan).

The remaining recovery was of a banded bird found dead and reported by a member of the public at a saltpan in China. This is a remarkably small proportion of birds reported in this manner but reflects the different languages, scripts and literacy levels in the countries throughout the Flyway. The vast, largely unpopulated area of Siberia in which the birds breed and carry out parts of their migration is not conducive to the finding and reporting of banded birds either.

The pattern of leg-flag sightings is probably even more influenced by human activities - especially the distribution of ornithologists and others interested in wildlife. It is not surprising therefore that 74 of the 98 flag sightings came from Hong Kong, Japan and New Zealand. Eleven of the Russian sightings came from one scientist who was particularly looking out for flagged birds. They were all seen in an eight day period in early June 1996 and were considered to relate to eleven different birds.

Even though the pattern of banding recoveries and flag sighting reports is undoubtedly subject to significant biases it is considered that these are affecting the relative quantities of records in the different areas. It is likely that the pattern still qualitatively reflects migration routes and migratory stopover regions.

The quality of the migratory information generated by banding and flagging studies could be improved by having more locations throughout the Flyway where banding and flagging, and the opportunity for more live controls, takes place. Also systematic searching for flagged birds in more parts of the Flyway would be beneficial.

Summary of Red-necked Stint migrational strategy

Based on the currently available banding recovery and leg-flag sighting data available in the Flyway a tentative outline of the main migration routes and stopover regions for the Red-necked Stint has been drawn up (Figures 3 and 4).

This shows that if birds carry out the whole of their migration in 2 - 4000 km 'hops' - as they do when crossing the continent of Australia and when leaving the north of Australia on northward migration - then the 10-13,000 km journey to and from the breeding grounds is likely to be accomplished in five stages.

Whilst there is good weight gain data (typically up to 60% addition of mass to the lean body weight) indicating that such a strategy is used at the southern end of the migration route (Barter 1984, Rogers *et al*. 1996, AWSG unpublished data) more weight gain/stopover period data are needed from other locations in the Flyway to indicate whether this long-hop migrational strategy is adopted throughout the journey. (Melville 1981) showed that many Red-necked Stints stopping off on migration in Hong Kong in April/May were exhibiting significantly elevated weights (up to 42g). But it is possible that some northward migration along the Chinese coast, or across the Siberia, is carried out in smaller steps especially in those areas where there is a more continuous string of habitats suitable for Red-necked Stints.

The typical migration of a Red-necked Stint from south-east Australia could be summarised as follows:

(a) Leave south-east Australia in late March to mid April for the north coast of Australia.
(b) Leave the north coast of Australia in mid to late April for Vietnam, northern Borneo or southern China.
(c) Move up the Chinese coast to the northern Chinese coast during May.
(d) Depart from the northern Chinese coast in the second half of May across inland Siberia towards the western parts of the breeding grounds.
(e) After a further stopover in central Siberia in late May or early June reach the breeding grounds in northern Siberia by the end of the second week in June.
(f) After breeding in June and July adult birds would commence their return migration from the breeding grounds from mid-July.
(g) Birds would head in the direction of the south-east Siberian coast and Japan where major migratory stopovers are made in late July and August.
(h) After a probable further stopover in the Taiwan/Philippines/Indonesia region during August/early September, birds reach the north coast of Australia from late August, but mainly in September.
(i) After a final refuelling operation in northern Australia birds cross the continent to south-east Australia during September and early October.

A similar pattern and timing of birds between the west Australia non-breeding areas and the north-east Siberian breeding areas is likely. The outline in Figures 3 & 4 is rather more speculative because of the smaller amount of data. There is no direct evidence from Australian banding of a migratory stopover on the Kamchatka Peninsula in Eastern Siberia on northward migration. However there is good count data which indicates that large numbers of Red-necked Stints call in at the Moruscheva Estuary there in late May/early June (Y.N. Gerasimov pers. comm.). There is also the recovery in northern Japan, on a subsequent northward migration, of a Red-necked Stint banded on the Kamchatka Peninsula during the last week of May (Kashiwagi 1995).

Conclusions and recommendations

Present data available from banding has enabled a broad outline of migration routes and key stopover regions to be delineated for the Red-necked Stint on its migration in the East Asian-Australasian Flyway between the breeding grounds in northern Siberia and the principal non-breeding areas in Australia.

Much more banding, and associated colour leg-flagging, needs to be carried out before a full picture will emerge. The rate of data generation would be enhanced, and potential biases lessened, if extensive banding and flagging were carried out in more countries, especially in China, Korea, Indonesia and, of course, Siberia. Systematic searches for leg-flagged birds would also be valuable, particularly in areas where least information is currently available e.g. Indonesia, Philippines, Malaysia,

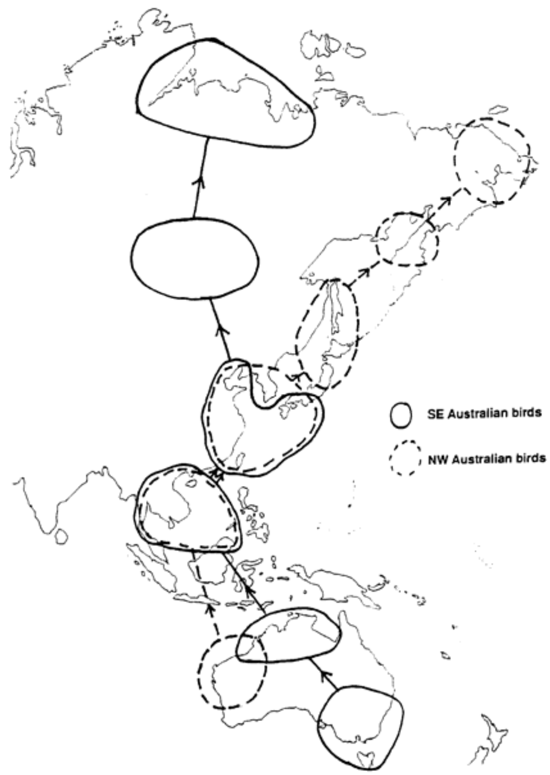

Figure 3. Principal migration routes and stopover regions of Red-necked Stints on northward migration.

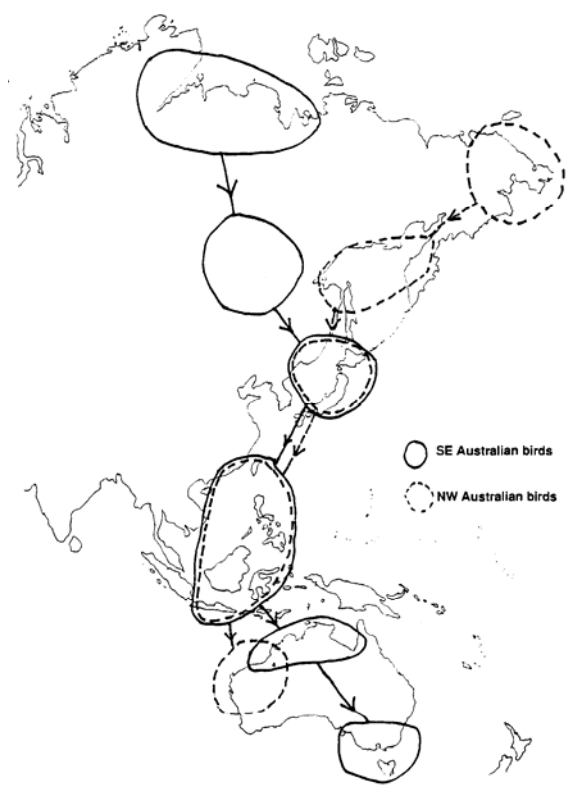

Figure 4. Tentative migration routes and stopover regions of Red-necked Stints on southward migration.

Papua New Guinea, Korea and eastern Siberia. Banding, and the collection of weight and weight gain data, would be especially useful in further delineating migrational strategy particularly in the central parts of the Flyway along the Chinese coast on northward migration and in south-eastern Siberia and Japan on southward migration.

Molecular studies might also reveal genetic differences between birds from different parts of the Flyway and thus could be beneficial in distinguishing populations and related migration routes.

ACKNOWLEDGMENTS

The greatest contribution to this study has been the huge amount of fieldwork put in by a large number of banders throughout Australia and elsewhere in the Flyway in order to get sufficient Red-necked Stints banded and leg-flagged to generate a volume of data worthy of analysis. Of particular note are the major banding contributions from the Victorian Wader Study Group, the AWSG North-West Australia Wader Expeditions, and the Tasmanian Wader Study Group.

Special thanks are also due to those who have gone out of their way to look for, and report, colour banded birds, especially observers in Hong Kong and Japan, and those who have coordinated the documentation of the sightings.

The Australian Bird and Bat Banding Scheme is thanked for its strong support, in a wide variety of ways and over a prolonged period. David Melville kindly made available all data on birds banded in Hong Kong and Pavel Tomkovich generously furnished details of recoveries of birds he had banded on the breeding grounds in NE Siberia. The Japanese Banding Office assisted with banding, flagging and recovery information provided directly and via Minoru Kashiwagi. Alan Fletcher is thanked for providing Tasmanian banding totals. Professor Les Underhill generously supplied band recovery rate information from southern Africa and Guy Morrison provided similar information from Canada.

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REFERENCES

Baker, G.B., E.B. Dettman, B.J. Scotney, L.J. Hardy & D.A.D.Drynan 1995. Report on the Australian Bird and Bat Banding Scheme, 1984-95. Australian Nature Conservation Agency, Canberra.

Barter, M.A. 1984. Weight variations of Red-necked Stint whilst wintering in Tasmania. Occasional Stint 3, 69-80.

Barter, M.A., & C.D.T. Minton 1987. Biometrics, moult and migration of Double-banded Plovers spending the non-breeding season in Victoria. Stilt 10, 9-14.

Chuang, Yuan-Hong 1992. Summary of 1989/90 Banding Results in Taiwan. Stilt 20, 4-47.

Evans, J. 1995. Wash Wader Ringing Group Biennial Report, 1993-94.

Kashiwagi, M.1995. Shorebird Banding in Japan (Tables). Report: The East Asia Migratory Bird Route Tour '95. WWF-Japan and FoE Shikoku.

Higgins, P.J. & S.J.J.F. Davies. (Eds) 1996. Handbook of Australian, New Zealand and Antarctic Birds. Vol. 3. Oxford University Press, Melbourne.

McClure, H.E. 1974. Migration and Survival of the Birds of Asia. Applied Scientific Research Corporation of Thailand, Bangkok.

