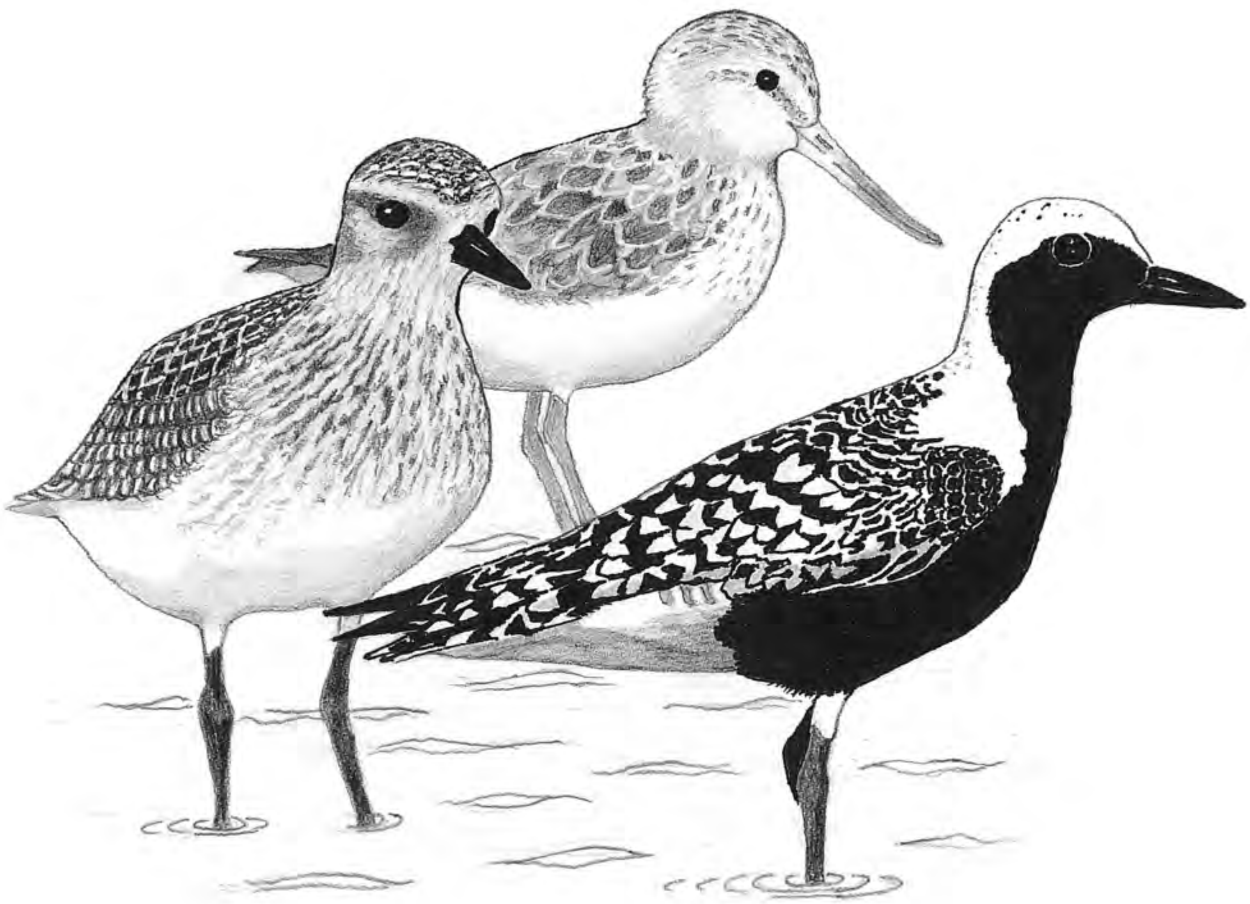
Stilt

The Journal for the East Asian-Australasian Flyway



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Australasian Wader Studies Group

Stilt

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MISSION STATEMENT

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

OBJECTIVES

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

OFFICE BEARERS

Chair: Alison Russell-French, PO Box 1045
Canberra ACT 2601, AUSTRALIA.
Email: alisonrf@iinet.net.au

Vice Chair: Phil Straw, P.O. Box 2006, Rockdale Delivery Centre NSW 2216, AUSTRALIA.
Ph and fax: (02) 9597 7765.
Email: philip.straw@awsg.org.au

Chair of Research Committee: Danny Rogers, 340 Ninks Rd, St Andrews Vic. 3761, AUSTRALIA. Ph: (03) 9710 1345.
Email: drogers@melbpc.org.au

Editor: Birgita Hansen, University of Ballarat (Mt Helen), PO Box 663, Ballarat, Vic 3353, AUSTRALIA. Ph: (03) 5327 9952
Email: editor@awsg.org.au

Secretary: Linda Patrick, PO Box 34, Shoreham, Vic. 3916, AUSTRALIA. Ph: (03) 5989 8963
Email: linda@farmingminds.com.au

Treasurer: Arthur Keates, PO Box 1483, Carindale Qld 4152, AUSTRALIA. Ph: 0410 960 955.
Email: arthur.keates@gmail.com

Conservation Officer: Golo Maurer, Suite 2-05, 60 Leicester Street, Carlton, Vic, 3053, AUSTRALIA. Ph: (03) 9347 0757
Email: golo.maurer@birdlife.org.au

STATE CONSERVATION OFFICERS

QUEENSLAND
Joyce Harding, PO Box 1530, Cleveland Qld 4163.
Email: pallara@powerup.com.au
Sandra Harding, 336 Prout Road, Burbank QLD 4156
Email: pitta@gil.com.au

NEW SOUTH WALES
Joan Dawes Ph: 02 9664 2546
Email: jdawes@bigpond.net.au

TASMANIA
Eric Woehler (South Tas), 37 Parliament St, Sandy Bay Tas 7005. Ph: (03) 6223 1980. Email:eric_woe@ipr imus.com.au
Ralph Cooper (North Tas) 7 Beach Rd, Legana Tas 7277.
Ph: (03) 6330 1255. Email: rabacooper@bigpond.com

SOUTH AUSTRALIA
Paul Wainwright, PO Box 255, Balhannah SA 5242
Ph: 0429 678 475. Email: paul.wainwright@sa.gov.au

VICTORIA
Doris Graham, 14 Falconer St, Fitzroy Vic 3068.
Ph (03): 9482 2112. Email:grahamdm@melbpc.org.au

WESTERN AUSTRALIA
Bill Rutherford (s. WA – cutoff Onslow), 199 Daglish St, Wembly, Perth 6014. Email: calidris@iinet.net.au
Chris Hassell (n. WA – cutoff Onslow), Global Flyway Network PO Box 3089, Broome, WA 6725. Ph: (08) 9192 8585
or 0408 954 655. Email: turnstone@wn.com.au

INTERNATIONAL REPRESENTATIVES

NEW ZEALAND

North Island:
Adrian Riegen, 213 Forest Hill Rd, Waiatarua, Auckland 0612, New Zealand. Ph: (09) 814 9741 Email: riegen@xtra.co.nz

South Island:
Rob Schuckard, 4351 Croisilles French Pass Rd RD3, French Pass 7139, New Zealand. Ph: 35765371
Email: rschckrd@xtra.co.nz

ASIA
Doug Watkins, Manager Wetlands International – Oceania, PO Box 4573, Kingston ACT 2604 AUSTRALIA.
Ph: +61 2 6260 8341.
Email: doug.watkins@wetlands-oceania.org

OTHER COMMITTEE MEMBERS

Maureen Christie, Roz Jessop, Greg Kerr, Marcel Klaassen, Amanda Lilleyman, Penny Johns, Clive Minton, Penny Johns, Kim Onton, Adrian Riegen, Roger Standen, Paul Wainwright, Doug Watkins and Dan Weller.

MEMBERSHIP OF THE AUSTRALASIAN WADER STUDIES GROUP

Membership of the AWSG is open to anyone interested in the conservation and research of waders (shorebirds) in the East Asian–Australasian Flyway. Members receive the twice yearly bulletin *Stilt*, and the quarterly newsletter *Tattler*. Please direct all membership enquiries to the Membership Manager at BirdLife Australia, Suite 2-05, 60 Leicester St, Carlton Vic 3053, AUSTRALIA.
Ph: 1300 730 075, fax: (03) 9347 9323.
Email: membership@birdlife.org.au

Annual Subscriptions:	Australia & New Zealand	A$40.00
	Overseas	A$45.00
	Institutions	A$50.00

Published in May 2014

9th Australasian Shorebird Conference

20-21 September 2014
Darwin, Northern Territory

REGISTRATION IS OPEN!

Earlybird Registration:	General Registration:
Before 31st July	*After 31st July*
Standard $150	Standard $170
Student $100	Student $120

The conference will be held at Charles Darwin University in Darwin, Northern Territory and will host a range of talks on shorebirds and issues within the East Asian-Australasian Flyway.
See the website for further details:

http://www.awsg.org.au/australasian-shorebird-conference.php

birdlife AUSTRALIA

AWSG Australasian Wader Studies Group

TREASURER'S REPORT FOR 2013

In 2013, total income exceeded expenses by $7,350.30.
The balance of $57,289.81 carried forward at 31 December 2013 includes commitments for future contract expenditure of $14,659.65
General accumulated funds were $42,630.16 at the end of the year.

Australasian Wader Studies Group
Income and Expenses
1 January 2013 - 31 December 2013

INCOME			EXPENSES		
Item	**2013 $**	**2012 $**	**Item**	**2013 $**	**2012 $**
Balance brought forward	49,939.51	68,858.35	Printing	3,596.92	4,300.73
Subscriptions	3,359.20	6,837.50	Postage/courier	841.81	
BirdLife Australia transfer	24,184.41		Surveys/reports/monitoring	12,452.61	32,963.30
Contracts - State Govts.		8,000.00	Donations	7,000.00	200.00
Contracts - Other	40,500.00	19,500.00	Travel/accommodation/meals	18,841.05	15,836.93
Donations	3,550.00	4,763.00	Salaries/superannuation etc	16,901.95	
Conference/meetings		8,213.69	Admin fee (BirdLife Australia)		750.00
Other income	116.40		Equipment/consumables	4,509.41	
			Other expenses	215.96	297.16
Total income	71,710.01	47,314.19	Total expenses	64,359.71	54,348.12
Total accumulated funds	121,649.52	116,172.54			
Balance carried forward	**57,289.81**	**61,824.42**			

Membership statistics:

Membership at the end of the year was:	2013	2012
Australia/New Zealand	230	195
Overseas (excl. NZ)	23	20
Institutions	10	8
Complimentary	55	55
Total	**318**	**278**

This summary of income and expenses for the past year is not an audited statement. It has been prepared for the information of AWSG members from records of transactions provided by BirdLife Australia relating to the Australasian Wader Studies Group.

The AWSG is a special interest group of BirdLife Australia and members who wish to see the audited accounts of BirdLife Australia should refer to the Concise Financial Report included in the BirdLife Australia Annual Report 2013.

THE IMPORTANCE OF BOWLING GREEN BAY AND BURDEKIN RIVER DELTA, NORTH QUEENSLAND, AUSTRALIA FOR SHOREBIRDS AND WATERBIRDS

DAVID A. MILTON[1], PETER V. DRISCOLL[2], SANDRA B. HARDING[1]

[1] 336 Prout Rd., Burbank Qld 4156 AUSTRALIA
Email: david.milton@csiro.au
[2] PO Box 6227, Mooloolah Valley Qld 4553 AUSTRALIA

Bowling Green Bay is a large tidal wetland about 50 km south of Townsville, north Queensland with extensive freshwater wetlands in its small catchment. Shorebirds and waterbirds were monitored intensively in Bowling Green Bay and nearby freshwater wetlands in 2011 – 2012 as part of a study of the ecological values of the Bowling Green Bay Ramsar site. Four surveys of the entire region were made between August 2011 and April 2012. Each survey involved aerial reconnaissance of coastal shorebird roost sites and thorough aerial counts of waterbirds on freshwater wetlands, followed by ground counts of accessible high tide shorebird roosts and a selection of four freshwater wetlands. During the study, shorebird roosts in the nearby mouth of the Burdekin River were surveyed twice from the air and ground (October 2011 and January 2012). The Bowling Green Bay region supported over 5,000 shorebirds, including internationally-significant numbers of the globally threatened Great Knot. The freshwater wetlands supported almost 60,000 waterbirds of 41 species. The mouth of the Burdekin River held almost 10,000 shorebirds of 23 species, including internationally-significant numbers of declining Greater and Lesser Sand Plover. Overall, around 90% of all waterbirds were counted outside the Bowling Green Bay Ramsar site boundary. The high diversity of shorebirds and waterbirds and the internationally-significant numbers of threatened shorebird species make this region of high conservation value. The results also demonstrate that the freshwater wetlands support some of the larger waterbird populations in eastern Australia, including three species present in internationally-significant numbers. The majority of these freshwater wetlands and the Burdekin River mouth have no formal protection, as they fall outside the Ramsar site boundary. We discuss the major threats and highlight the vulnerability of both the freshwater and coastal wetlands to degradation or loss from irrigated agriculture and water extraction.

INTRODUCTION

Bowling Green Bay, in north-eastern Australia, is a unique coastal wetland of great complexity that has been protected within the Bowling Green Bay National Park. It was declared a Ramsar site in 1993 as it met several of the criteria for a wetland of international importance (Kelly & Lee Long 2011). Two of the criteria that it met were (1) the provision of habitat to support over 20,000 waterbirds, including large populations of Magpie Geese (*Anseranas semipalmata*) and Brolga (*Grus rubicunda*); (2) it supported 1% of the East Asian - Australasian Flyway (EAAF) population of one species of shorebird: Black-tailed Godwit (*Limosa limosa*). Since the Ramsar site was gazetted, few data have been collected on the waterbirds, including Magpie Geese and Brolga. Much of the freshwater wetlands lie outside the Ramsar boundary and at the time of gazettal, there was an irrigated rice scheme operating in the region that may have attracted many of the waterbirds recorded. This rice growing scheme ceased in the 1990s and it is unclear if the Ramsar site ever did, or still does support the 20,000 waterbirds required to meet the Ramsar criteria.

Members of the Townsville Bird Observers Club (now BirdLife Townsville or BLT) have been surveying the shorebirds at coastal high tide roosts in Bowling Green Bay Ramsar site since 1995 with the support of the Queensland Parks and Wildlife Service. These surveys have focussed on high tide roosts on Cape Bowling Green in the north-eastern corner of Bowling Green Bay. This was the area where 2,058 Black-tailed Godwit were counted in 1996 (Harrison 1997). This count represented 1.3% of the estimated EAAF population (Watkins 1993) and demonstrated that the region met this Ramsar criterion. However, the surveys by BLT were not comprehensive, even within the Ramsar site. Pell and Lawler (1996) documented several other high tide roosts besides those surveyed by BirdLife Townsville. The numbers of birds counted on these roosts were substantial and suggest that the Ramsar site may also support additional shorebird species in internationally-significant numbers.

Although Bowling Green Bay is recognised as an internationally-significant wetland, the nearby delta of the large Burdekin River has also been shown to support internationally-significant numbers of at least one species of shorebird, Lesser Sand Plover (*Charadrius mongolus*) (Pell & Lawler 1996, Bamford *et al.* 2008). However, due to the remote location, there have been few subsequent surveys since the initial documentation of its importance (Queensland Wader Study Group, *unpubl. data*). Construction of major dams on the Burdekin River and diversion of flows for irrigation have reduced the

Figure 1. Intended initial systematic flight paths (white) for the Bowling Green Bay Ramsar site (greyed area) and adjacent areas, which had been planned for 27-28 August 2011. The actual initial flights are shown in black. The image also shows the Burdekin River Delta to the south east of Bowling Green Bay.

freshwater outflow from the river. The reduction in river flow has reduced the quantity of terrestrial organic matter that reaches the estuary to provide the prime source of nutrients for intertidal invertebrates (Blaber 2000, Nebel *et al.* 2008). If invertebrate populations have indeed declined, this may impact on the numbers of shorebirds the river delta can support.

The aims of this study were to: (1) survey the shorebirds and waterbirds, particularly Magpie Geese and Brolga, of the Bowling Green Bay Ramsar site (BGBRS) and adjacent freshwater wetlands; (2) analyse the available historical and contemporary data to assess the status of shorebirds in the Ramsar site and (3) undertake surveys of shorebirds in the Burdekin River delta to assess their current status.

METHODS

Throughout the document shorebirds and other waterbirds are treated separately, which reflects the distinction between the marine, coastal wetland habitat where the majority of shorebirds were encountered and the freshwater, subcoastal wetland habitat where the majority of other waterbirds were encountered. Different sampling techniques were employed as explained below and the much of the freshwater habitat surveyed was beyond the Ramsar boundary.

Waterbird surveys

Waterbirds such as Magpie Geese and Brolga vary in their seasonal habitat use, being more concentrated and thus more detectable during the dry season (Blackman 1979, Bayliss & Yeomans 1990a). We scheduled the first survey of the BGBRS and adjacent lands for late August to coincide with the mid-late dry season during the period when the birds should be more concentrated. Due to problems of access, land tenure and extent of the area being surveyed, the abundance of Magpie Geese, Brolga and other waterbirds over much of the survey area could only be estimated effectively from the air.

Consequently, the first survey included an extensive, systematic aerial survey of the region by light plane (Figure 1) with subsequent ground checking of aerial counts at four selected sites that were accessible from the ground. It became apparent that targeting wetlands or specific locations from the air was going to be the only feasible way to gain an estimate of total numbers of waterbirds. As we were particularly interested in targeting wetlands where birds would be present, flying set transects across all of the terrain within the survey area was not practical. This was due to the tendency for wetlands to dry out making the systematic approach inefficient in terms of time and cost, especially as the aerial surveys needed to be repeated on each visit. That is, aerial surveys on both the initial and later field trips involved overflying locations that had been found to have waterbirds but also included less systematic checks of the whole area to detect any previously unknown locations where waterbirds were in high numbers.

The initial systematic survey methods followed those used on other, similar waterbirds surveys made in Australia (Kingsford *et al.* 2012). The spacing of the aerial transects (600 m) was designed to obtain a better than 60% coverage from a height of 480 ft (146m) at a speed of 60 kts (110 km.h^{-1}). The same basic height and speed was used during subsequent surveys but not along set transects. Previous survey experience suggested that waterbirds, including Brolgas and Magpie Geese, could be detected effectively at this height and speed (Blackman 1979, Kingsford *et al.* 2012). Two observers made simultaneous counts of Magpie Geese, Brolgas and other waterbirds on separate sides of the plane. One observer, Peter Driscoll (PD), was present during most aerial surveys and the second observer alternated between David Milton (DM) and Sandra Harding (SH) (Table 1). Three different light planes were used throughout the project (Carbon Cub, Foxbat and Pelican). All were high wing planes that enabled a clear view of the ground below.

Table 1. Details of the aerial surveys and ground counts of waterbirds and shorebirds in the Bowling Green Bay Ramsar site (BGBRS) and adjacent freshwater wetlands between August 2011and March 2012 (PD = Peter Driscoll, DM = David Milton, SH = Sandra Harding; GB = George Baker; ST = Stephanie Tomkinson).

Date	Observers	Time of day	Activity
27 August 2011	PD, SH	AM	Systematic aerial survey of BGBRS
	PD, SH	PM	Systematic aerial survey of BGBRS
	DM	AM/PM	Targeted ground reconnaissance of accessible freshwater wetlands outside the BGBRS and accessible known shorebird high tide roosts.
28 August 2011	PD, SH	AM/PM	Targeted aerial survey of freshwater wetlands with high concentrations of Magpie Geese within and outside the BGBRS.
	DM	AM	Aerial survey of freshwater wetlands outside the BGBRS and mouth of Burdekin River.
29 August 2011	PD, DM	AM	High tide aerial survey of Cleveland and Bowling Green Bay coast for shorebirds at roosts.
	SH	AM	Ground reconnaissance of accessible freshwater wetlands and shorebird roosts outside the BGBRS.
	PD, DM	PM	Targeted aerial survey of freshwater wetlands outside the BGBRS with high concentrations of Magpie Geese.
30 August 2011	PD, DM, SH	AM/PM	Ground counts of Magpie Geese, Brolgas and other waterbirds on accessible freshwater wetlands within and outside BGBRS with large concentrations of Magpie Geese.
31 August 2011	PD	AM	Targeted aerial survey of wetlands during departure flight south.
26 October 2011	DM	AM	Systematic coastal aerial survey inside and outside BGBRS.
	PD	AM	Selective sub coastal aerial survey inside and outside BGBRS.
	SH, GB	AM	Ground counts of freshwater wetlands outside BGBRS.
	SH, GB, DM, PD	PM	Ground counts of freshwater wetlands outside BGBRS.
27 October 2011	DM, SH, PD	AM/PM	Ground counts by boat of shorebird roosts within BGBRS
	DM, SH, PD	AM	Ground counts of freshwater wetlands
28 October 2011	PD, SH	AM	Ground counts by boat of shorebird roosts within BGBRS
	DM, GB	AM	Ground counts by boat of shorebird roosts inside BGBRS – aborted trip to Cape Bowling Green.
	PD, DM, SH	PM	Low tide feeding counts of shorebirds in Cleveland Bay
29 October 2011	PD, DM, SH	AM/PM	Ground counts by boat of shorebird roosts at the mouth of the Burdekin River
30 October 2011	PD, DM, SH	AM/PM	Ground counts of shorebird roosts within BGBRS including at Chunda Bay and Alva
21 January 2012	PD, SH, DM	AM	Ground counts (boat) of shorebird roosts: western BGBRS
	SH, DM	AM/PM	Ground counts of freshwater wetlands outside BGBRS.
	PD	PM	Selective sub coastal aerial survey inside and outside BGBRS.
22 January 2012	PD, SH, DM	AM	Ground counts (boat) of roosts: eastern BGBRS including Cape Bowling Green.
	PD, SH, DM	PM	Ground counts of freshwater wetlands outside BGBRS.
23 January 2012	PD, SH, DM	AM	Ground counts (car & foot) supra-tidal wetlands, near Alva outside BGBRS.
	PD, SH, DM	AM	Ground counts of freshwater wetlands outside BGBRS.
24 January 2012	PD, DM, SH	AM/PM	Ground counts (boat) of shorebird roosts: Burdekin River mouth
17 March 2012	PD, ST	AM	Ground counts (boat) of shorebird on western side of BGBRS
20 March 2012	PD, DM, SH	AM	Ground count of Salmon Ck shorebird roost, western side BGBRS
		PM	Ground counts of Cromarty freshwater wetland outside BGBRS.
21 March 2012	PD, DM, SH	PM	Ground counts of accessible freshwater wetlands outside BGBRS.
22 March 2012	PD	AM	Aerial survey of shorebird roosts and selected freshwater wetlands in BGBRS
23 March 2012	DM, SH	AM	Ground counts of accessible freshwater wetlands outside BGBRS.

Our prior observations of Magpie Geese daily movement patterns found that the birds congregate and early morning before dispersing to feed during the day. Flights were made in early to mid-morning and later in the afternoon when the Magpie Geese were most likely to be roosting and thus concentrated around freshwater wetlands (Table 1). During all aerial transects, counts of Magpie Geese, Brolga, shorebirds and other waterbirds seen by each observer were recorded against the time of observation. These observation times were linked, post-survey to GPS tracking of the flight routes to give their location.

After the flights, four large accessible wetlands with high counts of Magpie Geese and other waterbirds were resurveyed from the ground. Ground access was more restricted and so only the same four large freshwater wetlands (Cromarty, Horseshoe, Carrick, Jerona; Figure 2) were counted from the ground and counted from the air during each survey (Table 1). As noted above, during the initial survey, some locations were counted more than once from the air. Hence the highest count of individual species or taxa grouping (see below) was used as the representative value of aerial counts for the first survey. All apparent freshwater wetland sites were overflown and counted on each of the four surveys at least once, but not necessarily in the context of a set flight pattern. Furthermore, although aerial surveying was most intense during the initial survey, aerial counts were made on every survey where birds were found in high numbers. Hence, it was possible to make a seasonal comparison of counts for particular wetlands and for the study area as a whole.

Calibrating aerial counts of waterbirds

The extent and mostly inaccessible nature of most of the freshwater wetlands in and adjoining the BGBRS meant we primarily relied upon aerial counts to estimate numbers of waterbirds across the study area. To do so required calibration of aerial counts to bird numbers counted from the ground. Four wetlands (Cromarty, Horseshoe, Carrick and Jerona) were taken as examples to represent the range of wetlands across the whole of the study area (Morton *et al.* 1990, 1993) (Figure 2) and each was counted from the ground and from the air on every survey. It was assumed that collectively, the ground counts from these wetlands were representative of the species composition found across the whole study area.

Each record of bird(s) counted from the air was assigned coordinates to within 100m and was not initially allocated to a particular wetland, as was the case with all the ground counts. Therefore to match aerial with ground counts from particular wetlands, aerial counts were loaded in a GIS, mapped, grouped and summed where they occurred in the vicinity of the different wetlands.

The calibration of aerial counts to give estimates of actual bird numbers for the whole of the survey area was based upon comparing all aerial counts with ground counts from the four wetland sites, referred to here as the calibration sites. In undertaking the calibrations, species were firstly allocated to different categories or groups based on size, behaviour and detectability. Secondly, some assumptions also needed to be made about the nature of the data.

The groups (A, B or C) are explained below and indicated in Table 2.

Group A species are those where considerable numbers were counted from both the air and from the ground at the calibration sites (refer to assumptions 5 & 6 below).

Group B species are calibrated collectively as groupings of species (dk: ducks/grebes, eg: herons/egrets/ibis, te: terns, pg: pygmy geese). As a whole, each group was counted in good numbers from the ground and from the air at the calibration sites. The raw aerial counts also included “unidentified birds” of each group (unidentifed duck, unidentified egret etc) which were first allocated to species within each group according to the relative abundance of identified taxa from the ground counts at the calibration sites (refer to assumptions 4, 5 & 6).

Group C species were very poorly represented in the aerial counts, usually because of their small size or cryptic nature. These species have been indexed to Magpie Geese aerial counts (refer to assumption 7).

The assumptions below form the basis of how aerial counts have been used to estimate overall waterbird numbers with calibration measures based upon comparing aerial and ground counts from the calibration sites.

One: All of the main gatherings of waterbirds were counted from the air for the whole survey area on each of the surveys.

Two: Collectively, the four calibration sites are representative of the species composition that occurs throughout the study area (Morton *et al.* 1990, 1993). This assumption is based on our subjective aerial assessment that the sites represented a broad range of the wetland habitat types and conditions that occurred throughout the study area.

Three: The ratio of birds counted from the air to birds counted from the ground at the calibration sites would be the same for each species or taxa group across the whole study area (visibility does not change).

Four: There is uniformity of the species composition across the whole survey area for subgroups of category B taxa and the mix of species within each subgroup is represented by ground counts at the four calibration sites (Morton *et al.* 1990, 1993). This is a special case of assumption 2.

Five: Based upon results from the calibration sites, if <u>more</u> birds of a species, or a taxa subgroup were counted from the air than counted from the ground then the aerial count is taken as the actual count of the species or subgroup. The alternate situation is noted below. The premise in both cases is that the actual count is taken to be the higher of either the aerial or ground count. Some species are counted more accurately from the air, others from the ground.

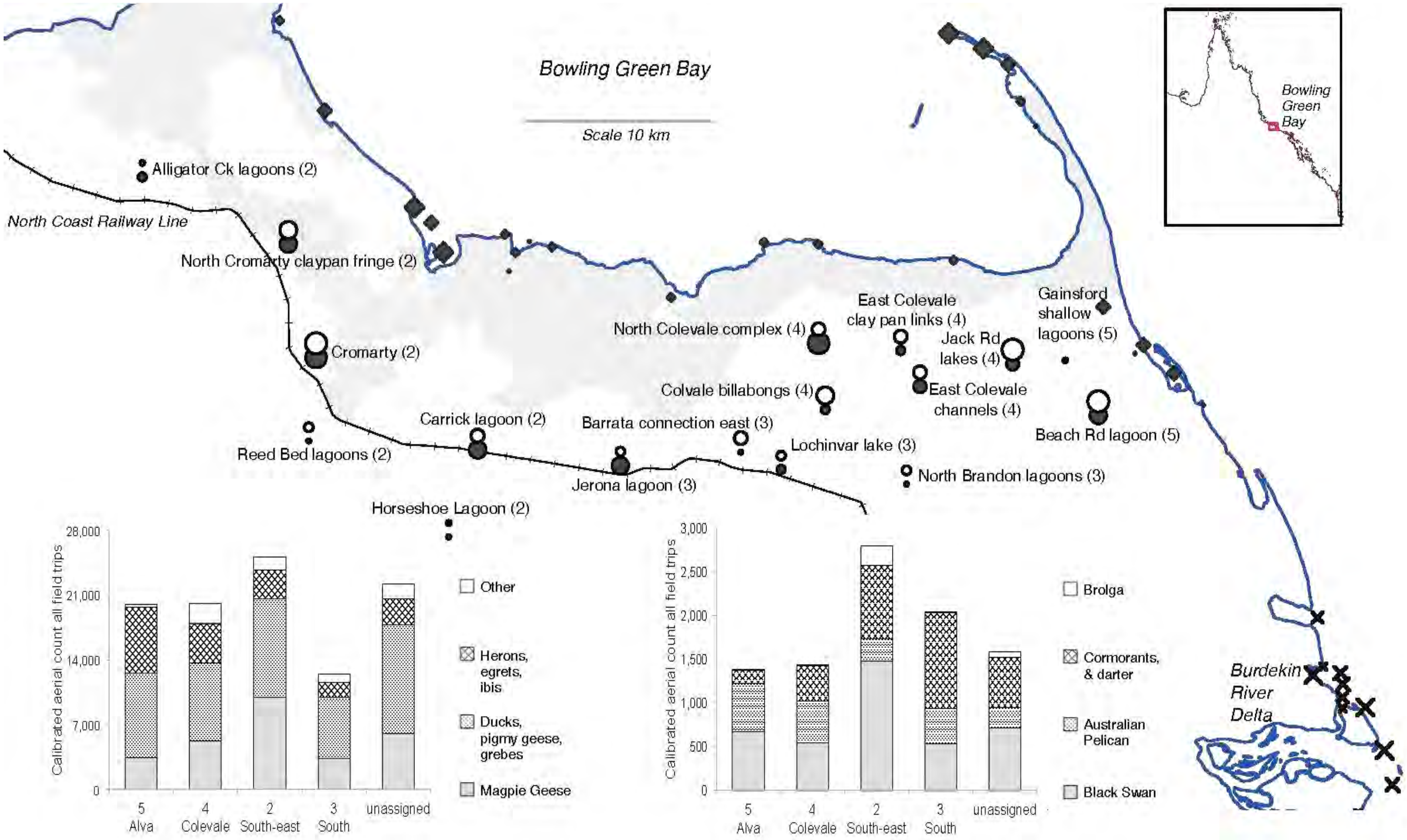

Figure 2. Location of high tide roosts for Bowling Green Bay (diamonds) and the Burdekin River Delta (crosses), and major wetlands (circles) in and outside the BGBRS (greyed area). The size of symbols generally indicate the relative total bird counts. The named freshwater wetlands are assigned closed circles (total calibrated aerial counts for all species) and open circles (magpie geese only). In addition, the histograms indicate the relative abundance of different species for each of four wetland groups: Alva (5), Colevale (4), South-east (2) and South (3). These wetland groups are indicated in brackets after the named wetlands by use of the group number to show which wetlands belong to which groups.

Six: based upon results from the calibration sites, if fewer birds of a species or taxa grouping were counted from the air than counted from the ground then the aerial count is taken as an index of actual numbers based upon the ratio of ground count divided by aerial count. This index is then applied for the relevant species or groups across the entire survey area. The index is used to adjust aerial counts upwards. Using the little black cormorant as an example, there were 381 counted from the ground throughout the sampling at the calibration sites and 177 counted from the air. Hence the index for little black cormorants throughout the survey area is 381/177=2.153, which becomes the multiplier for estimating little black cormorant numbers from aerial counts of little black cormorant.

Seven: Each of the Group C species was assumed to be as abundant throughout the survey area as they were found to be at the calibration sites (based upon ground counts), as per assumption 2. Magpie Geese (a Group A species) were ubiquitous and readily counted from the air making this species suitable for use as an indicator of the presence of Group C species throughout the survey area. Hence the numbers of each of the group C species have been indexed to aerial Magpie Geese counts using data from the calibration sites. That is, the index of a Group C species is its ground count divided by the Magpie Goose aerial count, which is then used to predict the numbers of that Group C species across the whole study area by multiplying by aerial counts of Magpie Geese at all locations in the study area. Using the Masked Lapwing as a example, a total aerial count of 8135 Magpie Geese for all the sampling at the calibration sites is matched by a total of 173 total ground counts of Masked Lapwing (Table 2). Hence the index for Masked Lapwing is 173/8135=0.0213, which becomes the multiplier for estimating Masked Lapwing numbers from aerial counts of Magpie Geese.

We tested the relationship between counts of each species using a simple correlation of ground against aerial count, expressed as an *R*-squared value. The slope and intercept weighted-least-squares regression were tested for deviation from 1:1 with the standarised T^2-statistic (Anderson 1971). All statistical analyses were undertaken in SAS version 10.2 (SAS Institute, Cary, NC, USA).

Shorebird surveys

Shorebirds were surveyed during the four field trips along the coastline by a combination of aerial reconnaissance and ground counts (Table 1). The only aerial counts of shorebirds that have been used are of those species listed in Table 2 and referenced in Table 3, and relate to primarily freshwater habitats. Only ground counts, not aerial counts of roosting shorebirds at high tide are tabulated. For shorebirds, the aerial work was primarily used for the purpose of locating roost sites and identifying any temporal changes in the positioning and size of high tide roost sites. Such flights were made in conjunction with the freshwater wetland surveys and were always undertaken prior to making counts of shorebirds from the land or boat.

Ground counts of shorebirds were made during the October, January and March field trips during the non-breeding season when shorebird abundance is highest in Australia. Most high tide roosts of shorebirds in the study were accessed by boat from ramps at Jerona in southern BGB or Cungulla on the western side, depending on the tide height and their location. Some roosts on the western foreshore of Bowling Green Bay could be accessed from the land (Figure 2). Counts were made of these roosts from the land when boat access was difficult due to strong winds. A total of 17 roosts (of 19 known) within BGBRS were surveyed at least once during this project (Table 4). Two additional roosts previously counted by BLT were not occupied by shorebirds during the study.

Data on additional shorebird surveys of Cape Bowling Green and selected roosts on the western side of Bowling Green Bay were provided by George Baker of BLT. These surveys covered the period from 1995 to 2012 and were undertaken by BLT members with Queensland National Parks vessel support.

Shorebird roosts in the Burdekin River mouth were also surveyed twice from the air (for position) and by boat (October 2011 and January 2012). These roosts were over 20 km south-east of Bowling Green Bay and well outside the BGBRS. Four high tide roosts known from previous surveys by QWSG (Pell & Lawler 1996) were confirmed to still occur in the delta of the Burdekin River. Several new roosts were also identified and counted following the aerial reconnaissance.

RESULTS

Waterbirds

Comparison of aerial and ground counts

A total of 47 species of bird associated with freshwater wetlands were counted during the study at the four calibration wetlands (Table 2). No additional species were seen during aerial surveys of other wetlands. Total ground counts were 20% higher than aerial counts at these wetlands. The pattern varied widely between species, with almost twice as many of some species such as Brolga being seen from the air. Among the 47 species counted, Magpie Geese were the most abundant species at the four wetlands. They represented almost 52% of the aerial counts and 49% of the ground counts made at these wetlands. Pacific Black Duck were the next most abundant species. Duck species were the most abundant group of waterbirds across the four wetlands. Shorebird numbers were low, reflecting their preference for feeding on coastal intertidal flats or at the margins of drying freshwater wetlands. They accounted for less than 5% of the total number of birds counted from the ground and less than 1% of the aerial count.

Table 2. Comparison of aerial and ground counts of birds recorded at four wetlands sampled during the study. The counts have been summed over the four field trips (4 surveys). CROM = Cromarty; HORL = Horseshoe Lagoon; CARR = Carrick Lagoon; JERL = Jerona Road Lagoon; A = aerial count; G = ground count. The calibration groups are defined in the text.