Melville, D.S. 1981. Spring measurements, weights and plumage states of *Calidris ruficollis* and *C. ferruginea* in Hong Kong. Wader Study Group Bulletin 33, 18-21.

Minton, C.D.T. 1996. Analysis of overseas movements of Red-necked Stints and Curlew Sandpipers. VWSG Bul., 20: 39-43.

Minton, C.D.T., H.P. Sitters & R.E. Jessop 1996. Report on 1996 NW Australia Wader Study Expedition, 2nd March - 20th April 1996. Stilt in press.

Morrison, R.I.G. 1984. Migration Systems of some New World shorebirds. pp. 125-202 in Shorebirds: Migration and Foraging Behaviour, Behaviour of Marine animals, Vol. 6 (Burger, J. and Olla, B.L. eds) Plenum Press, New York and London.

Morrison, R.I.G. & C.L. Gratto 1979. Canadian Wildlife Service Shorebird Colour-Marking Program, James Bay 1978. Contributors Progress Report. Ottawa, Canadian Wildlife Service.

Mundkur, T. 1993. A Status Overview of Shorebirds in the East Asian - Australasian Flyway. Asian Wetland Bureau, Kuala Lumpur.

Ramsar, 1996. Proceedings of the 6th Meeting of the Conference of the Contracting Parties, Brisbane, Australia, 1996. Recommendation 6.4. Ramsar Convention Bureau.

Rogers, K.G., D.I. Rogers & C.D.T. Minton 1996. Weights and pre-migration mass gain in the Red-necked Stint in Victoria. Stilt 29, this issue.

Shigeta, Y. 1995. Bird Banding Surveys of Shorebirds and Little Tern in Japan. Report: The East Asia Migratory Bird Route Tour '95. WWF-Japan and FoE Shikoku.

Watkins, D. 1993. A National Plan for Shorebird Conservation in Australia. AWSG Report to WWF Australia.

FOOD CARRYING AND A NEW PREY ITEM OF MARSH SANDPIPERS *Tringa stagnatilis*.

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Marsh Sandpipers, *Tringa stagnatilis* are summer residents or passage migrants in the Townsville area (north Queensland, Australia) where they are found in shallow water on tidal flats or shallow, ephemeral, freshwater pools. They are moderately common, usually occurring in small numbers from single birds to flocks of up to twenty (Wieneke 1995).

On 12 April 1996 we observed a flock of approximately 55 Marsh Sandpipers feeding in a pool, about 200m in diameter, of shallow brackish water on tidal flats beside the causeway road leading to the Australian Institute of Marine Science, 25 km south of Townsville. A flock of this size were probably passage migrants and some of the birds were in partial breeding plumage with streaking on the neck and chest (Hayman *et al*. 1986). This area is about 8 km from the coast and only inundated by very high tides or after rain. Also in the area were 40 Gull-billed Terns *Sterna nilotica*, 10 Caspian Terns *S. caspia*, Silver Gulls *Larus novaehollandiae*, 6 White-faced Herons *Egretta novaehollandiae*, Little Egrets *E. garzetta*, Intermediate Egrets *Ardea intermedia* and Large Egrets *A. alba.* No other migratory waders were present.

Some *T. stagnatilis* were feeding independently or in smaller groups but a flock of about 25 were feeding in a tight group, walking briskly though the shallow water, with heads lowered, probing and scything with their bills, often with the head fully or partly submerged in water, in a manner reminiscent of Red-necked Avocets *Recurvirostra novaehollandiae*. Occasionally a bird would run for a distance of up to 40 metres to the edge of the pool, carrying a small fish in its bill. At the water's edge it would drop the fish onto the sand and, after grabbing at it several times, presumably to manoeuvre the prey into a suitable position, swallowed it. A Silver Gull sometimes attempted to pirate the fish. Having eaten its prey, the sandpiper would run back to rejoin the feeding group. For a half hour period we observed a steady procession of sandpipers leaving with fish, and then rejoining the feeding flock.

We can find no record of fish as a prey species for *T. stagnatilis* though they have been recorded as food items for Common Redshank *T. totanus*, Common Greenshank *T. nebularia* and Wood Sandpiper *T. glareola. T. totanus* occasionally feeds on worms which are carried several metres and washed in pools before being swallowed. (Higgins & Davies 1996). Unfortunately we could not record the species of fish.

REFERENCES

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

Higgins, P.J. & S.J.J.F. Davies. 1996. Handbook of Australian, New Zealand & Antarctic Birds. Vol. 3. Snipe to Pigeons. Oxford University Press, Melbourne.

Wieneke, J.,1995. Where to Find Birds in North East Queensland. Privately, Townsville

DISTURBANCE OF BEACH THICK-KNEE *Esacus magnirostris* BY AIRCRAFT.

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Disturbance has long been recognised as a potential factor contributing to the decline or disappearance of shorebirds (King *et al.* 1992, Pfister *et al.* 1992, Burton *et al.* 1996). The effects of disturbance may be exacerbated when imposed on nesting areas of rare or threatened birds such as the Beach Thick-knee, *Esacus magnirostris*. Beach Thick-knees are considered vulnerable and possibly in decline (Marchant & Higgins 1993). However, little is known of the biology and behaviour of this species possibly due to low population density, sparse distribution and preference for undisturbed habitats (Garnett 1992). This species is only found in small numbers in the remote coastal habitat of Australia's north, including offshore islands such as Hinchinbrook Island (Garnett 1992). This island is visited by relatively few people, and has thus far undergone little anthropogenic coastal modification. Here, suitable habitat above the high-water line provides ideal nesting and roosting areas for the Beach Thick-knee.

At noon on 25 November 1994, while walking along Ramsay Bay on the north-east of Hinchinbrook Island, we were fortunate to observe a Beach Thick-knee in vegetation above the high-water line of the beach. However, as we watched, a sight-seeing tourist aeroplane flew along the beach at very low altitude, and disturbed the bird to the extent that it was flushed from its roost to another beach towards the south of the island.

While this example of disturbance probably had no critical effects on the disturbed bird itself, the concern lies in the potential for disturbance during breeding periods, when vulnerable eggs or chicks could be left unguarded, or during critical times when the birds rely on the appropriate conditions for resting or feeding (see Loegering & Fraser, 1995). The potential ramifications of human disturbance could prove disastrous to rare or threatened birds. With the increased usage of relatively unmodified areas and the subsequent increase in disturbance, there is an urgent need to understand the vulnerability of shorebird species such as the Beach Thick-knee to all types of disturbance.

REFERENCES

Burton, N.H.K., P.R. Evans & M.A. Robinson. 1996. Effects on shorebird numbers of disturbance, the loss of a roost site and its replacement by an artificial island at Hartlepool, Cleveland. Biological Conservation 77, 193-201.

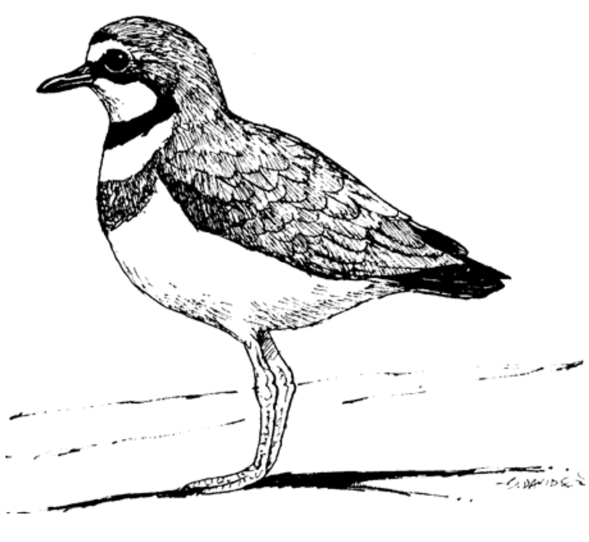
Garnett, S.T. 1992. Threatened and extinct birds of Australia. RAOU Report 82.

King, B.R., J.T. Hicks & J. Cornelius. 1992. Population Changes, Breeding Cycles and Breeding Success over Six Years in a Seabird Colony at Michaelmas Cay, Queensland. Emu 92, 1-10.

Loegering & Fraser 1995. Factors affecting piping plover chick survival in different brood-rearing habitats. J. Wildl. Manag. 59, 646-55.

Marchant, S. & P. Higgins (Eds) 1993. Handbook of Australian, New Zealand and Antarctic Birds. Vol. 2. Raptors to Lapwings. Oxford University Press, Melbourne.

Pfister, C., B.A. Harrington & M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. Biological Conservation 60, 115-26.



AN UNUSUAL NEST OF THE COMB-CRESTED JACANA *Irediparra gallinacea*.

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The Comb-crested Jacana *Irediparra gallinacea* builds its nest on a platform or shallow cup of pads and roots of water-lilies. The eggs are sometimes laid on a large leaf with no nest structure (Marchant & Higgins 1993). I knew of no exceptions to this, until I discovered a remarkable exception.

A nest was located in February 1995 under the branches of a Paperbark tree *Melaleuca leucadendron*, about four metres out from the banks of the Ross River, Townsville, north Queensland, Australia (19°15'S 146°50'E). The bird had used aquatic vegetation, largely Water Hyacinth *Eichornia crassipes* for the nest walls, however the actual platform was not the usual lily pad, but rather a polystyrene tile. The tile was somewhat fragmented around the edges and a green scum had discoloured the surface. When the bird was sitting on the nest, the tile sank giving the impression of a normal green base. However, when the Jacana was away from the eggs the platform rose, exposing its white sides and edges.

I made daily visits to the site for several days with the aim of following the incubation through to the hatching stage and beyond. Unfortunately, the site was in an area of considerable public disturbance and on my fifth visit the nest had been vacated. Wading out to the nest I found no evidence of the eggs having hatched, and it is possible that the parent had relocated the clutch. On several subsequent visits no Jacana nests, adults or chicks were seen in the vicinity of the tile although chicks could have been hidden in dense aquatic vegetation further along the river.

The provision of polystyrene tiles might be valuable as an artificial nest site for Jacanas under certain circumstances. Tiles, coloured or otherwise, could perhaps be anchored by a length of weighted wire. Such artificial sights might be successfully used to lure adults to lay in specific areas.

REFERENCE

Marchant, S., & P.J. Higgins (Eds) 1993. Handbook of Australian, New Zealand and Antarctic Birds. Raptors to Lapwings. Vol. 2. Oxford University Press, Melbourne.

A WHIMBREL *Numenius phaeopus* PHENOMENON IN CAIRNS, AUSTRALIA.

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Wader counts of the Cairns foreshore (16 °55'S, 145°46'E) have been regularly undertaken for many years by Dawn and Arnold Magarry, who have kindly contributed many hours of their time to the AWSG. However, all counts have been conducted on early morning tides which always seemed the logical time to count this site.

I spent July and August 1994 working in Cairns and at the end of each day I enjoyed the sunset along the esplanade, which I combined with wader watching. I quickly became interested at the influx of Whimbrels *Numenius phaeopus* that flew in at that time every evening.

As north Queensland coordinator for the AWSG National Count project I was aware that the previous summer counts in the area had turned up about 30-40 Whimbrels on average. However, I was experiencing numbers in the low hundreds arriving every night, and that was in the northern hemisphere breeding season.

Whimbrel numbers began to increase on the Cairns foreshore after 17:00. Birds often arrived in small chevrons of up to a dozen individuals, but also arrived as singles or in pairs. They always arrived from the south, from the direction of the Trinity Inlet, a region of dense mangroves that has many serpentine creeks. From my experience of navigating around the area by boat, and from interviewing many recreational boaters, fisherman and commercial operators, it is clear that no significant numbers of any species of bird are obvious. Whimbrels are only flushed in twos and threes. This suggests that dense areas of vegetation can belie the numbers of birds that may actually be present.

During November 1995 I took part in a low-level aerial survey between Cairns and Ingham, with Stuart Pell and Wayne Lawler from the QWSG. The survey was in the morning, at high tide, and no significant numbers of Whimbrel were recorded (relative to the Cairns sunset counts).

Table 1. Selected counts of Whimbrels on the Cairns foreshore.

Date	Count
7.2.95	742
23.2.95	475
21.4.95	743
21.5.95	117
8.2.96	610
9.2.96	800
11.2.96	810
25.3.96	1005

On my sporadic visits to Cairns I have counted in excess of 1000 Whimbrels arriving at dusk in the summer months. Counts cease due to poor visibility but sound cues suggest that some birds are still arriving after dark. It would be of great advantage to our records to make nocturnal counts, using nightsight or image intensifying equipment. Unfortunately, we have no access to such technology at present. Although some feeding may take place, this does not seem the reason for the nightly influx of birds, which occurs irrespective of the tide. It is the angle of elevation of the sun that appears to be the stimulus for the birds arrival on the foreshore.

Counts have been kindly taken for me at dusk by Andrew Anderson and recently the newly formed Cairns branch of the Bird Observers Club of Australia (BOCA) has taken an interest in the phenomenon. Table 1 shows a selection of Whimbrel counts made by A. Anderson and Grahame Finnigan (CBOC). The largest count recorded by the author was 1027 Whimbrel on 21 March 1995.

Recent events in Cairns has seen the re-emergence of council plans to reclaim prime wader feeding and roosting habitat on the foreshore, for an expansion of parklands and structural developments. The discovery of the "Whimbrel phenomenon" may be timely, as it emphasises the value of the area as a rich natural resource right on the doorstep of Cairns.

Watkins (1993) lists the Cairns foreshore as the fourteenth most important Whimbrel site in Australia, with a number of 145 birds giving it the status as a site of national importance. The new count results not only put the Cairns foreshore into Australia's four most important Whimbrel sites, but it also gives it the status as a site of international significance; the flyway population estimate is 40000, so the 1% criteria is 400 birds. Additionally, it serves to show us that even today, close to the heart of a bustling city, waders can still provide us with surprises that have been under our very noses.

REFERENCE

Watkins, D. 1993. A National Plan for Shorebird Conservation in Australia. RAOU Rep. 90.

COMPARISON OF FLAG SIGHTINGS VERSUS RECOVERIES FOR WADERS MARKED IN VICTORIA, AUSTRALIA.

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Experimental colour plastic leg-flagging of waders commenced on a trial basis in Victoria in December 1989 and was introduced on a comprehensive scale during 1990. Since then an orange leg-flag has been placed on the right tibia (occasionally tarsus, especially on Sanderling *Calidris alba* and Ruddy Turnstone *Arenaria interpres*) of most migrant and resident waders caught, subject to manpower/time constraints at the time of catching. Recaptures of flagged birds have shown that the markers are durable and an interim analysis indicated a retention rate of over 90% during the first three years. For totals see Table 1.

Reports of sightings of flagged birds, both within Australia and overseas, have flooded in and details have been listed in VWSG Bulletins 17-20. Similarly reports are regularly received via the banding office in Canberra of birds which have been recovered, by other banders or by members of the public, where the metal band has been the prime source of the record (a conventional recovery).

Sufficient time has now elapsed for a comparison to be made of the relative reporting rates by the two methods ie. 'flag sightings' versus 'recovery reports'. For this analysis only birds flagged or banded in the period 1990-1995, and sighted or recovered in the same period, have been included. Sightings within Australia include only those outside of Victoria. Only Palaearctic migrant waders (the majority of birds banded/flagged) are included in the analysis ie. residents and the Double-banded Plover *Charadrius bicinctus* (from New Zealand) are excluded.

There is clearly a far higher rate of reporting of movements emanating from Victoria via flag sighting reports than via conventional recovery reports received through the Bird Banding Office. The above figures - 17 times higher for overseas and a massive 39 times higher for reports within Australia - probably exaggerate the true difference because the data may include an unknown number of multiple sightings of the same leg-flagged bird (eg. Red-necked Stints *Calidris ruficollis* and Curlew Sandpipers *C. ferrugunea* at Mai Po, in Hong Kong). Nevertheless it is clear that enormous benefits have derived from the colour flagging programme particularly in relation to delineating migration routes and stopover sites on migration. The leg-flagging programme will therefore be continued in the future.

SCAVENGING BEHAVIOUR OF RUDDY TURNSTONES *Arenaria interpres*.

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In April 1996 one of us (CS) visited Heron Island, Great Barrier Reef, Queensland, Australia. During lunch on the first day, a Ruddy Turnstone *Arenaria interpres* was seen foraging around the feet of students seated at a table. The bird was feeding on food scraps that had been dropped from the table. On seeing this, CS tore some bread from his sandwich and tossed it in the direction of the bird, which immediately walked towards the bread and began to eat it.

Over the next few days, it became obvious that many Turnstones were accustomed to humans and their food scraps. The scraps that the Turnstones were seen feeding on were crumbs from sandwiches, biscuits and cornchips. Lane (1987) reports Turnstones feeding on bread and chocolate thrown by bathers on Lord Howe Island. Jenkins (1971) recorded a Turnstone, which landed on board a ship at sea, eating bread, biscuits, potato chips and other foods of human origin. On the Houtman Abrolhos, Western Australia, Turnstones have been recorded taking bread and other scraps among fishermen's huts (Storr 1966). These appear to be the only other published records of Turnstones scavenging human food scraps in Australia or New Zealand (see Higgins & Davies 1996).

In their attempt to find food scraps on Heron I., the Turnstones also entered the enclosed sleeping quarters and kitchen area of nearby weatherboard buildings. Bent (1929) and Storr (1966) both record Turnstones entering settlements, and it has even been suggested that Turnstones were actually attracted to a camp in Alaska,

Table 1. Comparison of Flag Sightings versus Recoveries for waders in Victoria and reported between 1990 and 1995.

		Number	Recovered Overseas	Recovered Within Australia
BANDED		27043	18 (0.067%)	7 (0.026%)
			Sighted Overseas	**Sighted** Within Australia
FLAGGED		17079	195 (1.14%)	174 (1,02%)
RATIO	Flag sighting / Recovery reporting		17 times	39 times

USA, where they fed on food scraps near the tents (Gill 1986). However, there are no records of Ruddy Turnstones actually entering buildings in Cramp & Simmons (1983) or Higgins & Davies (1996). Indeed, we can find no other records of Ruddy Turnstones entering buildings to scavenge. Buff-banded Rails *Gallirallus philippensis* were also seen entering buildings on Heron I.; however this species has been previously recorded picking up crumbs inside human habitation (see Marchant & Higgins 1993).

REFERENCES

Bent 1929. A.C. 1929. Life Histories of North American Shorebirds. Bull. US Nat. Mus., 146.

Cramp, S., & K.E.L. Simmons. 1983. Handbook of Birds of Europe the Middle East and North Africa. Volume 3. Waders to Gulls. Oxford University Press, Oxford.

Gill, R.E. 1986. What won't Turnstones Eat? Brit. Birds 79, 402-403.

Jenkins, J.A.F. 1967. A Hitchhiking Turnstone. Notornis 18, 130-31.

Lane, B.A. 1987. Shorebirds in Australia. Nelson, Melbourne.

Higgins, P.J., & S.J.J.F. Davies. 1996. Handbook of Australian, New Zealand and Antarctic Birds. Vol. 3. Snipe to Pigeons. Oxford University Press, Melbourne.

Marchant, S., & P.J. Higgins. 1993. Handbook of Australian, New Zealand and Antarctic Birds. Volume 2. Raptor to Lapwings. Oxford University Press, Melbourne.

Storr, G.M. 1966. Birds of the Northern Islands of the Houtmann Abrolhos. Emu 65, 209-21.

INTRASPECIFIC AGGRESSION IN THE SHARP-TAILED SANDPIPER *Calidris acuminata.*

.Intraspecific Aggression in the Sharp-Tailed Sandpiper *Calidris acuminata.* - J. Starks

Starks, J. c/- RAOU National Office, 415 Riversdale Rd, Hawthorn East, Vic. 3123. AUSTRALIA

The following observation of intraspecific aggression between two Sharp-tailed Sandpipers *Calidris acuminata* was made at Avalon Salt-works, during a high tide count of waders at the salt-works. Small numbers of Sharp-tailed Sandpipers forage along the muddy edges of channels and ponds at the salt-works. On 15 December 1994, I observed a particularly vicious attack by an adult Sharp-tailed Sandpiper against a juvenile. The birds were foraging together on a narrow bank of mud along the edge of a channel when a squabble broke out. The adult bird was the aggressor and appeared intent on driving the juvenile away from a particular patch of mud. The two birds engaged each other with their bills and much flapping of wings, although the juvenile appeared to be defending itself rather than retaliating. The adult forced the juvenile into the water, then proceeded to jump on top of it, successfully pushing the juvenile completely underwater. The juvenile surfaced a second or two later and flew off. The adult did not give chase but resumed feeding.