Species	**CROM**		**HORL**		**CARR**		**JERL**		**Total**		**Calibration group**
	A	**G**	**A**	**G**	**A**	**G**	**A**	**G**	**A**	**G**	
Australasian Darter	–	10	8	69	–	5	–	6	8	90	C
Australasian Grebe	–	–	–	207	–	28	–	22	–	257	C
Australian Pelican	40	9	17	12	90	33	6	18	153	72	A
Australian Pratincole	–	–	–	–	–	2	–	–	–	2	
Australian White Ibis	–	22	–	2	–	–	–	11	–	35	B eg
Australian Wood Duck	–	–	–	–	–	53	–	–	–	53	B dk
Black Kite	–	5	–	–	–	–	–	–	–	5	
Black Swan	755	557	429	324	112	73	3	40	1299	994	A
Black-fronted Dotterel	–	1	–	–	–	–	–	11	–	12	C
Black-necked Stork	–	5	–	1	2	1	–	6	2	13	C
Black-winged Stilt	10	300	–	–	25	1	95	117	130	418	A
Brolga	162	41	–	–	–	3	–	38	162	82	A
Cattle Egret	810	64	–	4	–	36	150	24	960	128	B eg
Comb-crested Jacana	–	49	–	82	–	15	–	1	–	147	C
Common Greenshank	–	1	–	–	–	–	–	2	–	3	
Common Tern	–	34	–	–	–	–	–	94	–	128	B te
Cotton Pygmy-goose	75	7	60	60	–	–	30	–	165	67	B pg
Dusky Moorhen	–	–	–	1	–	–	–	–	–	1	C
Eastern Great Egret	–	114	–	6	–	17	–	215	–	352	B eg
Glossy Ibis	20	16	10	1	–	17	–	3	30	37	A
Green Pygmy-goose	–	101	120	19	20	–	–	–	140	120	B pg
Grey Teal	–	71	–	4	–	4	–	90	–	169	B dk
Gull-billed Tern	–	6	–	10	–	–	–	–	–	16	B te
Hardhead	–	–	30	490	–	16	–	35	30	541	B dk
Intermediate Egret	–	551	–	5	–	31	–	47	–	634	B eg
Little Black Cormorant	60	69	106	110	10	198	1	4	177	381	A
Little Egret	–	19	–	3	–	5	–	29	–	56	B eg
Little Pied Cormorant	65	10	2	25	–	12	–	16	67	63	A
Magpie Goose	4340	3266	240	763	1575	2059	1980	3242	8135	9330	A
Marsh Sandpiper	–	65	–	–	–	–	–	–	–	65	C
Masked Lapwing	–	104	–	5	2	29	–	35	2	173	C
Pacific Black Duck	100	1126	130	258	220	290	–	1043	450	2717	B dk
Pacific Golden Plover	–	7	–	–	–	–	–	–	–	7	C
Pied Cormorant	–	1	–	–	–	–	–	–	–	1	C
Plumed Whistling-Duck	–	131	–	–	–	–	–	96	–	227	B dk
Purple Swamphen	–	21	–	–	–	–	–	–	–	21	C
Royal Spoonbill	60	199	–	5	–	59	100	246	160	509	B eg
Sharp-tailed Sandpiper	–	89	–	–	–	–	–	3	–	92	C
Straw-necked Ibis	–	3	–	–	1	1	–	–	1	4	C
Unidentified Duck	974	–	180	–	152	–	130	–	1436	–	B dk
Unidentified Egret	780	–	70	–	592	–	374	–	1816	–	B eg
Unidentified Tern	–	–	137	–	94	–	–	–	231	–	B te
Wandering Whistling-Duck	–	648	10	2	200	3	–	67	210	720	B dk
Whiskered Tern	–	108	–	256	–	4	–	–	–	368	B te
Whistling Kite	–	6	–	4	1	2	–	–	1	12	
White-bellied Sea-Eagle	–	1	–	–	–	1	–	–	–	2	
White-faced Heron	4	24	–	–	4	–	3	4	11	28	A
White-necked Heron	–	11	–	–	–	–	–	16	–	27	C
White-winged Black Tern	–	–	–	3	–	–	–	–	–	3	B te
Yellow-billed Spoonbill	–	9	–	–	–	–	–	–	–	9	B eg
Grand Total	8255	7881	1549	2731	3100	2998	2872	5581	15776	19191	

Table 3. Estimates of the maximum number of birds on the freshwater wetlands throughout the Bowling Green Bay study area (Fig. 2). The species are those recorded from the four calibration sites, excluding the birds of prey (Table 2). The uncalibrated and the calibrated aerial counts are shown as alternative estimates. The 1% FPE for each species is based upon the current waterbird population estimates (Delany & Scott 2006). (No est.= no population estimate available). The values are the highest for any one of the surveys from the four field trips. Estimates exceeding the 1% FPE are shown in bold type. For species codes (A) to (C) refer to Table 2.

Species or group subtotal	**Maximum aerial count**		**1% population estimate**
	uncalibrated	calibrated	
Australian Pelican (A)	1 087	1 087	10 000
Black Swan (A)	1 864	1 864	10 000
Black-winged Stilt (A)	324	1 040	3 000
Brolga (A)	263	263	1 000
Glossy Ibis (A)	186	230	10 000
Little Black Cormorant (A)	1 103	2 376	10 000
Little Pied Cormorant (A)	361	361	No est.
Magpie Goose (A)	16 418	18 830	20 000
White-faced Heron (A)	37	135	No est.
Subtotal Group A	21 643	26 186	
Australian Wood Duck (B dk)		341	10 000
Grey Teal (B dk)		1 092	20 000
Hardhead (B dk)		3 494	10 000
Pacific Black Duck (B dk)		**17 540**	10 000
Plumed Whistling-Duck (B dk)		1 464	10 000
Wandering Whistling-Duck (B dk)		4 647	10 000
Subtotal Group B ducks	16 833	28 578	
Australian White Ibis (B eg)		198	10 000
Cattle Egret (B eg)		726	10 000
Eastern Great Egret (B eg)		**1 997**	1 000
Intermediate Egret (B eg)		3 597	10 000
Little Egret (B eg)		317	1 000
Royal Spoonbill (B eg)		**2 890**	1 000
Yellow-billed Spoonbill (B eg)		51	1 000
Subtotal Group B egrets etc	9 808	9 776	
Cotton Pygmy-goose (B pg)		**113**	100
Green Pygmy-goose (B pg)		204	1 000
Subtotal Group B pygmy geese	317	317	
Common Tern (B te)		221	No est.
Gull-billed Tern (B te)		27	1 000
Whiskered Tern (B te)		636	10 000
White-winged Black Tern (B te)		4	No est.
Subtotal Group B tern	399	888	
Australasian Darter (C)	23	182	1 000
Australasian Grebe (C)	0	517	No est.
Australian Praticole (C)	0	4	No est.
Black-necked Stork (C)	10	25	300
Comb-crested Jacana (C)	0	297	No est.
Common Greenshank	0	6	1 000
Dusky Moorhen (C)	40	2	No est.
Pied Cormorant (C)	7	2	No est.
Purple Swamphen (C)	100	40	1 000
Straw-necked Ibis (C)	130	6	10 000
White-necked Heron (C)	5	55	1 000
Black-fronted Dotterel (C)	0	24	160
Marsh Sandpiper (C)	0	129	10 000
Masked Lapwing (C)	77	350	10 000
Pacific Golden Plover (C)	0	13	1 000
Sharp-tailed Sandpiper (C)	100	185	1 600
Subtotal Group C	492	1 837	
Grand Total	49 492	67 582	

Table 4. The ground counts of shorebirds, terns, raptors and other waterbirds on high tide roost sites made during the project within the BGBRS. BGB = Bowling Green Bay; * = only Cungulla and Salmon Ck roosts in western Bowling Green Bay were surveyed due to cyclonic winds and heavy rain; **†** = Birdlife Townsville surveys: 30 September 2011; 28 November 2011; 12 January 2012. ¶ No survey of Cape Bowling Green was made in Oct 11.

Species	**Western BGB (5 roosts)**			**Southern BGB (7 roosts)**			**Cape Bowling Green (5 roosts)**			**TOTAL**	
	Oct 11	Jan 12	Mar 12*	Oct 11	Jan 12	Sep 11†	Nov 11†	Jan 12	Jan 12†	Oct 11¶	Jan 12
Australian Darter	–	–	–	–	–	–	1	–	–	–	–
Australian Pelican	–		8	–	2		5	6	6	–	8
Bar-tailed Godwit	314	70	117	146	132	62	166	286	26	460	488
Beach Stone-curlew	1	1	2	–	–	–	–	1	–	1	2
Black-tailed Godwit	–	–	–	–	–	70	1047	450	800	–	450
Brahminy Kite	–	–	1	1	–	–	–	–	–	1	–
Caspian Tern	4	4	–	6	7	7	–	10	5	10	21
Common Greenshank	15	1	–	–	–	5	–	2	–	15	3
Common Tern	–	–	9	–	–	–	710	300	55	–	300
Crested Tern	102	5	2	–	–	710	100	–	10	102	5
Curlew Sandpiper	–	–	–	–	4	12	65	–	76	–	4
Eastern Curlew	80	41	–	4	4	6	6	13	7	84	58
Eastern Reef Heron	4		–	–	–	–	–	–	–	4	–
Great Knot	–	2850	90	800	25	120	1443	50	400	800	2925
Greater Sand Plover	750	40	56	10	398	–	124	100	143	760	538
Grey Plover	50	95	25	1	–	–	–	–	–	50	95
Grey-tailed Tattler	10	–	–	–	–	–	–	13	–	10	13
Gull-billed Tern	30	1	–	1	–	–	–	–	–	31	1
Least Frigatebird	–	–	22	–	–	–	–	–	–	–	–
Lesser Crested Tern	–	–	4			330	–	–	–	–	–
Lesser Sand Plover	300	20	14	30	2	–	–	–	–	330	22
Little Egret	2	–	–	–	–	–	–	–	–	2	–
Little Tern	542	38	–	37	14	14	75	14	250	579	66
Osprey	–	–	–	–	–	–	–	1	1	–	1
Pacific Golden Plover	–	–	–	1	–	–	2	–	25	1	–
Pied Oystercatcher	5	8	4	9	2	2	–	6	4	14	16
Red Knot	–	–	4			–	–	–	–	–	–
Red-capped Plover	–	–	28	42	42	10	–	16	–	42	58
Red-necked Stint	–	12	–	105	214	210	–	15	658	105	241
Sharp-tailed Sandpiper	141	–	–	170	62	140	1448	28	95	311	90
Silver Gull	13	8	1	9	2	10	16	10	–	22	20
Terek Sandpiper	–	–	–	–	–	–	–	25	–	–	25
Whimbrel	66	26	29	1	–	16	–	6	–	67	32
White-bellied Sea-eagle	–	–	1	–	1	–	–	–	–	–	1
White-faced Heron	1	–	–	–	–	–	–	–	–	1	–

There was a significant correlation between aerial and ground counts for Black Swan and Magpie Goose (P< 0.001), but these were not statistically different from 1:1 (T^2 = 1.6 and 0.9 respectively). Nevertheless, ground counts of Magpie Geese were generally larger than those made from the air. This is consistent with previous aerial surveys of Magpie Geese in the Northern Territory, which found dry-season aerial surveys under-counted by over half (Bayliss & Yeomans 1990b). The differences in our counts were not as large, with the average aerial counts being 73% of ground counts.

Distribution and numbers

Using the location of aerial count records and known wetland habitat (Driscoll *et al.* 2012), 17 freshwater wetland sites have been mapped (Figure 2). These 17 sites are grouped into four main regions of wetland habitat within the study area, namely Alva, Colevale, South-east and South. On this basis, the general spatial and temporal distribution of calibrated aerial counts are shown in Figure 2. An unassigned category of counts (20% of the total) is also recognised (Figure 2) and includes all those aerial records that could not be readily assigned geographically to a specific wetland.

About 90% of all waterbirds (including Magpie Geese) were found outside the BGBRS (Figure 2). A maximum of around 4,000 waterbirds were counted inside the BGBRS boundary in August compared to about 50,000 outside the boundary but within 10 km of the BGBRS (Driscoll *et al.* 2012). That is, most waterbirds were in the expansive freshwater systems of the subcoastal plains amongst agriculture lands outside of the BGBRS. The area to the south west of the BGBRS, including the Cromarty wetlands, holds particularly large numbers of waterbirds including a high count of 17,000 in August, 44% of which were at Cromarty (Figure. 2). Waterbirds in the Colevale area were almost as abundant as in the south west but were not as consistently high on field trips after August. Relatively few waterbirds were seen in the Alva and South regions (Figure 2).

Waterbird numbers peaked in August 2011 and declined as the dry season progressed and the shallower wetlands dried (Figure 2). Numbers of waterbirds in the survey area during the wet season were also low compared to early in the dry season as the amount of available foraging habitat for ducks, egrets and herons increased in the wider region and birds are likely to have dispersed.

Estimates of maximum populations of species using the freshwater wetlands throughout the study area are presented in Table 3. The estimates are for those freshwater wetlands depicted in Figure 2 and include the more scattered occurrences of waterbirds (the unassigned category). In deriving the estimates, calibrated aerial counts were used and the maximum count for any one season across all wetlands has been tabulated. For most species, the maximum count was for the August survey but this was not always the case. Even though species will not necessarily be at their highest abundances at the same time, the maximum counts have been summed to give a total of for all species of over 67,000 birds. Without any form of calibration on the aerial counts the comparable number is over 49,000, and the species breakdown for uncalibrated aerial counts is also shown in the table.

Four species exceeded numbers greater than 1% of their regional estimates given in Delany and Scott (2006): Eastern Great Egret, Royal Spoonbill, Pacific Black Duck and Cotton Pygmy Goose. The species listed in Table 3 are those that were recorded at the calibration sites (Table 2), with the exception of the birds of prey. Although the freshwater wetlands were the principal habitat of most of the listed species, for some the maximum estimates understate their numbers within the study area. These species include the migratory shorebirds and terns. The estimates of numbers for these species must be considered in conjunction with the counts of species at high tide on roost sites along the coastline.

Shorebirds

The majority of shorebirds in the Bowling Green Bay catchment occur on high tide roosts within the BGBRS boundary, unlike the situation with waterbirds (Figure 2). Of the 17 roosts counted, seven new roosts were identified. The new roosts were mostly along the southern coast of Bowling Green Bay and were only accessible by boat. These roosts were not the largest in the BGBRS, but had a different species composition to those at Cape Bowling Green (Table 4). We also identified one new roost on Cape Bowling Green that was south of those regularly monitored by BLT. The shorebirds found beyond the BGBRS were all either on freshwater wetlands or coastal claypans that were seasonally inundated by king tides (Figure 2). Many of these birds probably periodically rely on the intertidal flats within the BGBRS for feeding. There were very few non-migratory shorebirds counted on the large number of freshwater wetlands surveyed.

Only two complete surveys (October 2011 and January 2012) could be made within the BGBRS due to cyclonic conditions prevailing throughout the March 2012 survey period. A total of 19 species of shorebird, seven tern or gull species, six other waterbirds and three raptors were counted at high tide roosts in BGBRS (Table 4). Only one species of shorebird was counted in internationally-significant numbers – Great Knot (Table 4). Most other species were counted in much lower numbers than have been recorded in previous surveys by BLT members. The distribution of species also differed, with the two species of sand plover, Grey Plover, Eastern Curlew and Whimbrel being mostly confined to the western and south-western parts of Bowling Green Bay (Table 4). Black-tailed Godwits were found only at Cape Bowling Green and Sharp-tailed Sandpipers were mostly restricted to southern Bowling Green Bay roosts. This distribution pattern and the relative abundance of some species also differed from that found during previous surveys by BLT. The numbers of several species, (Black-tailed Godwit, Sharp-tailed Sandpiper and Red-necked Stint) recorded by BLT at Cape Bowling Green during the period of the study were substantially higher than found during our surveys of the entire BGBRS. Our data also suggest that Great Knot were not strongly faithful to specific roosts within Bowling Green Bay (Table 4). We counted large numbers of Great Knot in different parts of Bowling Green Bay during each survey.

A total of 38 species of shorebird and other species were counted at 11 high tide roosts during the two surveys of the Burdekin River mouth (Table 5). Of these, 21 species were migratory shorebirds and there were two resident species (Australian Pied Oystercatcher and Red-capped Plover). The highest counts were made in October 2011, when almost 10,000 birds were counted, including over 8,900 shorebirds (Table 5). Great Knot were the most abundant species and both Lesser and Greater Sand Plover were present in internationally-significant numbers (3824 and 1760 respectively, Table 5). The species composition during the January 2012 survey was similar to that in October 2011. However, the abundance of shorebirds was almost half that counted in the previous survey and no species was present in internationally-significant numbers.

Table 5. The number of shorebirds and other waterbirds counted from the ground at 11 high tide roosts in the Burdekin River delta (Figure 2). Species present in internationally-significant numbers are highlighted in **bold**.

Species	November 1995	October 2011	January 2012
Australian Darter	–	2	–
Australian Pelican	–	13	28
Australian Pied Oystercatcher	11	4	21
Bar-tailed Godwit	254	241	568
Black-necked Stork	–	2	–
Broad-billed Sandpiper	8	–	–
Black-tailed Godwit	–	20	–
Brahminy Kite	–	1	1
Caspian Tern	–	71	47
Common Greenshank	37	–	7
Common Sandpiper	4	–	–
Common Tern	–	80	750
Crested Tern	–	107	117
Curlew Sandpiper	192	147	1
Eastern Curlew	62	307	155
Great Knot	2263	2052	1145
Greater Sand Plover	488	**1760**	**1279**
Grey Plover	7	58	36
Grey-tailed Tattler	14	48	–
Gull-billed Tern	–	39	–
Lesser Crested Tern	–	42	–
Lesser Sand Plover	**3824**	**912**	91
Little Curlew	1	–	–
Little Egret	–	2	–
Little Pied Cormorant	–	2	2
Little Tern	–	526	272
Pacific Golden Plover	41	–	–
Pied Cormorant	–	2	–
Red Knot	9	150	100
Red-capped Plover	100	203	19
Red-necked Stint	1348	1334	118
Ruddy Turnstone	15	7	2
Sanderling	15	29	–
Sharp-tailed Sandpiper	229	1557	181
Silver Gull	–	24	12
Terek Sandpiper	41	84	209
Whimbrel	41	21	244
Whistling Kite	–	–	6
TOTAL	8974	9643	5411

DISCUSSION

Waterbirds

The Bowling Green Bay Ramsar site was nominated in 1993 based on the site supposedly having met the criteria of > 20,000 waterbirds. Our surveys found that fewer than 5,000 waterbirds were present within the Ramsar site (Driscoll *et al.* 2012). The aerial surveys showed that there are few freshwater wetlands within the Ramsar site and that the overwhelming majority of waterbirds occur in adjacent freshwater wetlands on private land. Also, we did not find substantial populations within the BGBRS of either Brolga or Magpie Geese. These species were originally noted as being internationally-important for the BGBRS. Given the lack of suitable freshwater habitat within the Ramsar site, the majority of the large populations previously identified in the early 1990s were probably never within the Ramsar site boundaries. They were more likely to have been concentrated in the adjacent irrigated rice crops, or on freshwater wetlands where they have been found during this study. Rice crops provide attractive feed for the herbivorous Magpie Geese and attract invertebrate and small vertebrate prey for Brolgas. The availability of habitat and food to support large Brolga and Magpie Goose populations may also have declined over the last 20 years, as the rice farming industry collapsed in the mid-1990s. Magpie Goose populations in south-eastern Australia have shown declines and range contractions. These have been mostly attributed to changes in water management and the loss of breeding habitat (Nye *et al*. 2006).

Nevertheless, existing freshwater wetlands in the Bowling Green Bay catchment still hold large waterbird populations that are regionally and nationally significant (Kingsford & Porter 2009, Kingsford *et al.* 2012). The Bowling Green Bay catchment wetlands rank within the top five most important wetlands in eastern Australia. These wetlands currently have no formal protection and are all found on freehold or leasehold land. Many of these wetlands have freshwater extracted for on-farm use to water cattle, sugar cane or crops. Thus, the large populations of waterbirds in the region are vulnerable to habitat loss from unsympathetic farming practices and climate change (Traill *et al.* 2010). Four species of waterbird are also present in internationally-significant numbers (Delany & Scott 2006), Cotton Pygmy Goose, Eastern Great Egret, Pacific Black Duck and Royal Spoonbill. These species had not previously been identified as being present in the region in significant numbers. However, environmental and land use changes during the last 20 years have also probably contributed to the changes in numbers and composition of waterbird communities.