There are some notes on intraspecific aggression in Coates (1985), who says aggression between juveniles is fairly common at the time of southern migration. Individuals may become irritable when their feeding space is infringed upon by another. The intruder is faced in crouched posture with head lowered, bill open and with threatening calls uttered. The aggressor then flies at the intruder and they meet in mid-air, in the manner of fighting cocks. The skirmishes will be repeated until the intruder moves away. Coates (1985) contains an accompanying photograph of two juveniles fighting. Johnsgard (1981) describes territorial interactions between individuals on the breeding grounds but does not provide any information on behaviour on the wintering grounds.

REFERENCES

Coates, B.J. 1985. The Birds of Papua New Guinea. 1. Dove. Brisbane.

Johnsgard, P.A. 1981. The Plovers, Sandpipers, and Snipes of the world. University of Nebraska Press. Nebraska.

REPORT ON CHONGMING DAO (CHINA) SHOREBIRD RESEARCH AND TRAINING WORKSHOP - 25 MARCH - 16 APRIL 1996 Report on Chongming Dao (China) Shorebird Research and Training Workshop - 25 March - 16 April 1996 - M. Barter & D. Tonkinson

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Background
During the second consultative meeting under the China Australia Migratory Birds Agreement, held at Coolum, Queensland, Australia, in June 1995, it was agreed that it would be desirable to hold a cooperative shorebird research and training workshop at Chongming Dao, near Shanghai, during the 1996 northward migration period.

The Australasian Wader Studies Group (AWSG) was subsequently contracted by the Australian Nature Conservation Agency (ANCA) to work with the National Bird Banding Center of China (NBBCC) in the organisation and running of the workshop.

The AWSG participants, Mark Barter and Dale Tonkinson, were responsible for preparation and presentation of the workshop class room activities and organisation of the field work.

The NBBCC selected the Chinese participants and made arrangements for accommodation and transport.

The workshop objectives were to:

- share knowledge on shorebird ecology and conservation needs
- develop surveying and banding skills, through training programmes
- collect information on the role of Chongming Dao as a staging site for shorebirds on migration from north-west Australia to the breeding grounds, with specific reference to the Great Knot *Calidris tenuirostris* and Bar-tailed Godwit *Limosa lapponica*.

As it was decided that the workshop activities should be based on the study of shorebird migration and, in particular that of the Great Knot and Bar-tailed Godwit, the timing chosen was from 5 - 16 April, with a pre-workshop field assessment phase from 25 March - 4 April. These dates covered the main arrival periods of both target species.

The AWSG was also running a shorebird banding expedition in north-western Australia from 2 March - 19 April and it was hoped that useful arrival data could be obtained for species migrating from this region. The main target species of the north-west Australia expedition also included Great Knot and Bar-tailed Godwit.

Pre-Workshop field assessment
This phase was conducted by a five-person team comprising both the AWSG representatives and:

1. Yuan Xiao - Chongming Bird Banding Station
2. Qian Fa Wen - NBBCC
3. Tang Si Xian - East China Normal University.

This activity was invaluable in developing familiarity with the geography of, and locations of shorebirds on, east Chongming Dao. We were able to identify sites where the fieldwork activities could be satisfactorily undertaken, as well as commence collecting data on shorebird distribution and abundance, the location of hunters, and identify mist-netting and migration departure observation sites.

The Workshop
The workshop was attended by 14 participants from widely spread Chinese nature reserves, banding stations, universities and the NBBCC.

Subjects covered included: shorebird identification, habitat surveying techniques, counting methods, banding techniques, migration, migration departure observation, primary wing feather moult and ageing, and data analysis and application.

Field work complemented and reinforced the class work. The culmination of the field work was the conducting of a complete survey and count of east Chongming Dao by workshop participants.

It is estimated that a total of 100 hours was spent on all activities over the 12 days of the workshop (i.e. 8.3 hours/day). There were no rest days. Approximately, 28% of the time was spent on presentation of workshop material, 53% in the field, and 19% on follow up discussions on the fieldwork and two quizzes.

Formal response from the workshop participants indicated that their expectations had been met, they were confident in using the learnt skills. It was suggested that future workshops could be improved by spending more time on fieldwork and on discussions about what had been learnt.

Some highlights
1. A complete, one day coverage of coastal shorebird habitat, usage and disturbance on east Chongming Dao was obtained by the workshop. This data complements that obtained in previous years and will enable an assessment to be made of habitat and disturbance changes over a ten year period.

2. A count of the eastern end of the island over a seven day period (25-31 March) gave a total of 24,770 waders

of 29 species, including 9,033 Dunlin, 7,202 Kentish Plover, 5,761 Great Knot and 794 Eastern Curlew. A one day workshop count on 15 April, using five teams, gave 10,950 birds of 20 species, of which 7,770 were Dunlin, 1316 Kentish Plover and 1,262 Great Knot.

3. A total of 295 birds of 20 species was banded and an additional 19 birds were processed but not banded. A total of nine birds with Australian bands was caught; five had leg-flags. Additionally, two bands recovered in May 1995 were obtained from hunters.

4. Great Knot were arriving with a body mass which was, on average, less than 50% of the departure mass from north-western Australia. The average mass of Great Knot was 129g (range 93-163g); three birds weighed less than 100g (average non-breeding mass = 137g).

5. None of the Bar-tailed Godwit caught exceeded the average non-breeding mass for the relevant sex (i.e. female: 292g; male: 264g). Arriving females averaged 249g (range 215-280g); males averaged 211g (range 155-240g). Average north-west Australia departure masses are female - 419g and male - 350g.

6. A preliminary view is that great Knot and Bar-tailed Godwit move on quickly after arrival, even though very light. Supreme jumpers become hoppers!

7. Shorebirds were often observed showing typical premigratory behaviour. Records were obtained of the departure of nine flocks**.**

8. At the end of the workshop, the Chinese participants had a three-hour discussion on four topics selected by themselves. These were:

- How to improve cooperation on shorebirds between China and Australia?
- How to develop and conduct shorebird research activities in China?
- How to improve Chinese shorebird knowledge?
- Training requirements.

It is planned to produce a detailed report, with interpretation, on the results of the surveys, counts and banding work. Additionally, it is proposed that the banding data will be analysed in conjunction with that from the concurrent AWSG north-west Australia banding expedition and published as a scientific paper. It is also planned to write a number of notes for publication in *The Stilt.*

The Future

As a result of the experienced gained during the workshop, and discussions with interested parties, the AWSG made the following recommendations for consideration by ANCA, The Ministry of Forestry and the NBBCC.

1. A Chinese shorebird action plan should be developed. Elements that should be included are:

- identification of significant shorebird habitat, both coastal and inland
- determination of shorebird distribution, abundance and conservation status
- establishment of a network of conservation reserves to protect the most important shorebird sites
- development of shorebird study skills, particularly within nature reserves and at banding stations.

The plan should be of three to five years duration and could be developed through discussions between the NBBCC and Wetlands International. It is suggested that ANCA could play a major role in funding the development and implementation of the plan.

It should be noted that the workshop participants recommended that a national shorebird research plan for China be developed.

2. Consideration should be given to establishing a shorebird research station on Chongming Dao, probably in conjunction with the Chongming Bird Banding Station. The island provides excellent opportunities for studies of mud flat ecology, human disturbance effects and shorebird migration strategies.

3. The Shanghai Government and local land managers should be encouraged, and suitably funded, to establish a staffed nature reserve on east Chongming Dao with a shorebird management plan. The nature reserve could act as the focus of controlled eco-tourism activities and for education of the local inhabitants, including school children, concerning the need for shorebird conservation. As such, it could act as a model for introduction elsewhere in China.

4. A further shorebird research and training workshop should be arranged for March/April 1997 with the objectives of maintaining the impetus gained from the 1996 workshop and adding to the pool of Chinese nationals trained in shorebird studies. Either the Yellow River Delta or the Shuangtaihe Estuary Nature Reserves would be suitable sites.

POPULATION MONITORING COUNTS: A REPORT ON THE WINTER 1995 AND SUMMER 1996 COUNTS.

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A decision has been taken to include count data once per year in the Spring edition of *The Stilt*. In future years I will endeavour to include both counts for that year. However that will require a very prompt return of the Winter count results for me to make the Spring edition. This year I have included count data for Winter 1995 and Summer 1996 (see following pages).

It is pleasing that we are now getting a consistently high number of the designated sites covered as this provides much greater opportunity to predict trends. Of particular note, as this is one of our major sites, are the regular returns once again being received from St Vincent Gulf, South Australia.

For Winter 1995 a total of 175 areas were counted over 30 designated sites. Red-capped Plover *Charadrius ruficapillus* numbers returned to normal after a particularly high count in 1994 no doubt due to dry conditions inland.

For Summer 1996 a total of 172 areas were counted over 28 designated sites. Overall numbers were down on the last two years. The major anomaly is the count for Eighty Mile Beach near Broome where the total count saw an increase to 140,000 birds over the normal numbers of approximately 40,000. Most of these extra numbers were in the counts for Bar-tailed Godwit *Limosa lapponica* and Great Knot *Calidris tenuirostris* although counts for a number of other waders were up also. Some inconsistency can be expected in this area as it is a particularly difficult area to count due to the need for a speedy count because of considerable bird movement. Some of the increase can also attributed to an increase in the number of counters. Apart from Eighty Mile Beach the general downward trend fits the three year cycle as 1992 was the last low year. The downward trend for Pacific Golden Plover *Pluvialis fulva* continued. The results are tabulated on the following pages. Table 1 present the regional coordinators and their contact details. Why not help out with the count program?

Table 1. Regional Co-ordinators and Contacts for the Population Monitoring Counts. Anybody interested in counting an area should contact the regional co-ordinator listed below, or the author.

New South Wales	Phil Straw, Chairman NSW WSG, 02 597 7765 or 018 464 189
Northern Territory	Niven McCrie 089 451 130 or Ray Chatto 089 221 740
Queensland	Peter Driscoll, Chairman Qld Group, 07 3289 0237
	Ivell & Jim White, Count Co-ordinators, 07 802 0757
South Australia	David Close, 08 278 4337 or John Hatch, 08 362 2820
South East	Richard & Margaret Alcorn, 053 821 686
Tasmania	Priscilla Park, 002 487 007
Victoria	
Port Phillip Bay (Eastern)	Mike Carter, 03 9787 7136
Altona	Jeff Campbell, 03 9563 7345
Werribee	Mark Barter, 03 9803 3330 or Bob Swindley, 03 9723 4341
	or Jonathon Starks c/o RAOU National Office 03 9882 2622
Bellarine Peninsula	Margaret Cameron 052 299 792
Westernport	Ellen McCulloch c/o BOCA 03 9877 5342 or Laurie Living 03 9762 5852
Corner Inlet (East)	Clive Minton, 03 9589 4901 or Bob Swindley, 03 9723 4341
Corner Inlet (West)	Peter Dann, 059 568 300 or Mark Barter 03 9803 3330
Western Australia	
Perth	Bryan Barrett, 09 457 2335 or Mike Bamford, 09 309 3671
Albany	Vic Smith, 098 444 217 or Tim Hunt 098 444 560
	or Viv McCormack Convenor Albany Bird Group, 098 441 073
Broome	Becky Hayward & Jon Fallaw 09193 5600

Result of the Winter 1995 Wader Count	Cairns	Tnsvlle	Mcky	Gldstn	Moretn Bay	Lockyer Valley	Tweed Est	Richmnd Est	Clrnce Est	Hunter Est	Tuggerah Lakes	Parr Est	Botany Bay	Shlhvn Est	Shallow/ CnrInlet	Wstnpt Bay
Latham's Snipe																
Black-tailed Godwit		45			4				38	30				83		
Bar-tailed Godwit	40	59			2226		122	43	326	250	82	49	103		1016	4
Little Curlew																
Whimbrel	15	43	3		642		15	33	3	13			2			5
Eastern Curlew	20	63	27	5	631		55	32	47	230	1		68	30	252	200
Marsh Sandpiper					8	9										
Common Greenshank	5	16		4	25		4	4							2	10
Wood Sandpiper																
Terek Sandpiper		3			5			1								
Common Sandpiper		11														
Grey-tailed Tattler	22	11			448		13	24							12	
Wandering Tattler																
Tattler sp.																
Ruddy Turnstone					20		4	1			8				4	16
Great Knot	70	532			867			2	75	5	2					
Red Knot		50			5					2					50	
Sanderling															1	
Red-necked Stint	72	222			257		15	11			2		2		247	73
Pectoral Sandpiper																
Sharp-tailed Sandpiper																
Curlew Sandpiper	8	13		115	516			3							7	5
Bush Stone-curlew																
Beach Stone-curlew	2	5	1		3											
Pied Oystercatcher		9	41	47	484		6	4	14				64	3	802	416
Sooty Oystercatcher			3												148	1
Black-winged Stilt				45	1387	180	313	47	18	250	10	24	55			
Banded Stilt	2															
Red-necked Avocet					440	4				3000						44
Pacific Golden Plover	5	5			12											
Grey Plover					16										55	
Red-capped Plover	5	84		28	152	1		16			16			6	65	75
Double-banded Plover					108		26	59	5		10		11	73	1155	364
Lesser Sand Plover	5	44			75										3	
Greater Sand Plover		1			35			1							6	
Oriental Plover																
Black-fronted Dotterel				4	11	7	12					31				
Hooded Plover															3	
Red-kneed Dotterel						2						1				
Banded Lapwing																
Masked Lapwing	34	20	5	10	52	50	24	2	4		46	6	2		9	65
Long-toed Stint																
Unidentified small					83											
Unidentified medium																
Unidentified large																
Spotted Redshank																
Broad-billed Sandpiper																
Ruff/Reeve																
Painted Snipe																
Snipe sp.																
Total Number	305	1236	80	258	8512	253	609	283	530	3780	177	111	307	195	3837	1278
Total Species	14	20	6	8	26	7	12	16	9	8	9	5	8	5	18	13

Result of the Winter 1995 Wader Count	East PtPhllp	Altona	Wrrbee Avalon	BllrneP/ Mud Isl	EDerw Pittw	Marion Bay	Cape Portland	NWCst Tas	SECst SA	West EyrePen	StVinc Gulf	Albany	Swan	80 Mile	Broome	Dwin	TOTAL
Latham's Snipe																	0
Black-tailed Godwit			5												873		1078
Bar-tailed Godwit					13						6			2153	3685		10177
Little Curlew																	0
Whimbrel															116		890
Eastern Curlew			4	24	11				1					59	22		1782
Marsh Sandpiper											5						22
Common Greenshank		26	18	37	4	2					63			99	5		324
Wood Sandpiper																	0
Terek Sandpiper				1										28	280		318
Common Sandpiper																	11
Grey-tailed Tattler									2					14	230		776
Wandering Tattler																	
Tattler sp.																	0
Ruddy Turnstone			6	17			9	150	1		1			7	75		319
Great Knot														611	1980		4144
Red Knot				1				20				8		220	140		496
Sanderling																	1
Red-necked Stint		125	730	336	82	55	16	300	2		70	26		199	1102		3944
Pectoral Sandpiper																	0
Sharp-tailed Sandpiper				1													1
Curlew Sandpiper			592	120	5						1	1		172	1050		2608
Bush Stone-curlew																	
Beach Stone-curlew																	11
Pied Oystercatcher		6	39	34	597	108	38	154	8		13	64		9	85	4	3049
Sooty Oystercatcher		1	1		40	2	40	80	3			12			20		351
Black-winged Stilt	125	207	406	180							38				180		3465
Banded Stilt			6								1165						1173
Red-necked Avocet		117	435								300			1	17		4358
Pacific Golden Plover																	22
Grey Plover												1		2			74
Red-capped Plover	3	125	174	348	255	68	142	100	16		205	15		87	6	4	1996
Double-banded Plover		381	269	557	295	5	220	450	9								3997
Lesser Sand Plover																	127
Greater Sand Plover												1		47	83		174
Oriental Plover																	0
Black-fronted Dotterel	32		55	17	6		1										176
Hooded Plover				2	6	5	19	24				1					60
Red-kneed Dotterel			2	1													6
Banded Lapwing							17	10									27
Masked Lapwing	25	11	125	131	463	53	31		6		12						1186
Long-toed Stint																	
Unidentified small														200			283
Unidentified medium																	
Unidentified large																	
Spotted Redshank																	0
Broad-billed Sandpiper																	0
Ruff/Reeve																	0
Painted Snipe																	
Snipe sp.																	0
Total Number	185	999	2867	1807	1777	298	533	1288	48	0	1879	129	0	3908	9949	8	47426
Total Species	4	9	16	18	12	8	10	9	9	0	12	9	0	16	18	2	

Result of the Summer 1996 Wader Count	Cairns	Tnsvlle	Mcky	Gldstn	Moretn Bay	Lockyer Valley	Tweed Est	Richmnd Est	Clrnce Est	Hunter Est	Tuggerah Lakes	Parr Est	Botany Bay	Shlhvn Est	Shallow/ CnrInlet	Wstnpt Bay
Latham's Snipe												2				
Black-tailed Godwit		45			4					370						
Bar-tailed Godwit	40	59			2226		122	162		1300	381	238	533		12334	384
Little Curlew																
Whimbrel	15	43	3		642		15	54		69			47		7	38
Eastern Curlew	20	63	27	5	631		55	98		135	2	2	307		1723	1085
Marsh Sandpiper					8	9		2		131		3				
Common Greenshank	5	16		4	25			35		100	22	4			249	133
Wood Sandpiper																
Terek Sandpiper		3			5			79		94			9			7
Common Sandpiper							4									
Grey-tailed Tattler	22	11			448		13	94		5	1		147			8
Wandering Tattler																
Tattler sp.																
Ruddy Turnstone					20		4	41		1	8		44		25	83
Great Knot	70	532			867			18		32					50	
Red Knot		50			5			3		10					2040	
Sanderling								51							150	
Red-necked Stint		222			257		15	45		20	1		143		14415	4041
Pectoral Sandpiper																
Sharp-tailed Sandpiper								31					44		3	116
Curlew Sandpiper		13		115	516			112		2600		150	68		1275	7056
Bush Stone-curlew																
Beach Stone-curlew	2	5	1		3											
Pied Oystercatcher		9	41	47	484		6				2		46		985	306
Sooty Oystercatcher			3								2		13		302	1
Black-winged Stilt				45	1387	180	313	25		2	22	336	40			
Banded Stilt	2															
Red-necked Avocet					440	4				68						
Pacific Golden Plover	5	5			12			94		42	8		52			33
Grey Plover					16										460	
Red-capped Plover	5	84		28	152	1		5					13		44	32
Double-banded Plover					108		26						1		4	19
Lesser Sand Plover	5	44			75			22		30			2		62	4
Greater Sand Plover		1			35			39							3	
Oriental Plover																
Black-fronted Dotterel				4	11	7	12					12	2			
Hooded Plover															5	
Red-kneed Dotterel						2										
Banded Lapwing																
Masked Lapwing	34	20	5	10	52	50	24	2			51	22	2		31	217
Long-toed Stint																
Unidentified small					83											
Unidentified medium																
Unidentified large																
Spotted Redshank																
Broad-billed Sandpiper																
Ruff/Reeve																
Oriental Pratincole																
Asiatic Dowitcher																
Total Number	225	1225	80	258	8512	253	609	1012	0	5009	500	769	1513	0	34167	13563
Total Species	12	19	6	8	26	7	12	20	0	17	11	9	18	0	20	17

Result of the Summer 1996 Wader Count	East PtPhllp	Altona	Wrrbee Avalon	BllrneP/ Mud Isl	EDerw Pittw	Marion Bay	Cape Portland	NWCst Tas	SECst SA	West EyrePen	StVinc Gulf	Albany	Swan	80 Mile	Broome	Dwin	TOTAL
Latham's Snipe	18		20	116													156
Black-tailed Godwit			21											13	20		473
Bar-tailed Godwit			19	221	84	3		350			847	70	13	45400	9687		74473
Little Curlew																	0
Whimbrel					5							3		1	27		969
Eastern Curlew			11	169	110						103	1		44	28		4619
Marsh Sandpiper	13	72	80	421							59			10	2		810
Common Greenshank	5	63	109	229	44	2		50	17		351	70	3	361	201		2098
Wood Sandpiper	2		3														5
Terek Sandpiper				1										3120	146		3464
Common Sandpiper	3		1	3								3			5		19
Grey-tailed Tattler				1			2		8			34		2725	790		4309
Wandering Tattler																	
Tattler sp.																	0
Ruddy Turnstone			4	38			174	1050	655		195	8		139	348		2837
Great Knot				22							50	450		70315	11265		83671
Red Knot			15	110	1			11			450	200		1380	2802		7077
Sanderling								12	501					10			724
Red-necked Stint	67	1993	7504	5389	2127	106	1262	2500	2069		1039	3398		3233	2422		52268
Pectoral Sandpiper	2		5														7
Sharp-tailed Sandpiper	1084	344	3002	679				20	454		1540	6			1		7324
Curlew Sandpiper	10	2627	3329	174	404		51	550	345		1760	2054		4115	2410		29734
Bush Stone-curlew																	
Beach Stone-curlew																	11
Pied Oystercatcher			37	46	687	64	28	252	20		22	52		4	65		3203
Sooty Oystercatcher					15	3	21	50	1			4			10		425
Black-winged Stilt	120	157	340	343							160	2	14				3486
Banded Stilt			140	309							7850						8301
Red-necked Avocet			39								350	202					1103
Pacific Golden Plover			31	30			68		33			12		4			429
Grey Plover				191				21			157	58	7	108	81		1099
Red-capped Plover	14	194	67	224					52		1297	341		167			2720
Double-banded Plover					52	8	64	70									352
Lesser Sand Plover				1			2	5			9			780	670		1711
Greater Sand Plover				2								45		6325	1452		7902
Oriental Plover														2622			2622
Black-fronted Dotterel	5		11	15	12				5								96
Hooded Plover				1	4	11	16	7									44
Red-kneed Dotterel			3	1													6
Banded Lapwing											34						34
Masked Lapwing	264	144	282	265	596	51	174		85		64						2445
Long-toed Stint																	
Unidentified small		160															243
Unidentified medium																	
Unidentified large																	
Spotted Redshank																	0
Broad-billed Sandpiper														2	12		14
Ruff/Reeve																	0
Oriental Pratincole														462			462
Asiatic Dowitcher															2		2
Total Number	1607	5754	15073	9001	4141	248	1862	4948	4245	0	16337	7013	37	141340	32446	0	311747
Total Species	13	9	23	26	13	8	12	14	13	0	19	20	4	23	22	0	