On-going monitoring surveys of waterbird numbers in the region should focus on the period August – September, when the number of available wetlands is optimal for the largest population of waterbirds and as other, more distant and/or marginal wetlands contract in size. Such surveys would need to include both aerial and land-based methods to be comprehensive as most wetlands are on private land and inaccessible. Only four large wetlands can be accessed by car and these (Table 2) could be monitored more frequently. These wetlands cover the range of wetland types present in the region (Morton *et al.* 1990, 1993). If these wetlands continue to support large waterbird populations, they should be a reliable proxy for the populations present in the region.

Shorebirds

The shorebird species composition of the coastal high tide roosts in the Bowling Green Bay Ramsar site is typical of similar habitats elsewhere along the adjacent Queensland coast (Driscoll 1997). This study found that Great Knot were the only species present in internationally-significant numbers in Bowling Green Bay. The location of these birds differed between surveys and local movements appeared to be related to wind and tide height. Rogers *et al.* (2006) and Driscoll (2001) found a similar pattern of shifts in roosting preferences by Great Knot as the tidal cycle changed. Previous counts of shorebirds in Bowling Green Bay have focussed on Cape Bowling Green, where Great Knot have rarely been recorded. More comprehensive surveys of the entire bay are needed to detect the main roosts used by Great Knot. Other species such as Curlew Sandpiper and Sharp-tailed Sandpiper were only found on roosts in southern Bowling Green Bay. This further supports the need to expand the coverage of the Birdlife Townsville surveys undertaken with the Marine Park vessels to include the southern and western parts of Bowling Green Bay.

Surveys of Cape Bowling Green by Birdlife Townsville since 1996 found internationally-significant numbers of Black-tailed Godwit in 1996 (2,058; Harrison 1997) and Red-necked Stint in 2011 (> 6,000 birds). The high count of Black-tailed Godwit was one of the criteria that contributed to the nomination of the Bowling Green Bay Ramsar site. However, despite a large number of counts of Cape Bowling Green since 1996 (n = 152), Black-tailed Godwit have not been seen in internationally-significant numbers since. The highest count in the 150 surveys since was less than 1000 birds (threshold 1,390 birds). Similarly, the high count of Red-necked Stint has occurred on only one occasion since the surveys began in 1996. Thus, Cape Bowling Green appears to be used by large numbers of these species only very infrequently.

In contrast, the more remote roosts in the Burdekin River delta have held internationally-significant numbers of at least one species of sand plover during the three surveys made to date. Thus, the Burdekin River delta also meets the criteria for nomination as a Ramsar site. Lesser and Greater Sand Plover are declining in the East Asian-Australasian Flyway (Mundkur & Nagy 2012). The most recent population estimates (Mundkur & Nagy

2012) show that the population of Lesser Sand Plover wintering in Australia has declined by an estimated 50% in the last five years. Over the same time, the Greater Sand Plover population wintering in Australia has also declined by about 26%. Thus, regions with internationally-significant numbers of both species need to be afforded greater formal protection.

There are currently few direct threats to the shorebirds in the Burdekin River delta. The delta is only accessible by boat, thus protecting it from most human disturbances. Apart from casual disturbance by fishers, the only other potential threats are several illegal holiday shacks built north of the main roosts. Possibly the greatest threat is indirect, with the extraction and diversion of water for irrigation in the upper Burdekin River catchment reducing organic nutrient discharge.

Calibrations between ground and aerial surveys

The calibrations outlined in the methods section are based upon the combined counts from all field trips across the four calibration sites. Only Black Swan and the Magpie Goose exhibited statistically-significant correlations between aerial and gound counts, which formed the basis for indexing of other species that were difficult to observe from the air. Despite a lack of confirmation of links between aerial and ground counts for other species, we maintain there is value in the calibration of aerial counts with ground counts to give better estimates of overall numbers of birds. There was no better way, with the available resources, to improve the estimate of waterbird numbers over the large area that was being sampled from the air. This is despite the differences between aerial and ground counts of Magpie Geese occasionally being larger than 25% (Figure 3). This suggests that in some wetlands, such as Cromarty, many Magpie Geese were difficult to detect from the air due to tree-cover around the margins. In almost all other wetlands in the region, trees rarely obscured the wetland margin. Thus, after calibration the aerial surveys are likely to provide a reasonable estimate of Magpie Geese abundance at most wetlands (Figure 2).

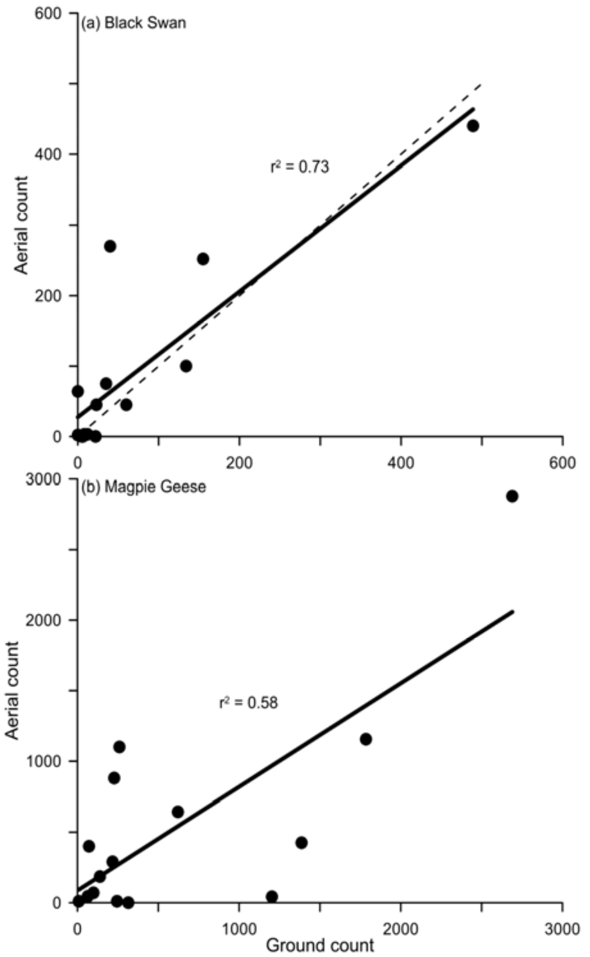

Figure 3. The relationship between ground counts and aerial counts of (a) Black Swan and (b) Magpie Geese at the four calibration wetlands. The solid line is the best linear fit to the relationship and the dotted line is the 1:1 line. Both relationships were highly significant ($P < 0.001$).

Conversely, aerial surveys also detected more Brolga than counted from the ground (Table 2). This is not surprising as Brolgas were mostly seen feeding in open situations away from wetlands. Thus, they were not as readily seen during ground counts. For this species, aerial surveys is the preferred method of counting their populations in this region and no calibration with ground counts was made, which is consistent with assumption 5 of the methods section.

CONCLUSION

In order to maintain the value of the large network of wetlands outside the BGBRS for waterbirds, state and local governments need to provide incentives for farmers to cooperate and manage their wetlands for their biodiversity values. The local Natural Resources Management group has had some success in getting landholders in the region to modify their farming practices to improve water retention and maintain key wetland habitats (M. McLaughlin, *pers. comm.*). Weeds such as *Hymenachne* are also a major threat to the viability of most wetlands in the region. They choke the surface of many wetlands, reducing the open surface waters that are available for foraging by many ducks, swans and other waterbirds. Problems such as these will require a committed cooperative approach from the community and government. Without this cooperation, the biodiversity values of these wetlands will come under increasing threat as the habitat changes with our climate (Traill *et al.* 2010). These wetlands are also outside the Ramsar site and thus not protected by this legislation. Thus, the Ramsar site did not meet the crieria of 20,000 waterbirds at listing. The shorebird surveys by Birdlife North Queensland (BANQ) have also shown that it does not meet the shorebird crieria identified at listing, with the exception of meeting the criteria for a single species: Great Knot. Our surveys showed that the current BANQ surveys to Cape Bowling Green do not adequately survey the roosts where Great Knot occur. The BANQ surveys need to be expanded to include the roosts in southern Bowling Green Bay in order to effectively monitor these important populations.

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REFERENCES

Anderson, T.W. 1971. An introduction to multivariate statistical analysis. John Wiley & Sons, New York, NY, 284 p.

Bayliss, P. & K.M. Yeomans. 1990a. Seasonal distribution and abundance of Magpie Geese, *Anseranas semipalmata* Latham, in the Northern Territory, and their relationship to habitat, 1983-86. *Australian Wildlife Research* 17: 15 – 38.

Bayliss, P. & K.M. Yeomans. 1990b. Use of low-level aerial photography to correct bias in aerial survey estimates of Magpie Goose and Whistling Duck density in the Northern Territory. *Australian Wildlife Research* 17: 1 – 10.

Blackman, G. 1979. Aerial photography applied to Brolga counts. *In:* Aerial surveys of fauna populations. pp. 97 – 105. Australian National Parks and Wildlife Service Special Publication No. 1. Australian Government Publishing Service, Canberra.

Delany, S. & D. Scott. (eds.) 2006. Waterbird population estimates – Fourth Edition. Wetlands International, Wageningen, The Netherlands.

Driscoll, P. V. 2001. Gulf of Carpentaria wader surveys 1998-9. Report prepared for the Queensland Environmental Protection Agency.

Driscoll, P. V., Milton D., & S. Harding. 2012. Waterbird and shorebird surveys of the Bowling Green Bay Ramsar Site. Report prepared for the Queensland Wetlands Program and the Commonwealth Department of Sustainability, Environment, Water, Populations and Communities, Australia. http://www.environment.gov.au/water/publications/environmental/wetlands/water-bird-survey-ramsar-42.html

Harrison, F. 1997. Cape Bowling Green, North Queensland; a site of significance for godwits. *Stilt* 31: 41.

Kingsford, R.T. & J.L. Porter. 2009. Monitoring waterbird populations with aerial surveys – what have we learnt? *Wildlife Research* 36: 29 – 40.

Kingsford, R.T., Porter, J.L. and S.A. Halse 2012. National waterbird assessment. Waterlines Report, National Water Commission, Canberra.

Kelly, K.E. & W.J. Lee Long. 2011. Ecological character description for the Bowling Green Bay Ramsar site, June 2011. Report for the Australian Department of Sustainability, Environment, Water, Population and Communities. 246 pp.

Morton, S.R., Brennan, K.G. & M.D. Armstrong 1990. Distribution and abundance of magpie geese *Anseranas semipalmata*, in the Alligator region, Northern Territory. *Australian Journal of Ecology* 15: 307 – 320.

Morton, S.R., Brennan, K.G. & M.D. Armstrong 1993. Distribution and Abundance of Brolgas and Bback-necked Storks in the Alligator Rivers Region, Northern Territory. *Emu* 93: 88 – 92.

Mundkur, T. & S. Nagy (eds.). 2012 Waterbird population estimates – Fifth Edition. Wetlands International, Wageningen, The Netherlands.

Nebel, S., Porter, J.L. & R.T. Kingsford. 2008. Long-term trends of shorebird populations in eastern Australia and impacts of freshwater extraction. *Biological Conservation* 141: 971 – 980.

Pell, S. & W. Lawler. 1996. Wader communities along the north-east Queensland coast (Bowen to Cairns). Report for the Queensland Department of Environment and Heritage.

Nye, E.R., Dickman, C.R. & R. T. Kingsford. 2006. A wild goose chase – temporal and spatial variation in the distribution of the Magpie Goose (*Anseranas semipalmata*) in Australia. *Emu* 107: 28 – 37.

Rogers, D.I., Battley, P.F., Piersma, T., van Gils, J. & K.G. Rogers. 2006. High tide habitat choice: modelling the roost selection of shorebirds around a tropical bay. *Animal Behaviour* 72: 563 – 575.

Traill, L.W., Bradshaw, C.J.A., Delean, S. & B.W. Brook. 2010. Wetland conservation and sustainable use under global change: a tropical Australian case study using magpie geese. *Ecography* 33: 818 – 825.

PROPORTIONS OF FIRST-YEAR INDIVIDUALS IN CANNON-NET CATCHES OF WADERS IN THAILAND WITH A COMPARISON TO AUSTRALIA

KRAIRAT EIAMAMPAI[1], SOMCHAI NIMNUAN[1], THITI SORNSA[1], DUANGRAT PHOTHIENG[1] SIRIPORN THONG-AREE[1], KUNTIDA ITTIPORN[1], KEN G. ROGERS[2], AND PHILIP D. ROUND[3] *

[1] *Wildlife Research Division, Department of National Parks, Wildlife and Plants Conservation, Phaholyothin Road, Chatuchak, Bangkok 10900, Thailand. Email eiam_kl@hotmail.com*

[2]*340 Ninks Road, St Andrews, Victoria 3761, Australia. Email kenrogers@hotkey.net.au*

[3] *Department of Biology, Faculty of Science, Mahidol University, Rama 6 Road, Bangkok 10400, Thailand.*
**Email philip.rou@mahidol.ac.th*

The paper presents information on proportions of juveniles (first-years) in cannon net catches made in the non-breeding season at two locations in Thailand, the Andaman Seaboard and the Inner Gulf of Thailand, since large-scale banding of waders started in that country in 2007/ 2008. We conclude that, for species common to the two countries, observed juvenile proportions in Thailand are consistent with those observed in Australia and, as a different suite of birds over-winters in Thailand, that monitoring of Thai birds adds to our knowledge of wader recruitment in the East Asian-Australasian Flyway.

INTRODUCTION

At least one-third of East Asia-Australasian Flyway (EAAF) wader populations are already declining as a result of the degradation of (especially) key passage and wintering areas, while adequate data on trends is lacking for the remainder (Wetlands International 2014). There is also increased concern that ongoing degradation of breeding areas, exacerbated by climate-change related factors, is additionally affecting the breeding productivity of especially Arctic-nesting species (Meltofte *et al*. 2007). Improving monitoring of fluctuations in annual productivity and extending monitoring to cover a greater number of flyway populations are therefore major priorities. Assessment of the proportions of juvenile (first-year birds) in cannon-net catches is one such monitoring method that has been used for EAAF waders for many years (Minton *et al*. 2005). Annual estimates for selected species, starting in 1978 / 1979, are available for sites and non-breeding populations in south-east and north-west Australia (Minton *et al*., 2005, 2006, 2007, 2008, 2009, 2010, 2011a,b, 2012), but there are few estimates for other EAAF sites or populations.

In this paper we report juvenile proportions from catches in Thailand, where cannon-netting has been regularly undertaken during routine conservation monitoring by the (Thai) Department of National Parks, Wildlife and Plants Conservation, since September 2007. Thailand is particularly important for both wintering and staging waders due to its long coastline with extensive mudflat and mangrove habitats. A total of 64 species of waders are known for the county and wintering populations of at least 20 species qualify as of international importance (Round 2006). We present juvenile proportion data from previously unmonitored populations and compare apparent fluctuations in the proportions observed with corresponding data reported from north-west and south-east Australia.

METHODS

Study Area

Data were collected from two major locations: the Andaman Seaboard, mainly at Ko Libong Non-Hunting Area; and several sites in the Inner Gulf of Thailand, between Phetchaburi and Samut Sakhon Provinces (Figure 1, Table 1). Both Ko Libong and the Inner Gulf of Thailand are internationally important wetlands, listed in Scott (1989), and are also Important Bird Areas (IBAs: BirdLife International 2004).

Substrates at Ko Libong were chiefly sandy, or sand and mud mixed, and catching was undertaken on sand beach roosting sites. The Inner Gulf of Thailand is a major delta encompassing outflow from five rivers, and the intertidal substrate was mainly soft, semi-liquid, mud. Catching took place at roosts on supra-tidal areas, either extensive coastal flats or mainly dry, out-of-use, salt-pans.

Cannon netting and timing of catches

Catches were made during the non-breeding season (the Palaearctic autumn through winter to early spring). At Ko Libong and other Andaman coast sites catches were in November or late March, occasionally early April and once (2012) late April. Catches in the Inner Gulf were made during September to March, with half of all catches being made during October to February. These dates loosely determine the ‘stable period’ which define a closed system (*sensu* Rogers 2006) in which there is assumed to be no influx or efflux of birds. Thus, all birds caught in this period are conventionally assumed to be drawn from the same population, allowing aggregation of individual catch data to give annual totals. As the boundaries of this stable period are not yet clearly defined for Thailand, we have drawn attention to a few catches near these boundaries whose inclusion in annual totals might be dubious. Annual catches were considered separately by location on the assumption that Andaman-wintering populations and those in the Inner Gulf might originate from different breeding areas.

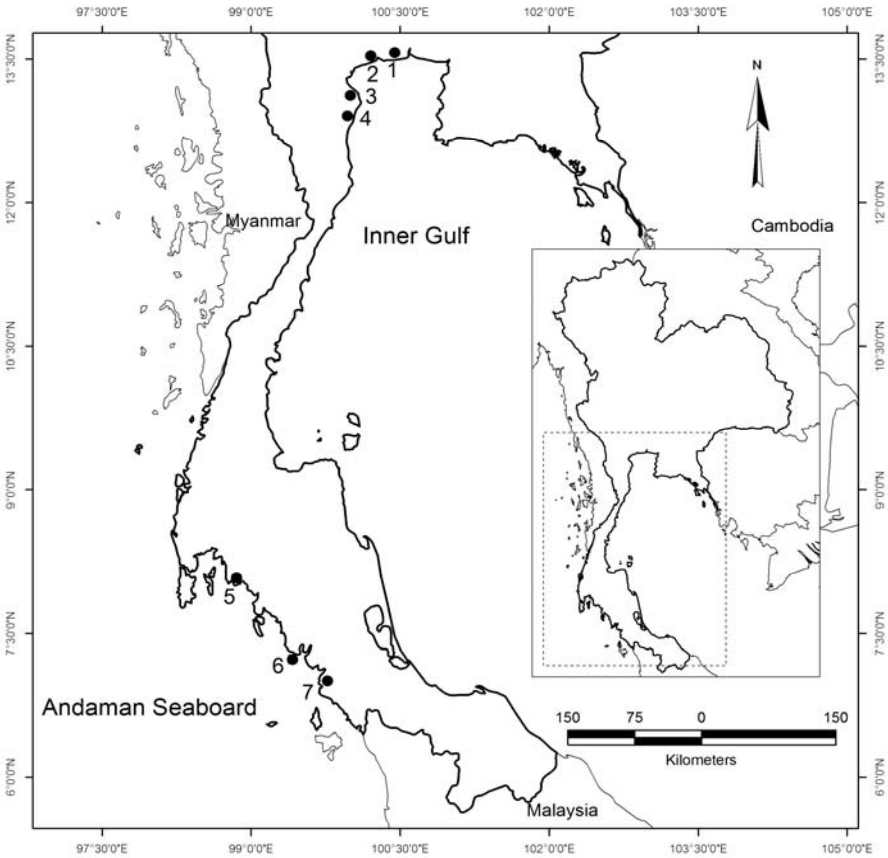

Figure 1. Map of Thailand to show cannon-netting sites (1 Khok Kham, 2 Thachin River Mouth, 3 Ban Pak Thale, 4 Laem Phak Bia, 5 Khlong Prasong, 6 Ko Libong, 7 Rawai Beach).