SIGHTINGS OF LEG-FLAGGED WADERS FROM VICTORIA, AUSTRALIA: REPORT 4

Minton, C. 165 Dalgetty Road, Beaumaris, Vic., 3193 AUSTRALIA.

Listed below are the reports received of the sightings of orange leg-flagged birds away from their banding locations in Victoria (and the south east coast of South Australia for Sanderlings *Calidris alba* and Ruddy Turnstones *Arenaria interpres*). This list follows those published earlier in VWSG Bulletins 17 to 19, the last of these being in December 1995. It contains all reports received up to 30 June 1996. Note however that many reports take some time to reach here and that there are probably sightings related to the northward migration in March/May still to be received. These will be incorporated into subsequent bulletins/listings.

To put the sightings into context Table 1 (prepared by Petina Pert) shows the number of each species orange flagged (to 31 Dec. 1995) since this procedure commenced on a trial basis on 30 December 1989. A comparison between the flag sighting rate and conventional recovery rates is the subject of a separate article elsewhere in this bulletin.

Large Sandplover

17.12.95 and 28.1.96	Manly Boat Harbour Moreton Bay, Queensland	Arthur and Cheryl Yeates

This could possibly be the same individual as seen in Moreton Bay the previous summer, especially considering only nine Large Sandplovers have been orange leg-flagged in Victoria.

Ruddy Turnstone

19.8.95	Yatsu Estuary, Narashino, Chiba, Japan 35^0 41'N 140^0 00'E	per Japanese Bird Migration Research Centre

This is the first report of a VWSG banded Ruddy Turnstone in Japan.

Eastern Curlew

3.4.95	Daimyojin River, Toyo, Ehime, Japan 33^0 57'N, 133^0 05'E	per Japanese Bird Migration Research Centre

This is the same as the incomplete record referred to as "250 km W of Tokushima" in leg-flag sighting Listing No.3

Bar-tailed Godwit

27.12.95	Karaka, Manukau Harbour, New Zealand (2 birds)	Tony Harbraken

After a year without any sightings in New Zealand it is nice to get some further records.

Red Knot

2.1.95	Jordan's, Kaipara Harbour, New Zealand (3 birds)	D. Lawrie
19.12.95	Karaka, Manukau Harbour, NZ	S. Davies
27.12.95	as above	D. Lawrie
14.1.96	Miranda, Firth of Thames, NZ	N. Green
20.1.96	Jordan's, Kaipura Harbour, NZ	A. Riegan
21.1.96	as above (2 birds)	Tony Harbraken

Another good crop of New Zealand sightings. It is a pity that neither VWSG or the NZWSG have been able to make any major catches of Red Knot in recent years in order to better understand the nature of the significant movements of Red Knot between Victoria and New Zealand.

Red-necked Stint

5.6.96 to 12.6.96	Tory Lakes, Daurskiy NR Transbaikal, Russia 50^0 0'N 115^0 41'E (At least 10 different birds seen)	Dr. Oleg Goroshko via Pavel Tomkovich
21.8.94	Nikko River, Nagoya, Aichi, Japan 35^0 05'N 136^0 50'E	per Japanese Bird Migration Centre
5.9.94	as above	as above
19.8.95	Shiokawa Estuary, Tahara, Aichi, Japan 35^0 25'N 137^0 19'E	as above
20.8.95	Tofutsu Lake, Abashiri, Hokkaido, Japan 43^0 58'N 144^0 23'E	as above
17.8.95	Hasaki, Kashima - gun, Ibaraki, Japan 35^0 45'N 140^0 19E	as above
20.8.95	Shiokawa, Toyohashi, Aichi, Japan 34^0 41'N 137^0 19'E	as above
17.4.96	Phan, Thiet, Bien Thuan, S. Vietnam	Hanno Stamm
13.10.95 to13.2.96	Lake Ellesmere, New Zealand	Colin Hill
29.10.95	Bowen, Queensland	Frank Harrison
8.11.92	Tullakool Saltworks, NSW	Tom Wheller
18.4.93	as above	as above
7.5.95	as above (2 birds)	as above
25.4.96	as above (5 birds)	as above
14.4.96	Five Boughs Swamp, Leeton, NSW	Keith Hatton
21.1.96	Carpenters Rocks, SA	Adrian Boyle
28.1.96	Port MacDonnell, SA	Robert Farnes
31.1.96	Port MacDonnell, SA	Adrian Boyle
20.4.96	Adelaide Saltworks, SA	Martin Bragg
1.11.95	Ocean Grange, Lakes NP, Vic.	Thierry Roland
22.10.95	Port Augusta, SA	P.A.Langdon

The sightings in southern Siberia in early June are especially exciting, indicating for the first time a possible migration route across the continent from the northern Chinese coast to the western parts of the Red-necked Stint breeding areas in the north of Siberia.

This is an unprecedented number of Red-necked Stint sightings from Japan. That country appears to be an important location on the migration route of the Red-necked Stint, at least on southward migration. Equally more evidence is gradually collecting of the importance of the Vietnam area as a stopover region for the smaller waders on northward migration.

These and previous sightings of Red-necked Stints at locations in New South Wales (and in South Australia) in April and May suggest that a few birds may abort their long overland single flight crossing to the northern coasts of Australia at a much earlier stage than expected. This could possibly be the result of encountering unexpected adverse weather conditions after setting off on their northward migration.

One wonders whether the further sightings at Lake Ellesmere - there have been regular sightings since 1990 - all refer to the same bird!

Curlew Sandpiper

22.4.95	Likas Bay, Sabah. East Malaysia	A. Greensmith
5.12.95 to 7.12.95	Stockton, NSW	Renee Ferster Levy
24.12.95	Botany Bay, NSW	Phil Straw
21.2.96	Botany Bay, NSW	Coral Smith

This is the first Curlew Sandpiper report in Sabah. The remaining records refer to three (or two) examples of birds which had probably changed their non-breeding area.

Sanderling

7.8.94	Torinoumi, Watari, Miyagi, Japan 38^0 02'N 140^0 55'E	per Japanese Bird Migration Research Centre
16.8.94	as above	as above
28.7.95	Kido River, Kujukuri, Naruto, Chiba, Japan 35^0 40'N 130^0 24'E (2 birds)	as above
30.7.95	Gannosu, Higashi-ku, Fukuoka, Japan 33^0 40'N 130^0 24'E	as above
15.8.92	Yotogonyu Beach, Maki, Niigata, Japan 37^0 51'N 138^0 53'E	as above (and Minoru Kashiwagi)
15.8.93	as above	as above
4.1.96	Moreton Island, Queensland	Peter Driscoll
28.10.95	South Ballina, NSW	Bo Totterman
16.11.95	Mouth of the Murray River, SA (4 birds)	Iain Stewart

Another marvellous collection of sightings, especially those in Japan. This species has the highest leg-flag sighting rate - probably because of its habit of frequenting sandy (as opposed to muddy) beaches and because of its relative tameness and 'open flock' feeding mode. Japan is clearly a major stopover site on southward migration. The bird in Queensland had apparently changed its non-breeding area. The movement along the coast to the Murray River mouth is a further indication of this species mobility (220 kilometres from the nearest banding site at Canunda National Park). Numerous sightings of flagged Sanderling have also been made by Robert Farnes at the Fitzroy River Mouth in western Victoria - midway between the Killarney Beach (Port Fairy) and South Australia (Brown Bay and Canunda NP) flagging and banding sites.

Table 1 shows the number of waders leg-flagged by the VWSG.

Table 1. Summary of Victorian Waders (orange) Leg-flagged by VWSG

Species	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**TOTAL**
Masked Lapwing	0	0	0	0	0	0	1	1
Grey Plover	0	0	0	1	0	0	6	7
Lesser Golden Plover	0	10	10	1	0	0	0	21
Lesser Sandplover	0	0	0	14	6	8	9	37
Double-banded Plover	0	0	0	0	0	8	0	8
Large Sandplover	0	0	0	0	3	6	0	9
Red-capped Plover	0	0	0	0	0	19	0	19
Red-necked Avocet	0	0	0	0	5	0	0	5
Ruddy Turnstone	0	99	188	37	35	1	194	554
Eastern Curlew	0	0	8	0	73	88	87	256
Whimbrel	0	0	0	0	16	0	0	16
Common Greenshank	0	0	21	21	51	0	1	94
Terek Sandpiper	0	0	2	2	2	2	0	8
Latham's Snipe	0	0	0	0	40	0	110	150
Bar-tailed Godwit	0	1	157	6	64	0	43	271
Red Knot	0	0	302	26	88	1	52	469
Great Knot	0	0	2	0	4	0	3	9
Cox's Sandpiper	0	0	0	1	0	0	0	1
Sharp-tailed Sandpiper	0	4	250	111	71	21	69	526
Broad-billed Sandpiper	0	0	0	0	0	1	0	1
Little Stint	0	0	0	1	0	0	0	1
Red-necked Stint	0	799	1259	2516	2282	1661	1384	9901
Curlew Sandpiper	146	462	367	1255	808	839	469	4346
Sanderling	0	0	163	0	191	1	47	402
TOTAL	**146**	**1375**	**2729**	**3992**	**3739**	**2656**	**2475**	**17112**

FURTHER SIGHTINGS OF WADERS LEG-FLAGGED (YELLOW) IN NORTH WEST AUSTRALIA; LIST NUMBER 3 - JULY 1996

Minton, C.[1] & R. Jessop[2]
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The list below contains details of all reports of yellow leg-flagged waders received since the last list was published (Minton & Jessop 1995).