Location	**Lat.**	**Long.**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**
Inner Gulf							
Khok Kham, Samut Sakhon	N 13 31	E 100 19	1		4	1	
Thachin River Mouth, Bang Ya Phraek, Samut Sakhon	N 13 30	E 100 16	2	6	3	2	3
Ban Pak Thale, Ban Laem, Phetchaburi	N 13 09	E 100 04			1		
Laem Phak Bia, Ban Laem, Phetchaburi	N 13 03	E 100 06	4	2	3	2	
Andaman Seaboard							
Khlong Prasong, Krabi	N 08 10	E98 56		2	2		
Ko Libong, Trang`	N 07 15	E 99 27	3	7	7	10	4
Rawai Beach, Satun	N 07 03	E 99 41		1			

Table 1. Locations of sites and number of discrete catches per season in Thailand.

Ageing of birds

The principal means of ageing was by examination of moult and wear status of (especially) primaries. Adults of most species tended to renew their primaries during autumn and early winter, whereas juveniles (i.e. first-years) had significantly more worn primaries than adults later in the winter, and in some first-years were renewing outer primaries only before northwards migration. Nomenclature follows Christidis & Boles (2008) but species are listed alphabetically by common name for convenience in both text and Table2.

Table 2. Proportions of juvenile waders in Thai cannon-net catches. A - Andaman Seaboard; G - Inner Gulf; * - the proportion of juvenile (first-years) recorded is unrepresentative owing to timing of catch (late April), when many adults may be presumed to have migrated.

Species	**Season**	**Location**	**Sample Size**	**No. of Juvs**	**Juv Prop Obs±SD**	**Normal 95% confidence limits**	**Binomial 95% confidence limits**
Broad-billed Sandpiper	2008/09	G	280	12	0.043±0.012	0.019-0.067	0.021-0.068
Limicola falcinellus	2009/10	G	83	6	0.072±0.028	0.017- 0.128	0.024-0.133
	2011/12	G	94	4	0.043±0.021	0.002-0.083	0.011-0.085
Bar-tailed Godwit	2007/08	A	139	15	0.108±0.026	0.056-0.159	0.058-0.165
Limosa lapponica	2008/09	A	81	2	0.025±0.017	-0.009-0.058	0-0.062
	2009/10	A	185	23	0.124±0.024	0.077-0.172	0.081-0.173
	2010/11	A	186	14	0.075±0.019	0.037-0.113	0.038-0.113
Curlew Sandpiper	2009/10	G	254	25	0.098±0.019	0.062-0.135	0.063-0.138
Calidris ferruginea	2010/11	G	36	4	0.111±0.052	0.008-0.214	0.028-0.222
	2011/12	G	21	5	0.238±0.093	0.056-0.420	0.048-0.429
Eurasian Curlew	2008/09	A	23	1	0.043±0.043	-0.04-0.127	0-0.013
Numenius arquata	2009/10	A	18	9	0.500±0.118	0.269-0.731	0.278-0.722
	2009/10	G	27	6	0.222±0.080	0.065-0.379	0.074-0.037
Great Knot	2007/08	A	40	11	0.275±0.071	0.137-0.413	0.15-0.425
Calidris tenuirostris	2008/09	A	12	1	0.083±0.080	-0.073-0.24	0-0.250
	2009/10	A	48	12	0.250±0.063	0.128-0.373	0.125-0.375
	2010/11	A	48	13	0.271±0.064	0.145-0.397	0.146-0.396
Grey Plover	2010/11	A	29	5	0.172±0.070	0.035-0.310	0.034-0.310
Pluvialis squatarola	2011/12	A	24	10	0.417±0.101	0.219-0.614	0.208-0.625
Greater Sand Plover	2008/09	A	404	63	0.156±0.018	0.121-0.191	0.121-0.193
Charadrius leschenaultii	2009/10	A	229	31	0.135±0.023	0.091-0.180	0.092-0.179
	2010/11	A	265	27	0.102±0.019	0.065-0.138	0.068-0.140
	2011/12	A	31	18*	0.581±0.089	0.407-0.754	0.419-0.742
	2007/08	G	38	9	0.237±0.069	0.102-0.372	0.105-0.368
	2009/10	G	24	6	0.250±0.088	0.077-0.423	0.083-0.417
Kentish Plover	2009/10	A	15	6	0.400±0.126	0.152-0.648	0.133-0.667
Charadrius alexandrinus	2010/11	A	27	8	0.296±0.088	0.124-0.469	0.148-0.481
Lesser Sand Plover	2008/09	A	706	123	0.174±0.014	0.146-0.202	0.147-0.203
Charadrius mongolus	2009/10	A	400	52	0.130±0.017	0.097-0.163	0.098-0.165
	2010/11	A	715	200	0.280±0.017	0.247-0.313	0.248-0.313
	2011/12	A	346	47	0.136±0.018	0.100-0.172	0.101-0.173
	2007/08	G	84	5	0.060±0.026	0.009-0.110	0.012-0.119
	2008/09	G	492	72	0.146±0.016	0.115-0.178	0.116-0.179
	2009/10	G	1110	123	0.111±0.009	0.092-0.129	0.093-0.130
	2010/11	G	903	54	0.060±0.008	0.044-0.075	0.044-0.075
	2011/12	G	201	3	0.015±0.009	-0.034-0.032	0-0.035
Red-necked Stint	2009/10	G	157	34	0.217±0.033	0.152-0.281	0.153-0.280
Calidris ruficollis	2010/11	G	330	17	0.052±0.012	0.028-0.075	0.030-0.076
Terek Sandpiper	2007/08	A	76	15	0.197±0.046	0.108-0.287	0.118-0.289
Xenus cinereus	2008/09	A	33	4	0.121±0.057	0.010-0.233	0.030-0.242
	2009/10	A	12	2	0.167±0.108	-0.044-0.378	0-0.417
	2011/12	A	15	8*	0.533±0.129	0.281-0.786	0.267-0.800
Whimbrel	2007/08	A	97	27	0.278±0.046	0.189-0.368	0.196-0.371
Numenius phaeopus	2008/09	A	22	1	0.045±0.044	-0.042-0.132	0-0.136
	2010/11	A	68	1	0.015±0.015	-0.014-0.043	0-0.044

Analyses

Data on the proportion of juvenile birds in catches are presented for each species from aggregated samples in each capture year. Assuming the same prior probability of being captured applies to all birds, juvenile proportion estimates will be binomially distributed (Bernoulli 1713, Snedecor & Cochran 1989) and, therefore, 95% confidence limits were calculated using the Excel CRITBINOM function. Smaller samples with low juvenile proportions would give lower confidence limits close to zero and upper ones close to one, indicating insufficient data to provide useful information. For larger samples with higher proportions, the normal distribution gives very similar confidence limits (at 95% confidence, limits = mean ± 1.96*SD). Confidence limits are calculated for both binomial and normal distribution assumptions to highlight cases where the juvenile proportion is small, and the commonly used normal approximation to the binomial distribution does not apply.

Data collected from species with adequate sample sizes were compared against data from cannon-netting captures in south-east and north-west Australia, using the information contained in Minton *et al.* (2005, 2008, 2009, 2010, 2011a, 2012). Instances where the proportion of juvenile birds recorded in Thai catches were likely unrepresentative owing to the timing (late April), with proportionately more adults having migrated, are highlighted.

RESULTS

Catches of waders of Thailand

Between September 2007 to April 2012, 293 species-samples were collected from 12 species over 70 capture events (usually one species-sample per capture event) (Table 1). Since many captures were small – the median sample size per species for a given capture event was only eight – samples of the more frequently caught species in the same year were combined by location for analysis. No data are presented for aggregate samples of fewer than 15 birds of any species in a single season. Data on the proportion of juvenile birds in catches are presented for 12 species for which aggregated sample-sizes (12-1110 individuals per species in a single location or season) were considered large enough to be potentially meaningful over five winter seasons (Table 2).

Comparison between Thai and Australian catches

Comparative juvenile proportion data from Australia were available for six of the 12 species captured in Thailand. The other six species for which Australian data were not available, or where comparisons may be inappropriate were: (1) Broad-billed Sandpiper, which were caught in reasonable numbers in Thailand but with few juveniles and where catches in south-east and north-west Australia are small; (2) Eurasian Curlew, for which there are only small samples in Thailand and which is vagrant to Australia; (3) Grey Plover, which is represented by only two small samples in Thailand. This species is common in Australia but catches are usually small and no age data has been reported; (4) Kentish Plover, which does not occur in Australia; (5) Lesser Sand Plover, for which the taxonomy of birds visiting Thailand and Australia is thought to different, rendering comparisons inappropriate. Thai birds, so far as known, are the taxon *C. m. schaeferi* of the central Asian-breeding "*atrifrons* group" of subspecies (*sensu* Prater et al. 1977) whereas Australian winterers are thought to be composed of the north-east Asian-breeding races *stegmanni* and *mongolus*, with possibly a few *schaeferi* (Marchant and Higgins 1993); and (6) Whimbrel, for which few juveniles were caught in Thailand in two of three years, and which is infrequently caught in Australia.

Over all the remaining six species, there was an absence of differences between regions in the frequency with which different juvenile proportions were recorded (Figure 2). Individual species comparisons are given below. Confidence limits for each species are given in the figures to indicate the statistical errors in juvenile proportion estimates due to sampling. No indication can be given of the size of errors due to presumed juvenile bunching in flocks at capture sites.

Bar-tailed Godwit

This species was not caught in Thailand in 2011 / 2012 (Figure 3). The very high proportion for south-east Australia in 2007/08 is likely to be a sampling aberration due to juvenile bunching. Thai proportions were of much the same order as Australian locations, with only the 2009 / 2010 results being perhaps lower than expected. Despite such differences, there is a broad agreement between locations in that, in most cases, changes from year to year and follows a similar pattern of increases and decreases.

Curlew Sandpiper

Curlew Sandpiper was not caught in any numbers in Thailand before 2008 / 2009, nor in south-east Australia in 2010 / 2011 (Figure 4). There is remarkable agreement between north-west and south-east Australia proportions. While the Thai proportion for 2009 / 2010 is lower than those for Australia, Thai data for the following two years are consistent with Australian data.

Great Knot

Great Knot is rare in south-east Australia, and thus sample sizes were inadequate to assess the proportion of juveniles. The proportions of juveniles in Thailand were consistent with those from north-west Australia except for 2011 / 2012, when very few were caught (Figure 5).

Greater Sand Plover

This species is also rare in south-east Australia, and sample sizes were insufficient to assess the proportion of juveniles. The aberrant high value for the proportion of juveniles in Thailand in 2011 / 2012 probably occurred because the catch was made very late in the season when most earlier migrating adults had already departed. In other years juvenile proportions varied similarly to those in north-west Australia, although they tended to be lower (Figure 6).

Red-necked Stint

The proportions of juveniles for both Australian locations were consistent over the whole period (Figure 7). Adequate sample sizes for comparison were only available for two years in Thailand. The 2008 / 2009 proportion was consistent with those from Australia but the low figure in 2010 / 2011 appeared to be an aberration, probably due to juvenile bunching.

Terek Sandpiper

Terek Sandpiper is rare in south-east Australia, and sample sizes were inadequate to assess the proportion of juveniles. For the years 2007 / 2008 through to 2009 / 2010 the proportions of juveniles were remarkably similar for both north-west Australia and Thailand (Figure 8). The unusually high proportion of juveniles from 2011 / 2012, the only other year for which comparative data were available, probably stems from the seasonal lateness of the capture event that year (late April), when proportionately more adults had already departed wintering areas.

Lesser Sand Plover

Data on Lesser Sand Plover are accorded special treatment, as, from 2008 / 2009 onwards, this was the only species caught in numbers sufficient to inform comparisons between the Andaman coast and Inner Gulf sites. In contrast, Bar-tailed Godwits, Whimbrels, Great Knots and Terek Sandpipers were only sampled at the Andaman coast sites, and smaller sandpipers, especially Red-necked Stints and Broad-billed Sandpipers, in the Inner Gulf.

In the Lesser Sand Plover the juvenile proportions for both the Andaman coast and the Inner Gulf were almost identical in first two years (Figure 9). In two other years, when the proportion was high for one location it was low at the other. In 2010 / 2011 the Andaman coast juvenile proportion of 0.28, which is possibly indicative of an exceptional breeding year, was perhaps more plausibly suggestive of an uneven distribution of juveniles in the sampled population. Combining the Andaman data with those for the Inner Gulf for the four years covered (Figure 9) smoothes out the apparent anomaly, suggesting that birds from the two locations are better considered as being from the same breeding population and part of the same closed system for the purpose of monitoring juvenile proportions.

DISCUSSION

For the six species for which we have the information to compare Thai and Australian data, the juvenile proportions in most Thai samples were of a similar order to those found in Australia. The further correspondence, both in magnitude and over time, is noteworthy and unlikely to be accidental.

Juvenile proportions greater than about 0.3 did not occur often but are of concern when they did. A juvenile proportion of 0.333 would imply that every pair of breeding adults in the population successfully reared one young bird, which survived to migrate to Thailand in its natal year. This would correspond to an exceptional breeding year. A few higher values than this occurred in our data and we suggest that values of 0.3 or more be treated with extreme caution as being likely to be a consequence of the tendency of young birds to associate locally, leading to high proportions in some catches and low proportions in others (Rogers 2006).

In several cases, comparison between normal and binomial confidence limits hardly differ, but there are seven cases where the normal distribution assumption gives an impossible negative lower limit, a clear indication of the inadequacy of the normal distribution approximation to the binomial for years in which only small numbers of juveniles were caught. In these cases, it is appropriate to refer only to estimates derived on the basis of a binomial distribution.

The correspondence between Thai and Australian juvenile proportions at the species level is an important result because it indicates that samples in both countries are representative of populations that share similar attributes. It was not previously known whether there could be, for example, a juvenile preference for Thailand, as opposed to Australia, as the first non-breeding destination. Any such bias would have made it hard to sustain the argument that Australian proportions were representative of the breeding population. Similarities in the proportions of juveniles may either suggest common breeding origins for birds over-wintering in the two countries or (perhaps more likely) that populations in different sectors of the breeding range are responding similarly to similar environmental fluctuations year to year so that fluctuations in annual productivity generally correspond. Importantly, more widespread and frequent sampling in Thailand and neighbouring countries will help fill gaps in our knowledge of how migrant waders use the East Asian-Australasian Flyway and further inform conservation efforts.

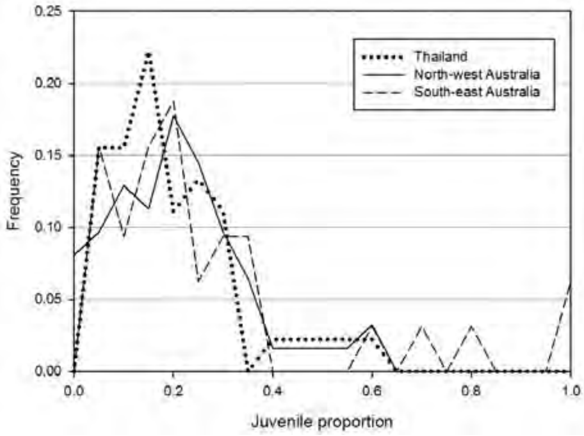

Figure 2. Frequency of different juvenile proportions, over all species and years, observed in Thailand compared with two Australian locations.

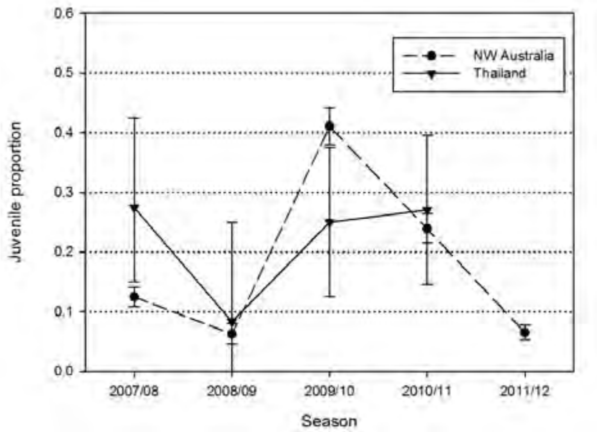

Figure 5. Juvenile proportions of Great Knots in Thailand compared with north-west Australia. Bars indicate 95% confidence limits.

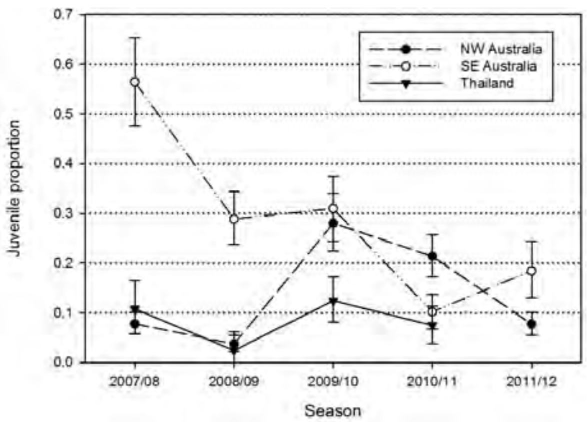

Figure 3. Juvenile proportions of Bar-tailed Godwits in Thailand compared with two sites in Australia. Bars indicate 95% confidence limits.

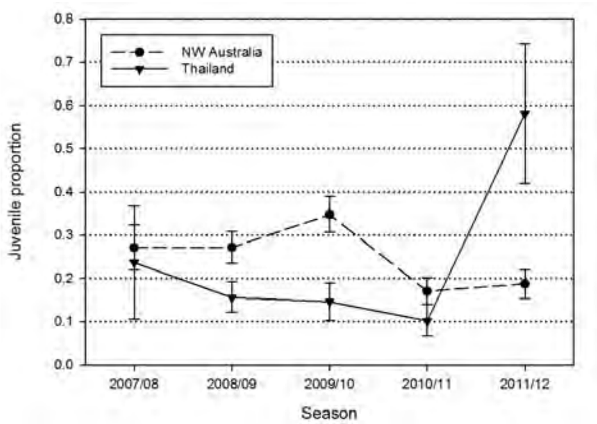

Figure 6. Juvenile proportions of Greater Sand Plovers in Thailand compared with north-west Australia. Bars indicate 95% confidence limits.

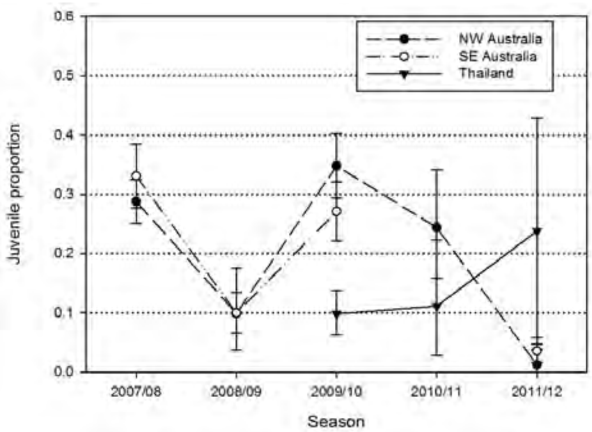

Figure 4. Juvenile proportions of Curlew Sandpipers in Thailand compared with two sites in Australia. Bars indicate 95% confidence limits.

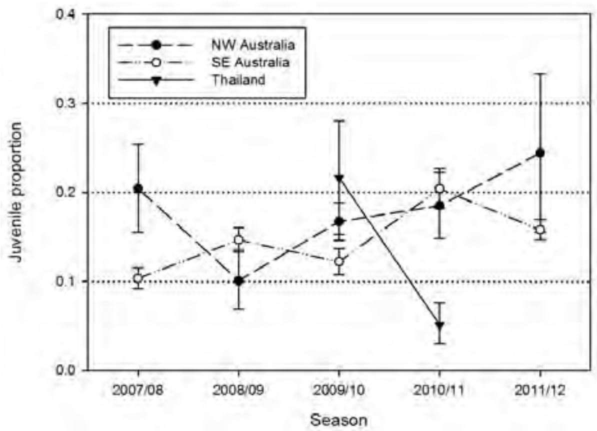

Figure 7. Juvenile proportions of Red-necked Stints in Thailand compared with two Australian sites. Bars indicate 95% confidence limits.

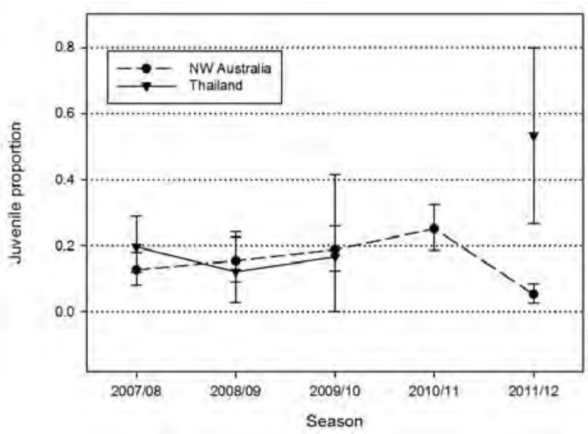

Figure 8. Juvenile proportions of Terek Sandpipers in Thailand compared with north-west Australia. Bars indicate 95% confidence limits.

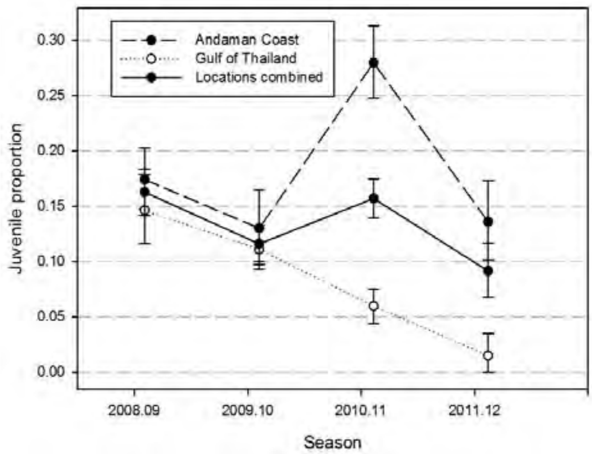

Figure 9. Juvenile proportions of Lesser Sand Plovers at sites in Thailand. Bars indicate 95% confidence limits.

In this paper, we have made a number of judgements relating to annual differences in observed juvenile proportions by species, both within Thailand and in relation to changes observed over the same period in north-west and south-east Australia. We have not supported these judgements with statistical testing even though the data are, on the face of it, sufficient to do so. An implicit assumption in the sampling process, required if the binomial theory is to apply, is that each bird in the population has an equal probability of being trapped. There is now strong evidence (see for example Harrington & Leddy 1982, Clark *et al*. 2004, Battley 2005, Rogers *et al*. 2005) that this assumption does not hold in that the distribution of juvenile birds in wader flocks is not necessarily homogenous: juveniles tend to congregate with other birds of the same age and can be over-represented in some parts of a flock and under-represented in others. Rogers (2006) showed that if a population is a closed system with no influx or efflux of birds, a large enough total sample, comprising one or more subsamples, would be representative of the overall population. It is not as yet possible to say how large a sample is needed for a sample to be representative although it is evident that bunching of juveniles is more likely to be apparent in smaller samples. In practice, this means that conventional statistical testing of differences would be inappropriate.

What then to do? Of necessity, we must assume the very high or low juvenile proportions are likely to be statistical aberrations due to juvenile bunching. Very high proportions, 0.3 and over, are also biologically unlikely. Intermediate proportions maybe subject to some bias but are, particularly if based on larger samples, more likely to be realistic. In circumstances where all data points may be subject to biases of unknown size and direction, judgement must be exercised by the analyst. It is with this perspective that similarities and differences between juvenile proportions have been assessed.

Results presented here underscore the usefulness of continuing cannon-netting of waders in Thailand, both to extend monitoring of the range of species and populations covered, and as a source of comparative data for Australian wintering populations. It will be important to repeat this analysis in the future to determine whether the present observed similarities are confirmed.

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REFERENCES

Battley, P.F. 2005. Mechanisms by which juvenile Bar-tailed Godwits form subgroups. *Stilt* 48: 18.

Bernoulli, J. 1713. *Ars Conjectandi*. Cited in Stewart, I. 2008. Taming the Infinite. Quercus Publishing, London.

BirdLife International. 2004. Important bird areas of Asia: Key sites for conservation. BirdLife International, Cambridge, UK.

Christidis, L. & W.E. Boles. 2008. Systematics and taxonomy of Australian birds. CSIRO Publishing, Collingwood.

Clark, J.A., R.A. Robinson, N.A. Clark & P. Atkinson. 2004. Using the proportion of juvenile waders in catches to measure recruitment. *Wader Study Group Bull*etin 104: 51-55.

Harrington, B.A. & L.E. Leddy. 1982. Are wader flocks random groupings? A knotty problem. *Wader Study Group Bulletin* 36: 20-21.

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

Meltofte, H., T. Piersma, H. Boyd, B. McCaffery, B. Ganter, V.V. Golovnyuk, K. Graham, C.L. Gratto-Trevor, R.I.G. Morrison, E. Nol, H.-U. Rösner, D.

Schamel, H. Schekkerman, M.Y. Soloviev, P.S. Tomkovich, D.M. Tracy, I. Tulp & L. Wennerberg. 2007. Effects of climate variation on the breeding ecology of Arctic shorebirds. *MoG Bioscience* 59. Copenhagen, Danish Polar Center. 48p.

Minton, C.D.T., R. Jessop, P. Collins & K. Gosbell. 2005. Monitoring Shorebird Breeding Productivity by the Percentage of First Year Birds in Populations in S. E. Australian Non-breeding Areas. Pp. 73–84. *In:* Straw, P. (Ed.) Status and Conservation of Shorebirds in the East Asian Australasian Flyway. Proceedings of the Australasian Shorebirds Conference 13-15 December 2003, Canberra, Australia. Wetlands International Global Series 18, International Wader Studies 17, Sydney, Australia.

Minton, C., R. Jessop. P. Collins & C. Hassell. 2006. Arctic breeding success in 2005, based on juvenile ratios in waders in Australia in the 2005/2006 austral summer. *Stilt* 49: 32–35.

Minton, C., R. Jessop & C. Hassell.2007. Breeding success of arctic waders in 2006, based on juvenile ratios in Australia in the 2006/2007 austral summer. *Stilt* 51–52: 3–4.

Minton, C., R. Jessop & C. Hassell. 2008. 2007 breeding success based on juvenile ratios of northern hemisphere waders which spend the non-breeding season in Australia. *Stilt* 53: 15–19.

Minton, C., R. Jessop & C. Hassell. 2009. Wader breeding success in the 2008 arctic summer based on juvenile ratios in birds which spend the non-breeding season in Australia. *Stilt* 56: 6–9.

Minton, C., R. Jessop & C. Hassell. 2010. Wader breeding success in the 2009 arctic summer based on juvenile ratios in birds which spend the non-breeding season in Australia. *Stilt* 57: 63–66.

Minton, C., R. Jessop & C. Hassell. 2011a. Wader breeding success in the 2010 arctic summer based on juvenile ratios in birds which spend the non-breeding season in Australia. *Stilt* 60: 58–60.

Minton, C., R. Jessop & C. Hassell. 2011b. Wader breeding success in the 2009 arctic summer. *Arctic Birds: Bulletin of the International Breeding Conditions Survey* 12: 53–56.

Minton, C., R. Jessop & C. Hassell. 2012. Wader breeding success in the 2011 arctic summer, based on juvenile ratios of birds which spend the non-breeding season in Australia. *Stilt* 62: 54–57.

Prater, A.J., J.H. Marchant & J. Vuorinen. 1977. Guide to the identification and ageing of Holarctic waders. British Trust for Ornithology, Tring.

Rogers, D.I., K.G. Rogers & M.A. Barter. 2005. Measuring recruitment of shorebirds with telescopes: a pilot study of age ratios on Australian non-breeding grounds. Pp. 63-72. *In:* Straw, P. & D. Milton. (Eds.) Status and Conservation of Shorebirds in the East Asian-Australasian Flyway. Proceedings of the Australasian shorebirds conference 13–15 December 2003, Canberra, Australia. International Wader Studies 17. Sydney, Australia.

Rogers, K.G. 2006. A note on estimating the variance of a juvenile proportion from a number of sub-samples. *Wader Study Group Bulletin* 110: 59–61.

Round, P.D. 2006. Shorebirds in the Inner Gulf of Thailand. *Stilt* 50: 96–102.

Scott, D.A. (Ed.). 1989. A Directory of Asian Wetlands. IUCN, Gland, Switzerland.

Snedecor, G.W. & W.G. Cochran. 1989. Statistical Methods. 8th edition. Iowa State University Press.

Wetlands International. 2014. Waterbird Population Estimates. Available at wpe.wetlands.org (accessed 13 Apr 2014).

SHOREBIRDS OF RAWA BENTO: A HIGH ALTITUDE SWAMP IN KERINCI SEBLAT NATIONAL PARK, SUMATRA

WASKITO KUKUH WIBOWO[1], SHAIM BASYARI[1], ZULQARNAIN ASSIDDIQI[1]

[1]*Kelompok Pengamat Burung Bionic Universitas Negeri Yogyakarta (Bionic Birdwatching Club State University of Yogyakarta), Gelanggang ORMAWA FMIPA UNY Karangmalang Yogyakarta 55281, Indonesia,* *wsawakita@yahoo.co.id*

A shorebird survey was conducted from 7–13 December 2011 at Rawa Bento, an upland swamp (*c.* 1400 m) in Kerinci Seblat National Park, Sumatra, Indonesia. One Greater Painted Snipe (*Rostratula benghalensis*), 38 Wood Sandpiper (*Tringa glareola*), and 15 Common Sandpiper (*Actitis hypoleucos*) were recorded. In addition, observations of more than 45 Snipe (*Gallinago spp.*) was the most interesting record and warrants further investigation. These records suggest that Rawa Bento may be an important upland swamp in Sumatra for shorebirds and should be subject to further monitoring.

INTRODUCTION

Rawa Bento is a high altitude (1,400 m), upland swamp, located in the Kerinci Seblat National Park, Sumatra, Indonesia. The park is listed as a UNESCO World Heritage Site, and is recognised as one of the most important areas for the critically-endangered Sumatran Tiger (*Panthera tigris sumatrae*) (Wibisono *et al.* 2011).

Previous studies on the avifauna of Rawa Bento have been conducted by various researchers (Harun *et al.* 2002, Novarino *et al.* 2000, Project Orang Pendek 1997, Salsabila 1996) and many birdwatchers visit the park each year. However, there appears to have been no detailed surveys done solely looking for the shorebirds. Although Rawa Bento is close to the west coast of Sumatra, detailed information on shorebirds in Jambi province is available only from Pantai Cemarathat lying on the east coast, approximately 350 km from Rawa Bento. There have been 32 shorebird species recorded at this site including Nordman's Greenshank *Tringa guttifer*, Asian Dowitcher *Limnodromus semipalmatus*, Great Knot *Calidris tenuirostris* and Red Knot *Calidris canutus* (Tirtaningtyas & Febrianto 2013).

Here I report on a shorebird count conducted in Rawa Bento swamp in order to provide information about the shorebirds present in the area and to add to species records for Jambi province more generally.

METHODS

Site description

Rawa Bento is an upland swamp of approximately 1,000 ha in area, located in the Kerinci Seblat National Park (1°43'38.42" S 101°20'24.50" E). Administratively, the park is located in Pauh Tinggi village, Gunung Tujuh Sub-district, Kerinci District, Jambi Province, Sumatra. The swamp can be reached in about five hours driving from Sungai Penuh, the nearest town, which also became the capital city of Kerinci District where the Kerinci Seblat National Park's office located. The word 'Bento' comes from the local name of *Leersia hexandra*, an aquatic plant that dominates the swamp. Some other common plants include *Eugenia spicata, Elaocarpus sp., Pandanus sp., Ilex cymosa* and *Cyperus halpan*. Almost 50% of the area has been cleared and converted to rice paddies (Giesen & Sukotjo 1991).

The swamp is divided into three major wetland types. The first is the rice paddies that cover almost 50% of the swamp. Some of this area was being plowed at the time, and the remainder was already planted. The second wetland type is the sedge-grass swamp dominated by *Leersia hexandra*. The vegetaton in this sedge-grass swamps is floating with running water below. The third wetland type is at the confluence of a river and the swamp, where the river breaks into three branches and then continues to flow out of the swamp. One branch of the river flows into the midle of the swamp forming a small lake, which separates the sedge-grass swamps from the lake vegetation. Several locations in this wetland were being used to graze cows and water buffalos. There are also shallow unvegetated areas where the water buffalo swallow causing some sedimentation, at the edge of the swamps where they border the river.

Survey methods

The survey covered all major wetland types that occur in the area. The number of shorebird species and individuals present in the swamp was determined using foot-based and boat-based surveys, conducted between 7 to 13 December 2011. Four persons divided into two teams and counted the area between 0700-1400 hours. Survey by boat followed the river and was conducted on 10, 11 and 13 December 2011. All the shorebirds present were identified and counted, either directly or from photographs taken at the time and counted later. To minimize double counting, the flight directions of the birds observed were noted.

RESULTS AND DISCUSSION

During the survey, the shorebirds were observed mostly in sedge-grass swamp. Four shorebird species were observed and counted during the surveys. A single Greater Painted Snipe *Rostratula benghalensis* was the only resident recorded on 12 December 2011. Three migratory species were recorded: Wood Sandpiper *Tringa glareola* with a maximum count of

Table 1. List of shorebird species counted in Rawa Bento between 7-13 December 2011.

Species	7 Dec.		8 Dec.		10 Dec.		11 Dec.		12 Dec.		13 Dec.	
	S	P	S	P	S	P	S	P	S	P	S	P
Rostratula benghalensis	-	-	-	-	-	-	-	-	1	-	-	-
Tringa glareola	20	-	-	-	38	-	-	-	23	-	15	-
Actitis hypoleucos	2	-	-	-	15	-	-	1	2	-	1	-
Gallinago spp.	39	-	45+	-	41	-	1	2	20	-	3	-
TOTAL	61		45+		94		4		46		19	

S = Sedge-grass swamp; P = Rice paddies.

38 birds on 10 December 2011, Common Sandpiper *Actitis hypoleucos* with a maximum count of 15 birds 10 December 2011, and either Swinhoe's or Pintail Snipe *Gallinago spp.*with at least 45 birds counted on 8 December 2011 (Table 1). Details of all shorebird counts and relevant past records are described below.

Greater Painted Snipe Rostratula benghalensis

During the survey, the only record of this resident shorebird was a female observed on 12 December 2011. It was recorded using sedge-grass swamp habitat. On Kerinci Seblat NP, there has been only three previous records of this species. It was first recorded by F. G. Rozendaal in the Kerinci valley at 800 m on 9 July 1981 (Marle & Voous 1988). Elliot & Martinez observed a male near Kersik Tuo in the Kerinci Valley at *c.* 1,400m which became a new altitude record (Holmes 1996). Harun *et al.* (2002) listed the bird from Bukit tapan and Sawah Sungai Penuh. The record from Rawa Bento constitutes the second high altitude record after Holmes (1996).

Wood Sandpiper *Tringa glareola*

Wood Sandpiper was encountered almost daily, with 38 birds on 10 December 2011 being the highest count. These birds were recorded using sedge-grass swamp habitats. Although it is a common visitor for Greater Sundas (MacKinnon & Phillipps 1993), there are only two previous records of this species in Kerinci Seblat NP. The first was of up to 20 birds in the Kerinci Valley recorded by Ben King on 1918 (Marle & Voous 1988). The second was a single record from Sawah Sungai Penuh recorded by Harun *et al.* (2002).

Common Sandpiper Actitis hypoleucos

As with Wood Sandpiper, Common Sandpiper was encountered almost every day, with the highest number being 15 birds on 10 December 2011. The birds were mainly observed in the sedge-grass swamp, with only a single bird observed in rice paddy fields on 11 December 2011. Records from Rawa Bento constitute the second high-altitude record after several birds at Kersik Tuo at the same elevation by A.Elliot (Holmes 1996). Another record from the park was from Sungai Penuh paddies (Harun *et al.* 2002).

Snipe Gallinago spp.

Snipes were observed in each survey in the sedge-grass swamp, and observed once on 11 December 2011 in rice paddy fields. On 8 December 2011, 45+ snipes were counted in the sedge-grass swamp, flying a short distance with no sound made, caused by the disturbance of the observer. Some specific characteristics could be observed on one bird: the head was not rounded, the eye position was in the rear half of the head and the toes were only slightly exceeding its tail (Figure 1). These characteristics might refer to Swinhoe's Snipe *Gallinago megala* as described by Hayman *et al.* (1986). This species has not previously been recorded in the park. However, as this might also refer to Pin-tailed Snipe *Gallinago stenura*, and both species are almost impossible to differentiate in the field unless the diagnostic shape of the outer tails is visible (Leader & Carey 2003), I cannot confidently assign these observations to one species or the other.