All birds would have been leg-flagged (yellow on right tibia) since August 1992 in NW Australia. Specific banding locations are:

1. Broome (Roebuck Bay)
2. Mile Beach (Anna Plains)
3. Port Hedland Salt Works

Also detailed below is an updated list of the numbers of birds leg-flagged in north west Australia since flagging commenced. The total received a significant boost during the March/April 1996 AWSG expedition and now stands at 21,489, and represents 38 species.

Date	**Location**	**Observer**
<u>Large Sand Plover</u>		
9.4.96	Mai Po Nature Reserve, Hong Kong 22^{0} 29’N, 114^{0}19’E	Paul Leader and Geoff Carey
<u>Terek Sandpiper</u>		
?.5.96	South Korea	per Jin Young Park
25.5.96	Mai Po Nature Reserve, Hong Kong 22^{0} 29N, 114^{0} 19’E	David Distris

This is the third sighting/recovery of a Terek Sandpiper linking Korea and north west Australia

Date	**Location**	**Observer**
<u>Grey-tailed Tattler</u>		
16.5.96	Nagahama Bird Sanctuary, Kanazawa-ku Yokohama, Japan 35^{0} 21’N, 139^{0} 38’E	Tamotsu Kashima (per Japanese Banding Office)

The link between Grey-tailed Tattlers from north west Australia and Japan is much less marked than between Queensland and Japan.

Date	**Location**	**Observer**
<u>Black-tailed Godwit</u>		
12.5.96	Cheonsu Bay, South Korea 36^{0} 30’N, 126^{0} 25’E	Jin Young Park

This is the first overseas report of a Black-tailed Godwit from Australia

Date	**Location**	**Observer**
<u>Bar-tailed Godwit</u>		
12.5.96	Cheonsu Bay, South Korea 36^{0} 30’N, !26^{0} 25’E	Jin Young Park

Bar-tailed Godwits from eastern Australia and New Zealand have a much stronger tendency to migrate through Japan than those from north west Australia, which mainly pass through China and Korea.

Date	**Location**	**Observer**
<u>Great Knot</u>		
20.4.96	Mai Po Nature Reserve, Hong Kong 22^{0} 29’N, 114^{0} 19’E	Geoff Carey
24.5.96	as above	Winnie Yeung
11.5.96	Sanbanze Tidal Flat, Ichikawa-shi, Chiba, Japan. 35^{0} 40’N, 139^{0} 39’E	Masaru Watanabe (per Japanese Banding Office)

Few north west Australian Great Knots migrate through Japan.

Date	**Location**	**Observer**
<u>Red-necked Stint</u>		
25.5.96	Lake Komuke, Monbetsu-shi, Hokkaido, Japan. 44^{0}	Kazuhiro Ohdate

	15'N, 143^0 01'E	(per Japanese Banding Office)
26.5.96	Lake Tofutsu. Abashiri-shi, Hokkaido, Japan. 43^0 55'N, 144^0 42'E	Noriyuki Funyu (per Japanese Banding Office)
9.6.96	Torey Lakes, Daursky Nature Reserve, Transbaikal, Russia. 50^0 0'N, 115^0 41'E	Dr. Oleg Goroshko (via Pavel Tomkovich)

Two nice sightings on northward migration through Japan; sightings on southward migration are more common. The bird in southern Siberia was in company with ten orange leg-flagged Red-necked Stints from Victoria.

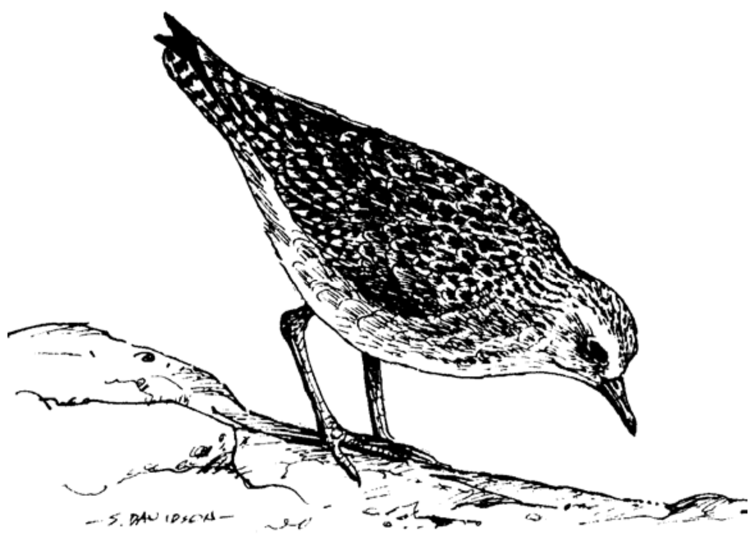
Curlew Sandpiper

9.4.96	Mai Po Nature Reserve, Hong Kong 22^0 29'N, 114^0 19'E	Paul Leader
19.4.96	as above (2 birds)	Paul Leader
20.4.96	as above (2 Birds)	Steve McChesney & Peter Kennerley
1.5.96	as above	Herbert Siegal
12.5.96	Sago, Kami-agata-machi, Tsushima Island, Japan. 34^0 38'N, 129^0 20'E	Hideo Ueda (per Japanese Banding Office)

At least one of the birds seen on the 20 April 1996 was different from those seen on 19 April 1996 because it had much less breeding plumage. Curlew Sandpipers are uncommon migrants on mainland Japan. Tsushima Island is halfway between Japan and Korea.

REFERENCE

Minton, C., & R. Jessop. 1995. Sightings of waders leg-flagged in NW Australia - List No. 2. Stilt 27, 33.



MOVEMENTS OF LITTLE TERNS *Sterna albifrons* BETWEEN JAPAN AND AUSTRALIA.

Minton, C. 165 Dalgetty Road, Beaumaris,Vic. 3193 AUSTRALIA

This note provides details of movements of Little Terns *Sterna albifrons* between Japan and Australia (Table 1). The movements have been produced by both band recovery and leg flag and leg band sightings. Movement of Little Terns between Japan and Australia has only recently been confirmed, though it has long been suspected.

Table 1. Details of banding and recovery/sighting of Little Terns between Japan and Australia. * These records refer to sightings of colour marked birds, the remainder relate to captures/recaptures except Japan 3B37110 where the bird was found dying

	Banding Details			Recovery Details		
Bands/Flags	**Date**	**Age**	**Place**	**Date**	**Place**	**Observer**
041-59331	14.1.90, 9.3.91, 29.1.94, 15.3.94*, 28.10.94 to 28.1.95*, 8.11.95 to 21.2.96*	Adult	Ocean Grange, Lakes, National Park, Victoria (37°58′S 147°44′E)	26.6.94	Tenryu River, Nagashima, Hamakita-shi, Japan (34°48′N 137°48′E)	per Japanese Banding Office
Note that this bird has been seen back in Australia in two successive 'years' subsequent to its recapture in Japan (close to a breeding colony)						
Japan 3B 37110	15.6.94	Chick	Tenryu River, Nagashima, Hamakita-shi, Japan (34°48′N 137°48′E)	2.10.94	Kowanyama, Queensland (15°29′S 141°44′E)	S.Yam (per Australian Banding Office)
Left tarsus- metal band, Right tarsus- green band	since June 1992	Chick	Mouth of Tone River, Hasaki- Machi, Kashima-gun, Ibaraki Prefecture, Japan (35°45′N 140°50′E)	29.9.94*	Nambucca Heads, New South Wales(30°39′S 152°59′E)	Clive Minton
Green band on tarsus	since June 1992	Unknown	Mouth of Tone River, Hasaki- Machi, Kashima-gun, Ibaraki Prefecture, Japan (35°45′N 140°50′E)	10.3.95*	Stockton Bridge, Newcastle, New South Wales (32°52′S 151°46′E)	David Geering
Left tarsus- purple band, Right tarsus- metal band	since June 1992	Unknown	Ishikawa Prefecture, Japan	8.11.94*, 23.12.94	Forster, New South Wales 32°10′S 152°35′E)	Tony Rose (per Peter Smith)

RUSSIAN COLOUR-BANDED/FLAGGED WADERS SEEN IN AUSTRALIA.

Minton, C. 165 Dalgetty Road, Beaumaris,Vic. 3193 AUSTRALIA

This list presents details of waders colour banded or colour flagged in Russia, and subsequently seen in Australia. Three species of Calidrids have found their way onto this list, and the ongoing vigilance of observers for colour-marked waders is encouraged. (see Table 1).

Table1.

	Banding details			Sighting details				
Species	**bands/flags**	**date**	**age/sex**	**place**	**bander**	**date**	**place**	**observer**
Red Knot	Stokholm 4363204 left tarsus-white over blue band right tarsus-pink over metal band	10.7.94	adult at nest	Faddeyevski Island, New Siberian Islands, Russia (75°33´N 143°50´E)	Tundra ecology'94 Expedition - Ake Lindstrom & Steffan Bensch	10.11.95	Broome, Western Australia (at Broome Bird Observatory) (18°0´S 122°22´E)	Mary Atkinson
Great Knot	Moskwa P904986 left tarsus-red over white flag right tarsus-metal band	22.6.94	breeding adult female	Upper Anadyr River, N.E.Siberia, Russia (64°55´N 168°35´E)	Pavel Tomkovich	9.9.94 19.9.94 17.10.95	Broome, Western Australia (Broome Bird Observatory) (18°0´S 122°22´E)	Becky Hayward & Jon Fallaw
	This bird was also seen back at the same nesting site in Siberia on 27.6.95. This is now a unique 'double double journey recovery'!							
Great Knot	Moskwa P952142 left tibia-red flag right tibia-metal band right tarsus-red flag	18.6.95	breeding adult female	Upper Anadyr River, N.E. Siberia Russia (64° 55´N 168° 35´E)	Pavel Tomkovich	17.12.95	Burdekin River mouth,nr.Bowen Queensland (19°37´S 147°30´E)	Stuart Pell & Frank Harrison
Curlew Sandpiper	left tarsus-white over yellow band right tarsus-pink over metal band	5 or 6.8.94	juvenile	Yana Delta, Russia (72°21´N 140°15´E)	Tundra Ecology '94 Expedition	30.10.94	Perkins Island Tasmania (40°45´S 145°02´E)	Simon Plowright
Curlew Sandpiper	left tarsus-pink band right tarsus-white over red band (metal band not seen)	14 or15.7.94	breeding adult female	Indigirka Delta Russia (c.72°N 149°E)	Tundra Ecology '94 Expedition	1 & 2.5.95	Ashmore Reef, off Western Australia (12°20´S 123°05´E)	Des Pike (ANCA)