Figure 1. One of 45+ Snipe at Rawa Bento, Kerinci Seblat National Park, Jambi province, on 8 December 2011. Several key features including head shape, eye position and slight extension of toes beyond the tail are suggestive of Swinhoe's Snipe (© Shaim Basyari).

Other Shorebird Species

Of the shorebirds recorded previously in the park, the Javan Woodcock *Scolopax saturata* was the only one that was not recorded during this survey. This Java-Sumatra endemic has been previously recorded in Kerinci-Seblat NP at high altitude, between 1,900 and 2,400m (MacKinnon & Phillipps 1993).

Snipe Records from Kerinci-Seblat National Park

The likely record of one Swinhoe's Snipe plus at least 44 other birds that might be either Swinhoe's or Pin-tailed Snipe, constitutes the first for the park. This record appears to be one of the highest numbers of snipe recorded for Sumatra.

Figure 2. A flock of about seven Wood Sandpipers in flight, with Rawa Bento swamp vegetation in the background, Kerinci Seblat National Park, on 12 December 2011 (© Zulqarnain Assiddiqi).

Figure 3. A Common Sandpiper at the edge of the swamp of the Rawa Bento, on 10 December 2011 (© Waskito Kukuh Wibowo).

Figure 4. Two Wood Sandpipers in Rawa Bento on 12 December 2011 (© Zulqarnain Assiddiqi).

There are only three previous confirmed records of Swinhoe's Snipe in Sumatra. The first record was a single specimen collected by Gibson-Hill in 1949, but without any information of its location and date (Marle & Voous 1988). The second was approximately 50 birds at Batu Lima, Sumatra Utara on 27 March 2002 that is also likely to constitute both Pin-tailed and Swinhoe's Snipes (crossland *et al.* 2009). The third record was three birds caught and ringed in Pantai Cemara, Jambi, during avian influenza research (Noni & Londo 2010). Pin-tailed Snipe was recorded only once from Kayu Aro, but no details of the observation was provided (Harun *et al.* 2002).

On the basis of daily observations of the snipe throughout the survey, I consider that Swinhoe's Snipe was most likely to be the more common species present. But, although the snipes were easily to find in the area close to the river, sedge-grass swamps and rice paddies, it was difficult to determine them to species level. Based on the observations of its flying behavior, there is a possibility that Pin-tailed Snipe was also present. In addition to the typical flight pattern of Swinhoe's Snipe of low, short distance flight without making any sounds, there were also individuals noted with zig-zag flight that were also vocalizing, which suggests Pin-tailed Snipe.

CONCLUSION

Rawa Bento may be an important upland swamp in Sumatra for small numbers of shorebirds on migration in the East Asian-Australasian Flyway. The swamps provide suitable feeding and roosting areas for at least four species of shorebird, including substantial numbers of *Gallinago* snipe. The nearest known high-altitude site for shorebirds is in the Kelabit Highlands (1,000-1,200 m) on Sarawak (Malaysia), where Sheldon *et al*. (2013) recorded 11 species, including some other interesting species such as Red-necked Phalarope *Phalaropus lobatus*, Oriental Plover *Charadrius veredus*, as well as Pin-tailed and Swinhoe's Snipe.

Given the lack of information about shorebirds in the park, I recommend further shorebird surveys over a longer period. These may reveal additional migrant species present in the area as well as providing a better understanding of the relative importance of this site to shorebirds during the migration period.

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REFERENCES

Crossland, A.C., S.A. Sinambela, A.S. Sitorus & A.W. Sitorus. 2009. The coastal zone of Asahan Regency: an area of international importance for migratory waders in North Sumatra Province, Indonesia. *Stilt* 55: 8-12.

Giesen, W. & Sukotjo. 1991. Lake Kerinci and the Wetlands of Kerinci Seblat National Park, Sumatra. PHPA/AWB Sumatra Wetland Project Report No. 6, Bogor.

Harun, S. Nuraeni & J. Holden. 2002. Daftar Jenis Burung di TNKS. Unpublish checklist.

Hayman, P., J. Marchant & T. Prater. 1986. Shorebirds – an Identification Guide to the Waders of the World. Houghton Miffin Company, USA.

Holmes, D.A. 1996. Sumatra bird report. *Kukila* 8: 9–56.

Leader, P.J. & G.J. Carey. 2003. Identification of Pintail Snipe and Swinhoe's Snipe. *British Birds* 96: 178-198.

MacKinnon, J. & K. Phillipps.1993. A Field Guide to the Birds of Borneo, Sumatra, Java and Bali. Oxford University Press, London.

Marle, J.G. van & K.H. Voous.1988. The Birds of Sumatra: an Annotated Check-list. Check-list 10. British Ornithologists' Union.Tring, UK.

Noni, F. & I. Londo. 2010. Field report for Wildlife Conservation Society, Sumatra, Indonesia: December 2009-January 2010. *Tattler* 18: 8-10.

Novarino, W. Hernawati, Kurnia & I. Gusmardi. 2000. Struktur komunitas burung di TNKS dan upaya peningkatan pemahaman masyarakat terhadap fungsi ekologinya Pp. 28-34. *In:* Prosiding Hasil Penelitian Small Research Grants Taman Nasioanal Kerinci Seblat 1998-1999, Jakarta.

Project Orang Pendek. 1997. Bird list Kerinci Seblat National Park, Sumatra and adjoining areas. FFI/LIPI/PHPA. Sungai Penuh, Jambi.

Salsabila, A. 1996. Fauna Burung di Taman Nasional Kerinci Seblat: Jurusan Biologi, FMIPA Universitas Andalas. *Jurnal Matematika dan Pengetahuan Alam* 5(2): 1-15.

Sheldon, F.H., C.E. Brown, M.A. Rahman, G.K. Tay & R.G. Moyle. 2013. Ornithology of The Kelabit Highlands of Sarawak, Malaysia. *The Raffles Bulletin of Zoology 2013* 61(2): 827-853.

Tirtaningtyas, F.N. & I. Febrianto. 2013. Burung Pantai Panduan Lapangan di Pantai Cemara, Jambi. Wildlife Conservation Society-Indonesia Program, Bogor.

Wibisono, H.T., M. Linkie, G. Guillera-Arroita, J.A. Smith, Sunarto, *et al.* 2011. Population Status of a Cryptic Top Predator: An Island-Wide Assessment ofTigers in Sumatran Rainforests. *PLoS ONE* 6(11): e25931.

RECENT OBSERVATIONS OF WHITE-FACED PLOVER *CHARADRIUS DEALBATUS* AND THREE OTHER SMALL PLOVERS ON THE EAST COAST OF NORTH SUMATRA PROVINCE, INDONESIA

ANDREW C. CROSSLAND[1] & ARI W. SITORUS[2]

[1] 46 Frensham Crescent, Woolston, Christchurch 8062, New Zealand.
E-mail: Andrew.Crossland@ccc.govt.nz
[2] Jalan M. Abbas/Semnanjung No. 26, Tanjung Balai Asahan, Sumatera-Utara, Indonesia.

This paper reports on observations of White-faced Plover *Charadrius dealbatus*, Little Ringed Plover *C. dubius curonicus*, Kentish Plover *C. alexandrinus* and Malaysian Plover *C. peronii* on the central east coast of North Sumatra Province, Indonesia during September-October 2010 and November 2012. All four species were found in low numbers (in total comprising <4% of all *Charadrius* plovers) at a relatively small number of sites. We report the first confirmed sightings of White-faced Plover in North Sumatra Province and confirm that the non-breeding range of this taxon includes the east coast of northern Sumatra. Our findings suggest that Sumatra is at the southern edge of the regular non-breeding range for migratory Little Ringed Plover and Kentish Plover populations using the East Asian-Australasian Flyway. We found that numbers of resident Malaysian Plover are very low and the species is absent from many areas of suitable habitat. It has disappeared from areas where it was known to occur in the past and this appears to be attributable to human disturbance and modification of preferred habitat.

INTRODUCTION

The east coast of Sumatra was originally characterised by extensive inter-tidal mudflats, mangrove forest and nipah palm swampland (Anderson 1826). Sandy habitats are limited mainly to narrow sand spits and beach formations in the vicinity of river mouths (Whitten *et al.* 2000, Crossland *et al*. 2006). Over the last 20+ years many hitherto relatively unmodified and lightly populated coastal areas have seen substantial land-use change and a corresponding increase in human settlement (Crossland *et al.* 2009, 2012). Mangrove forest and nipah swampland have been removed on a large scale and replaced with aquaculture ponds, oil palm plantations and other agricultural activity (Iqbal *et al.* 2010d, Crossland *et al.* 2012). There has been a substantial increase in human recreational activity on the coastline, particularly along sandy beaches (Crossland *et al.* 2012).

Occurrence of *Charadrius* plovers

Eastern Sumatra is a major transit and wintering zone for waders using the East Asian-Australasian Flyway (Silvius 1988, Whitten *et al.* 2000, Crossland *et al.* 2006). The occurrence of at least 44 migratory and resident species has been documented (Van Marle & Voous 1988, MacKinnon & Phillipps 1993, Crossland *et al.* 2006, Iqbal *et. al.* 2010a, Crossland & Sitorus 2011, Iqbal *et al.* 2013b). Of the *Charadrius* plovers, eight species are known to occur – Greater Sand Plover *Charadrius leschenaultii*, Lesser Sand Plover *C. mongolus*, Little Ringed Plover *C. dubius*, Malaysian Plover *C. peronii*, Kentish Plover *C. alexandrinus,* White-faced Plover *C. dealbatus*, Javan Plover *C. javanicus*, and Oriental Plover *C. veredus*.

Wader surveys since the late 1980s have confirmed that Greater and Lesser Sand Plovers are locally abundant, many sites supporting one or both of these species in flocks of 100s to 1000s (Silvius 1986, 1988, Danielsen & Skov 1989, Verheught *et al.* 1990, 1993, Crossland *et al.* 2006, 2009, 2012, Iqbal *et al.* 2010d). Oriental Plover is a rare vagrant to Sumatra with few verified records (Silvius 1987, Parrott & Andrew 1996). Javan Plover was not recorded in Sumatra until 2007, but small populations have recently been discovered in the south-eastern province of Lampung, and also on nearby Bangka Island (Iqbal *et al*. 2011, 2013a, c).

The White-faced (Swinhoe's) Plover is a recently rediscovered taxon, closely related to Kentish Plover (Rheindt *et al.* 2011, Bakewell & Kennerley 2008, Kennerley *et al.* 2008). This little known plover is reported to breed on beaches in southern China (Jones 2011) and winters in scattered coastal locations within East and South-east Asia (Kennerley *et al.* 2008, Chandler 2009). It was first recorded in the Sumatran realm at Rupat Island, Riau Province, in February 2005 (Iqbal *et al.* 2010b), with subsequent records at Cemara Beach, Jambi Province in February 2008 (Bakewell & Kennerley 2008) and at three localities in the Banyuasin area, South Sumatra Province, in October 2008, December 2008 and November 2009 (Iqbal *et al.* 2010b). Prior to this study, it had only been recorded once in the northern provinces of Sumatra, one bird at Peurolin, Aceh Province, in January 2009 (Iqbal *et al*. 2013b).

The *curonicus* sub-species of Little Ringed Plover is a migrant from North Asia and has an estimated Flyway population of 25,000 (Wetlands International 2014). It is a widespread visitor to Sumatra, but is generally uncommon and occurs in low numbers (van Marle & Voous 1988, Crossland *et al.* 2006, Iqbal *et al.* 2013b).

The Kentish Plover is found almost worldwide and an estimated 100,000 occur within the East Asian-Australasian Flyway (Bamford *et al.* 2008). The majority spend the non-breeding season in East Asia,

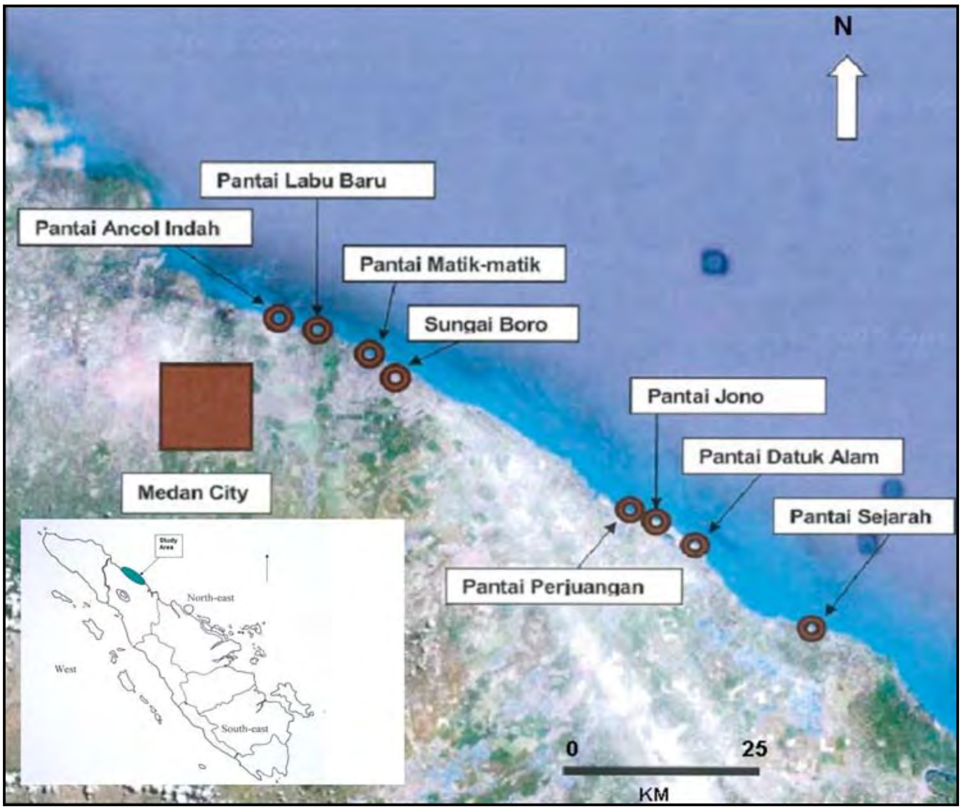

Figure 1. Map of the east coast of North Sumatra Province showing sites where small Charadrius plovers were found. Inset shows the location of the study area on a full map of Sumatra. Main map reproduced from Google Earth ©.

but small numbers migrate as far south as Indonesia (MacKinnon & Phillipps 1993). In Sumatra it is considered an uncommon visitor to all coasts (van Marle & Voous 1988, Strange 2001, Crossland *et al.* 2006).

The Malaysian Plover is resident on the coastlines of South-east Asia, including Sumatra where it is considered uncommon and local (Van Marle & Voous 1988, MacKinnon & Phillipps 1993, Iqbal *et al.* 2013b). At all seasons it is restricted to sandy, coralline and shelly shorelines (Hayman *et al.* 1986, Robson 2000). The world population has recently been estimated at 10,000-25,000 (Wetlands International 2014) and the species is considered near-threatened (Birdlife International 2014).

In September-October 2010 and November 2012 we surveyed waders along the central east coast of North Sumatra Province. The aim of this study was to document numbers and distribution of waders and to identify important sites (Crossland & Sitorus *in prep.*). In this paper we present data on the abundance and local distribution of the four small *Charadrius* plovers that occur regularly but are considered uncommon on the east coast of Sumatra – White-faced Plover, Malaysian Plover, Little Ringed Plover and Kentish Plover.

METHODS AND STUDY AREA

Between September and October 2010 we visited 40 coastal wetland sites along *c.*150 km of coastline within the Deli-Serdang, Serdang-Bedagai, Batubara and Asahan Regencies (Districts) on the central east coast of North Sumatra Province, Indonesia (Figure 1). In November 2012 we made repeat visits to seven sites: Pantai Labu Baru, Sungai Boro River-mouth, Pantai Nipah Indah, Pantai Jono/Kuala Kubah Padang, Pantai Perjuangan, Pantai Sejarah, and Padang Durian ricefields. Sites varied in size from large inter-tidal mudflat habitats and ricefields of >500 ha to small river-mouth estuaries, aquaculture pond complexes or sandy beaches of <5 ha. We undertook surveys at either high tide when many species were roosting, or at mid-tide when birds were concentrated into feeding congregations relatively close to shore. Count durations varied depending on bird abundance, number of species present, and whether birds were congregated into high-tide roosting flocks or were widely dispersed over feeding grounds. On average counts took 20-40 minutes at smaller sites and 1-4 hours at larger sites to complete. Observations were made by 10×42 binoculars and 25× spotting scope. We counted all waders encountered at each site with particular attention paid to searching for White-faced Plover and other small plovers.

RESULTS AND DISCUSSION

In contrast to many other wader species, small *Charadrius* plovers were found to be uncommon on the east coast of North Sumatra. During the two-month period of field work in 2010 we counted over 65,000 waders at 40 coastal wetland sites (Crossland & Sitorus *in prep.*). We found a total of 4192 *Charadrius* plovers, but the great majority were

Greater and Lesser Sand Plovers and only 155 (3.7%) were the four smaller target species. These were found at just seven sites (Table 1, Figure 1) and were absent from another 33. During our November 2012 survey of seven sites (including four which had held target species in 2010), we counted almost 17,000 waders of which 1246 were *Charadrius* plovers. These plovers included 36 (2.9%) small plovers, which were found at only four sites (Table 2). Details on each individual target species are given below.

White-faced Plover

We found White-faced Plover at one site in 2010 and at two sites in 2012. Our first sighting was of a single bird we photographed at Pantai Matik-matik, Serdang-Bedagai Regency, on 13 October 2010. Identification was confirmed by D. Bakewell (*pers. comm.*) from photographs. This bird was observed foraging on the lower foreshore of a white-sand beach, loosely associated with Lesser Sand Plovers and Terek Sandpipers *Xenus cincereus*. This sighting constitutes the first record of White-faced Plover for North Sumatra Province (Balen *et al.* 2013).

On 28 November 2012 we found a single White-faced Plover in non-breeding plumage at Sungai Boro, Serdang-Bedagai Regency. This bird was foraging amongst a group of Sanderling *Calidris alba* on a narrow white-sand beach adjacent to the river mouth (Figure 2). On 29 November 2012 we found a group of eight White-faced Plovers in various plumages, feeding and roosting on dead coral reef and mudflats at Pantai Jono, Batubara Regency (Figure 3). They were loosely associated with Kentish Plovers, Lesser Sand Plovers, Red-necked Stints *Calidris ruficollis* and Curlew Sandpipers *Calidris ferruginea*. These 2012 identifications were again confirmed by David Bakewell, an observer experienced with these species,from multiple photographs.

Kennerley *et al.* (2008) speculated that Sumatra may contain undiscovered wintering sites for White-faced Plover. Our 2010 and 2012 searches in North Sumatra and observations elsewhere (Bakewell & Kennerley 2008, Iqbal *et al.* 2010b, 2013b) confirm that the species does indeed reach the east coast islands and mainland of Sumatra but its numbers appear to be very low. Most sightings to date have been of individual birds, with the only groups observed being our party of eight at Pantai Jono and six reported by Iqbal *et al.* (2010b) at Pulau Betet, South Sumatra Province on 16 November 2009.