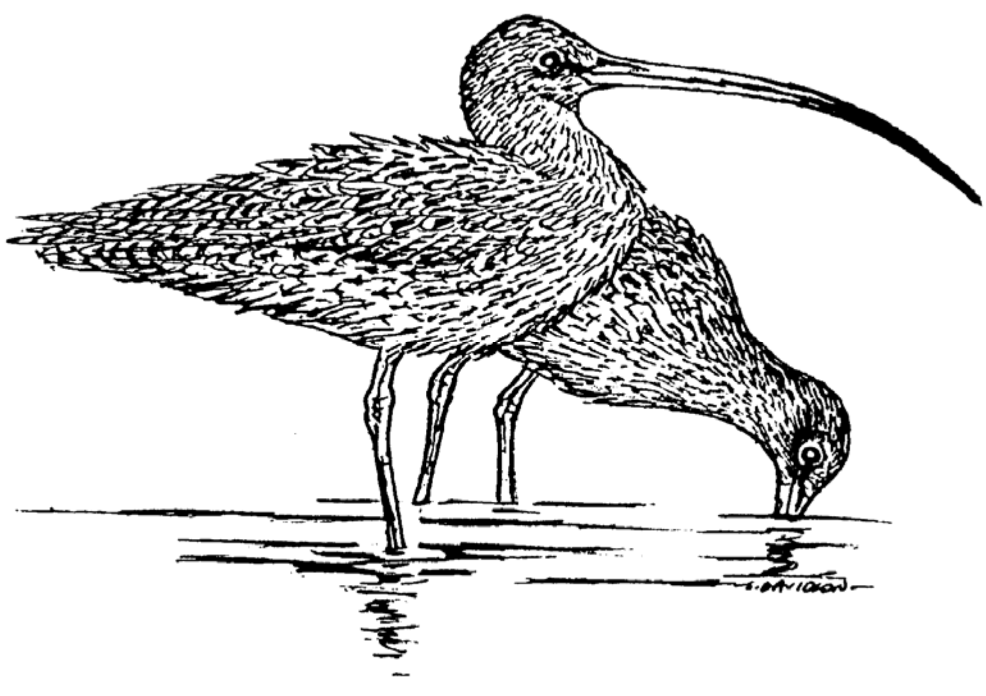
JAPANESE LEG-FLAGGED WADERS SEEN IN AUSTRALIA.

Minton, C. 165 Dalgetty Road, Beaumaris,Vic. 3193 AUSTRALIA

This note presents a list of Japanese leg-flagged waders sighted in Australia. Sightings of five species are presented here.

Species and Date seen	Location seen	Colour flag/metal band positions	Observer
Greytailed Tattler			
21.4.96	Boonooroo, Queensland (25°40´S 152°54´E)	blue flag left tibia metal band not seen	Chris Barnes 277 Bourborg St. Bundaberg, Q 4676
15.12.95	Leicester Island, Shoalwater Bay, Queensland (22°15´S 150°26´E)	blue flag left tibia metal band not seen	Greg Nye & Paul O'Neill (via Peter Driscoll)
15.11.95	Toorbul Foreshore, Pumicestone Passage, Queensland (27°02´S 153°06´E)	blue flag (position not reported)	Arthur & Cheryl Keats (via Peter Driscoll)
18 & 19.9.95	near Mackay, Queensland (21°09´S 149°12´E)	blue flag left tibia metal band not seen	Les Thyer, P.O. Box 5518, Mackay Mail Centre, Q 4740
30.11.95	Manly Boat Harbour, Moreton Bay, Queensland (27°27´S 153°11´E)	blue flag (position not reported)	Les Dick, Col Collins, David Siems, Hilary & Mannes (via Peter Driscoll)
6.1.96	Lytton, Moreton Bay, Queensand (27°25´S 153° 10´E)	blue flag on left tibia metal band on right tibia	Fiona Johnson (via Peter Driscoll)
11.2.96	Amity Spit, North Stradbroke Island, Queensland (27°24´S 153°10´E)	blue flag (position not reported)	Ian Gynther (via Peter Driscoll)
22 & 23 3. 96	Tweed Heads, Queensland (28°13´S 153°33´E)	blue flag left tibia metal band not seen	Edward Kleiber
5.4.96	Mirapool, Moreton Island, Queensland (27°20´S 153°26´E)	blue flag on tibia (leg not recorded)	Peter Driscoll
Bar-tailed Godwit			
3.2.95	Belongil Creek, 4.5 kms west of Cape Byron, New South Wales (28°38´S 153°35´E)	turquoise band/tape right tibia metal band not seen	John Izzard, 11 Newport Street, East Ballina, NSW 2478
Red Knot (These sightings probably all refer to the same individual bird)			
18.1.96	Richmond River Estuary, New South Wales (28°52´S 153°35´E)	blue flag left tibia metal band not seen	David Rohweder 4/25 Tamar Street, Ballina, NSW 2480
25.3.96 26.3.96 31.3.96	Chickiaba Lake, Richmond River, East Ballina, NSW (28°51´S 153°34´E)	blue flag left tibia metal band not seen	John Izzard, 11 Newport Street, East Ballina, NSW 2478

Species and Date seen	Location seen	Colour flag/metal band positions	Observer
Red-necked Stint			
29.10.94	Fern Island, BeagleBay, 130 km N of Broome, Western Australia (16°55´S 122°35´E)	blue flag left tibia metal band on right tibia	George Swann, P.O. Box 220, Broome, WA 6725
18.10.95	Bynoe Harbour, Darwin, Northern Territory (12°36´S 130°34´E)	blue flag left tibia metal band not seen	Ray Chatto, CCNT, P.O.Box 496, Palmerston, NT 0831
26.11.95	Fisherman's Islands, Brisbane River Mouth, Moreton Bay, Queensland (27°22´S 153°10´E)	blue flag left tarsus metal band right (tarsus?)	Peter Driscoll, Fahey Road Mt.Glorions, Q 4520
25-28.4.96	Bucasia, Mackay, Queensland (21°30'S 149°10'E)	blue flag left tibia metal band(position not recorded	Frank Harrison, 4/6 Albert St Cranbrook, Townsville Q 4814
Broad-billed Sandpiper			
15.11.95	Newell Beach, 8km NE of Mossman, Queensland (16°26´S 146°23´E)	blue flag left tibia metal band not seen	D.C.Richards, P.O.Box 853, Mossman, Q 4873



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All volumes of *The Stilt* are available as back issues. Costs of volumes 1-28 (subject to review), including surface postage, are:

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Single copies	$Aus 6.00	$Aus 7.00
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The cost of back issues for volumes 29 and later are currently being determined. Payment should be forwarded as a bank draft or money order in Australian currency or by *Visa/Bankcard* etc. (not *American Express*). All inquiries should be directed to the Secretary-Treasurer.

Indexes:

Author and species indexes have been published within *The Stilt* to volume 24.

Volumes Indexed	Volume containing Index
1-6	7
7-12	13
13-18	19
19-24	25

ADVICE TO CONTRIBUTORS

The Stilt publishes original papers, technical notes and short communications on the waders (“shorebirds”) of the East Asian/Australasian Flyway and relevant Pacific regions. The Editor welcomes any inquiries or questions from potential contributors.

Matters relating to format, style, nomenclature and taxonomy are discussed on the inside back cover of volume 28. The Editor encourages all potential contributors to read the *Advice to Contributors* carefully. Any questions relating to these issues are welcomed, and should be directed to the Editor.

Submission Procedure

The following procedure is designed to increase the efficiency and quality of the editorial process of *The Stilt*. All contributors are asked to follow the procedure carefully, in order to prevent unnecessary delays in the publication of material. Once again, if there are any problems or if you have any questions relating to the procedure, please contact the Editor.

The procedure gives contributors the opportunity to incorporate comments from the review and editorial process. In this way, the Editor hopes that contributors will be happy with the final version which is published.

Steps:

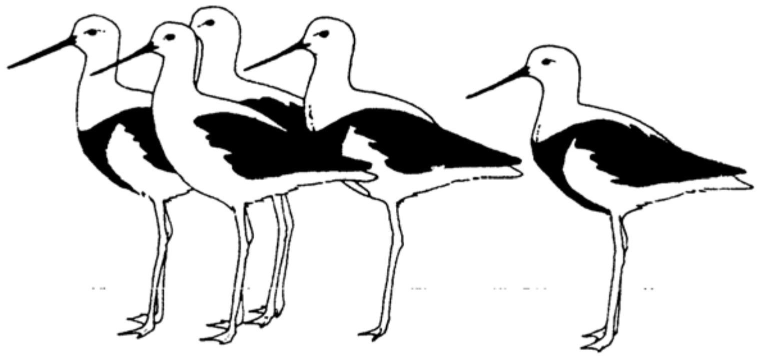
1. two hard copies (print outs) of submitted material should be forwarded to the Editor by post. A statement of whether the manuscript and graphics are available on diskette, or by email, is required. Remember to provide all contact details. The material should be complete, and the contributor should consider it the finished version.
2. one copy of the manuscript will be sent out to review, and one will be edited for matters of style, format, taxonomy and nomenclature. Comments will be made on the hard copies. Reviewers may remain anonymous if they wish.
3. both sets of comments will be returned to the contributor for consideration and incorporation. Where major disagreements occur between the reviewers comments and the contributor, or where comments are not incorporated satisfactorily, the Editor reserves the right to make the final judgement. Nevertheless, the reviewing system is intended to be a friendly and positive source of constructive criticism. Matters of style, format, taxonomy and nomenclature are generally not negotiable; these changes need to be made.
4. the contributor posts one hard copy of the final version, along with a diskette or attached email file, to the Editor. The Editor will check the changes, if any, that have been made. The reviewer will be consulted if required, or if requested by the contributor.
5. the editorial team is responsible for the final layout and publishing. The next the contributor will see of the submitted material is in its published form in *The Stilt*.

Deadlines:

The closing dates for submission of material have been revised. They are 10 February and 10 August 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.

The Tattler

Submission of material to *The Tattler* should be forwarded to the Assistant Editor, Phil Straw.



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