Little Ringed Plover

In 2010 we recorded Little Ringed Plover at just two sites - 32 birds at Pantai Datuk Alam and one bird at Pantai Sejarah, both in Batubara Regency (Table 1). In 2012 we found the species at one site – one bird at Pantai Jono, Batubara Regency (Table 2). This species seems to be generally scarce in North Sumatra Province, although it is more numerous and probably more widespread further north-west in Aceh Province (Crossland 2000, Iqbal *et al.* 2010c).

Kentish Plover

The Kentish Plover was the most abundant of the four small *Charadrius* plovers surveyed. A total of 116 were counted at four sites in 2010 (Table 1) and 26 birds at three sites in 2012 (Table 2). These totals included flocks of 64 at Pantai Sejarah, 30 at Pantai

Table 1. Counts of small *Charadrius* plovers on the central east coast of North Sumatra Province, September-October 2010.

Site	Lat., Long.	Date	White-faced Plover	Malaysian Plover	Little Ringed Plover	Kentish Plover
Pantai Datuk Alam	3°21'N, 99°29'E	2-Oct-10	0	0	32	20
Pantai Jono	3°23'N, 99°25'E	5-Oct-10	0	2	0	0
Pantai Perjuangan	3°23'N, 99°24'E	5-Oct-10	0	2	0	0
Pantai Sejarah	3°15'N, 99°32'E	8-Oct-10	0	0	1	64
Pantai Matik-matik	3°37'N, 99°03'E	13-Oct-10	1	1	0	0
Pantai Labu Baru	3°40'N, 98°54'E	14-Oct-10	0	0	0	2
Pantai Ancol Indah (West)	3°41'N, 98°53'E	14-Oct-10	0	0	0	30
Total			1	5	33	116

Table 2. Counts of small Charadrius plovers on the central east coast of North Sumatra Province, November 2012.

Site	Lat., Long.	Date	White-faced Plover	Malaysian Plover	Little Ringed Plover	Kentish Plover
Pantai Labu Baru	3°40'N, 98°54'E	28-Nov-12	0	0	0	2
Sungai Boro	3°38'N, 99°02'E	28-Nov-12	1	0	0	0
Pantai Jono	3°23'N, 99°25'E	29-Nov-12	8	0	1	18
Pantai Sejarah	3°15'N, 99°32'E	29-Nov-12	0	0	0	6
Total			9	0	1	26

Figure 2. White-faced Plover at Sungai Boro, Serdang-Bedagai Regency, 28 November 2012.

Figure 3. Five White-faced Plover (part of a group of eight) with a single Kentish Plover (far right), Pantai Jono, Batubara Regency, 29 November 2012.

Ancol Indah West, 20 at Pantai Datuk Alam and 18 at Pantai Jono. These are good-sized congregations for Sumatra and comparable to the 100 counted at Pantai Ancol, Deli-Serdang Regency by Iqbal (2010d) on 3 January 2009. Previous records of Kentish Plover from localities within the study area include Pantai Cermin (1912), Deli-Serdang (1918), Perbaungan (1920) (Van Marle & Voous 1988) and a count of 10+ at Bagan Percut, Deli-Serdang Regency, in December 1995 (Crossland *et al.* 2012). Collectively, this cluster of records indicates that Kentish Plover is almost certainly a regular migrant to the east coast of North Sumatra, but is probably overlooked amongst large mixed wader flocks.

Malaysian Plover

Despite many searches of sandy shoreline with apparently suitable habitat, Malaysian Plovers were found at only three of the 40 sites visited in 2010 (Table 1) and none of the sites visited in 2012 (Table 2). Sightings in 2010 comprised two birds at Pantai Jono and two at the adjacent Pantai Perjuangan (both Batubara Regency), with a single female sighted at Pantai Matik-Matik in Serdang-Bedagai Regency. Each of these sites held very low numbers and was surrounded by long stretches of apparently suitable sandy beach coastline, but Malaysian Plover were not found there. Although our surveys occurred outside of the February-July breeding season (Piersma &

Wiersma 1996), all Malaysian Plovers encountered exhibited territorial defence behaviours (injury-feigning, agitated calling and head-bobbing, etc.) and we assume they were occupying breeding beaches.

On the basis of our observations over time, we consider that the Malaysian Plover population is almost certainly in decline on the central east coast of North Sumatra Province. Its preferred open beach habitat is naturally limited due to the dominance of mangrove and mudflat shorelines. An upsurge in recreational developments over dozens of sandy beaches and sand spits since the late 1990s (ACC *pers. obs.*) seems to have displaced birds through habitat degradation and exposed them to intolerable levels of human disturbance. At all three sites where we found Malaysian Plovers in 2010 we noted the recent commencement of recreational development. This included construction of beach huts and picnic shelters near the tide line (Figure 4); new access roads; informal foot and motorcycle tracks; beach sweeping to remove litter and tideline debris; construction of jetties, sea walls and groynes, etc. Our assessment that this habitat modification and enhanced disturbance would inevitably displace birds was confirmed on our repeat visits two years later. At Pantai Jono and Pantai Perjuangan in 2012 for example, scores of new beach huts extended much further along the beachfront than had been noted in 2010, and plantings of palms, shade trees and casuarinas (implemented as part of an environmental enhancement scheme) had marched along the sand spits at both beaches. These new developments covered the open sandy habitats where Malaysian Plovers had previously been occupying foraging (and presumed breeding) territories (Figure 4).

Elsewhere in North Sumatra, Malaysian Plover have definitely disappeared from one coastal locality - Pantai Cermin in Serdang-Bedagai Regency, where a pair was recorded in March 1979 (van Marle & Voous 1988). We surveyed this site for waders in 1995, 1997, 2005, 2006 and 2010 (Crossland & Sitorus *unpubl. data*) and have never observed Malaysian Plover there, nor on the adjacent sandy shorelines to the north and south. Since the mid 1990s this site has been developed as a beach resort and fun park, attracting thousands of picnickers and bathers on weekends (ACC *pers. obs.*). High disturbance levels, regular beach sweeping and the installation of structures along the foreshore have rendered this beach no longer suitable as a breeding habitat for Malaysian Plover. At the Perbaungan River mouth, immediately east of Pantai Cermin, a high-tide roosting site used by waders in 1995, 1997 and 2005 (Crossland *et al*. 2012) also suffered increased human disturbance, and was found to support few birds in 2010 and 2012 after substantial expansion of the adjacent resort facilities (ACC *pers. obs*.).

Habitat modification and intensified levels of human disturbance have been found to detrimentally affect breeding populations of Malaysian Plover in other parts of the species' range. For example, on the east coast of Thailand, coastal development and associated beach erosion, have reduced breeding habitat availability in Petchburi and Prachuap Khiri Khan Provinces (Nutalaya 2006). Other research in coastal Thailand has shown that human recreational activity on beaches can cause displacement, nest trampling, increased vulnerability to predation, increased egg mortality (due to incubating birds leaving nests and the unguarded eggs suffering heat stress), and increased territorial conflict between adjacent breeding pairs (Yasue & Dearden 2006a, b, Yasue *et al.* 2007). Wells (1999) noted that Malaysian Plovers are quick to abandon sites in the face of

Figure 4. Small sand spit at Pantai Perjuangan, Batubara Regency, November 2012. This site held a pair of Malaysian Plover in October 2010, but had been modified by beach hut construction, sand-grooming and tree-planting by 2012, displacing the plovers.

incidental disturbance and cited examples from Malaysia where birds had been displaced from prime habitat. A study at Tanah Merah Beach in Singapore (Crossland *in prep.*) recorded a decline in a localised breeding population of Malaysian Plover from 5-7 pairs in the 2001 and 2002 breeding seasons (Crossland 2002) to two pairs in 2003 and one pair in 2006. This was due largely to increased human disturbance, predation, and loss of beach nesting habitat through coastal erosion and the spread of invasive vegetation (Crossland *in prep.*).

Status of small *Charadrius* plovers in North Sumatra

All four species were found to be uncommon and sparsely distributed on the central east coast of North Sumatra Province. Our findings confirm appraisals that the western Indonesian islands comprise the southern regular non-breeding range limit for Little Ringed Plover and Kentish Plover in South-east Asia (Crossland *et al.* 2006, Bamford *et al.* 2008). Both species are scarce further east in the Indonesian Archipelago (Strange 2001), with very few individuals of either taxon reaching Australia (Higgins & Davies 1996, Pizzey & Knight 2007). As far as is currently known, Sumatra also comprises the southern migration limit for White-faced Plover, with none as yet observed further south-east in the Indonesian archipelago. Our records strengthen the assessment by Iqbal *et al.* (2013b) that White-faced Plover is probably widely distributed along the east coast of Sumatra, but evidence of significant numbers is yet to be found.

Our observations indicate that Malaysian Plover occurs in very low numbers and is absent from many sites that appear to have suitable habitat. This resident species is certainly locally threatened on the east coast of North Sumatra Province. Its decline appears to be a direct consequence of increased human disturbance and habitat degradation on the relatively small number of sandy beaches available on a coastline that is predominantly muddy and mangrove-lined. Recent records of Malaysian Plover elsewhere in Sumatra and on its satellite islands are very sparse (Iqbal *et al.* 2013b, Crossland & Sinambela 2014). We recommend that other parts of the Sumatran coastline (both east and west coasts) be surveyed for Malaysian Plover (and White-faced Plover), to further clarify their status and to identify sites of conservation importance for these species that may require some form of protection and active management.

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REFERENCES

Anderson, J. 1826. Mission to the East Coast of Sumatra. William Blackwood and T. Cadell, Edinburgh.

Bakewell, D.N. & P.R. Kennerley. 2008. Field characteristics and distribution of an overlooked *Charadrius* plover from South-East Asia. *Birding Asia* 9: 46-57.

Balen, S. van, C. Trainor & R. Noske. 2013. Around the Archipelago. *Kukila* 17(1): 41-72.

Bamford, M., D. Watkins, W. Bancroft, G. Tischler & J. Wahl. 2008. Migratory Shorebirds of the East Asian-Australasian Flyway: Population Estimates and Internationally Important Sites. Wetlands International – Oceania.

Birdlife International. 2014. IUCN Red List for birds. Downloaded from http://www.birdlife.org on 1/04/2014.

Chandler, R. 2009. Shorebirds of the Northern Hemisphere. Christopher Helm, London.

Crossland, A.C. 2000. Notes on the waders wintering at the North-western tip of Sumatra, Indonesia. *Stilt* 36: 4-6.

Crossland, A.C. 2002. Seasonal abundance of waterbirds at Tanah Merah Beach, a newly formed inter-tidal habitat on the edge of reclaimed land in Singapore. *Stilt* 42: 4-9.

Crossland, A.C., S.A. Sinambela, A.S. Sitorus & A.W. Sitorus. 2006. An overview of the status and abundance of migratory waders in Sumatra, Indonesia. *Stilt* 50: 90-95.

Crossland, A.C., S.A. Sinambela, A.S. Sitorus & A.W. Sitorus. 2009. The coastal zone of Asahan Regency: An area of international importance for migratory waders in North Sumatra Province, Indonesia. *Stilt* 55: 8-12.

Crossland, A.C. & A.W. Sitorus. 2011. More Grey-headed Lapwings *Vanellus cinereus* in Northern Sumatra - vagrants or an extension of wintering range? *Stilt* 60: 34-36.

Crossland, A.C., L. Lubis, S.A. Sinambela, A.S. Sitorus, A.W. Sitorus & A. Muis. 2012. Observations of shorebirds along the Deli-Serdang coast, North Sumatra Province, Indonesia: 1995-2006. *Stilt* 61: 37-44.

Crossland, A.C. & S.A. Sinambela. 2014. New and significant records from Batam and Bintan Islands, Riau Archipelago. *Kukila* 17(2): 1-19.

Danielsen, F. & H. Skov. 1989. The Importance of south-east Sumatra as a summering area for non-breeding waders, especially the Bar-tailed Godwit *Limosa Lapponica*. *Stilt* 14: 40-42.

Hayman, P., J. Marchant and T. Prater. 1986. Shorebirds: an identification guide to the waders of the World. Croom Helm, London.

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

Iqbal, M., H. Abdillah & A. Nurza. 2010a. Black-winged Stilt *Himantopus himantopus himantopus*, a new shorebird for Indonesia. *Wader Study Group Bulletin* 117: 63-65.

Iqbal, M., H. Mulyono, R. R. Kadarisman & Surahman. 2010b. A new southernmost record of White-faced Plover *Charadrius dealbatus*. *Wader Study Group Bulletin* 117: 190-191.

Iqbal, M., A. Nurza & T.M. Sanir. 2010c. Notes on the wintering waders at north-eastern tip of Sumatra (Aceh Province), Indonesia. *Stilt* 57: 44-49.

Iqbal, M., Giyanto & H. Abdillah. 2010d. Wintering shorebirds migrate during January 2009 along the east coast of North Sumatra Province, Indonesia. *Stilt* 58: 18-23.

Iqbal, M., I. Febrianto, Giyanto & H. Zilkifli. 2011. The occurrence of the Javan Plover *Charadrius javanicus* in Sumatra, Indonesia. *Wader Study Group Bulletin* 118: 131-133.

Iqbal, M., I. Taufiqurrahman, Y. Khaleb & B. van Balen. 2013a. The distribution, abundance and conservation status of the Javan Plover *Charadrius javanicus*. *Wader Study Group Bulletin* 120: 75-79.

Iqbal, M., H. Abdillah, A. Nurza, T. Wahyudi, Giyanto & M. Iqbal. 2013b. A review of new and noteworthy shorebird records in Sumatra, during 2001-2011. *Wader Study Group Bulletin* 120(2): 85-95.

Iqbal, M., I. Taufiqurrahman, M. Gilfedder, & K. Baskoro. 2013c. Field identification of Javan Plover. *Wader Study Group Bulletin* 120(2): 96-101.

Jones, B.I. 2011. A new breeding ground for White-faced Plover discovered in South China. Downloaded from *http://www.birdguides.com/webzine/article.asp?a=2758*

Kennerley, P.R., D.N. Bakewell & P.D. Round. 2008. Rediscovery of a long-lost *Charadrius* plover from South-East Asia. *Forktail* 24: 63-79.

Li, Z.W.D., C.K. Yeap & K. Kumar. 2007. Surveys of coastal waterbirds and wetlands in Malaysia, 2004-2006. Pp. 1-40. *In*: Li, Z.W.D. & R. Ounsted. (Eds.). 2007. The status of Coastal Waterbirds and Wetlands in Southeast Asia: Results of Waterbird Surveys in Malaysia (2004-2006) and Thailand and Myanmar (2006). Wetlands International, Kuala Lumpur, Malaysia.

McKinnon, J. & K. Phillipps. 1993. A Field Guide to the Birds of Borneo, Sumatra, Java, and Bali: The Greater Sunda Islands. Oxford University Press, Oxford.

Nutalaya, P. 2006. Coastal erosion in the Gulf of Thailand. *GeoJournal* 38: 283-300.

Parrott, S. & P. Andrew. 1996. An annotated checklist of the birds of Way Kampas National Park, Sumatra. *Kukila* 8: 57-85.

Piersma, T. & P. Wiersma. 1996. Family Charadriidae (plovers). Pp. 384-442. *In*: Del Hoyo, J. A. Elliott & J. Sargatal (Eds.). Handbook of the Birds of the World, Vol. 3. Lynx Edicions, Barcelona.

Pizzey, G. & F. Knight. 2007. The Field Guide to the Birds of Australia. 8th ed. Harper Collins, Sydney.

Rheindt, F.E., T. Szekely, S.V. Edwards, P.L.M. Lee, T. Burke, P.R. Kennerley, D.N. Bakewell, M. Alrashidi, A. Kosztolanyi, M.A. Weston, W-T Liu, W-P Lei, Y. Shigeta, S. Javed, S. Zefania & C. Kupper. 2011. Conflict between genetic and phenotypic differentiation: the evolutionary history of a "lost and rediscovered" shorebird. *PLoS One* 6(11): e26995.

Robson, C. 2000. A Field Guide to the Birds of South-East Asia. New Holland Publishers, London.

Silvius, M.J. 1986. Survey of Coastal Wetlands in Sumatra Selantan and Jambi, Indonesia. PHPA-INTERWADER Report No.1, Kuala Lumpur.

Silvius, M.J. 1987. Notes on new wader records from Berbak Game Reserve, Sumatra. *Kukila* 3: 59-60.

Silvius, M.J. 1988. On the importance of Sumatra's east coast for waterbirds with notes on the Asian Dowitcher *Limnodromus semipalmatus*. *Kukila* 3: 117-137.

Strange, M. 2001. A Photographic Guide to the Birds of Indonesia. Periplus Editions, Singapore.

Van Marle, J.G. & K.H. Voous. 1988. The birds of Sumatra: an annotated checklist. British Ornithologist Union Checklist No. 10. Tring, UK.

Verheught, W.J.M., F. Danielsen, H. Skov, A. Purwoko, R. Kadarisman & U. Suwarman. 1990. Seasonal variations in the wader populations of the Banyuasin Delta, South Sumatra, Indonesia. *Wader Study Group Bulletin* 58: 28-35.

Verheught, W.J.M., Skov, H. & F. Danielseon. 1993. Notes on the birds of the tidal lowlands and floodplains of South Sumatra Province, Indonesia. *Kukila* 6: 53-84.

Wells, D.R. 1999. The Birds of the Thai-Malay Peninsula, Vol 1: non-passerines. Academic Press, San Diego & London.

Wetlands International. 2014. Waterbird Population Estimates 5. Downloaded from http:///www.wpe.wetlands.org on 1/4/2014

Whitten, T., S.J. Damanik, J. Anwar & N. Hisyam. 2000. The Ecology of Sumatra. Periplus Editions, Singapore.

Yasue, M. & P. Dearden. 2006a. The effect of heat stress, predation risk and parental investment on Malaysian Plover nest return times following a human disturbance. *Biological Conservation* 132: 472-480.

Yasue, M. & P. Dearden. 2006b. The potential impact of tourism development on habitat availability and productivity of Malaysian Plovers *Charadrius peronii*. *Journal Applied Eco*logy 43: 978-989.

Yasue, M., A. Patterson & P. Dearden. 2007. Are saltflats suitable supplementary nesting habitats for Malaysian Plovers *Charadrius peronii* threatened by beach habitat loss in Thailand? *Biological Conservation International* 17: 211-223.

PREDATION OF JAVAN PLOVER *CHARADRIUS JAVANICUS* BY PEREGRINE FALCON *FALCO PEREGRINUS* IN PANTAI TRISIK, YOGYAKARTA, JAVA, INDONESIA

IMAM KHOLIL

Kelompok Pengamat Burung BIONIC Universitas Negeri Yogyakarta,
Komplek Ormawa FMIPA UNY, Karangmalang, Yogyakarta, 55281, Java, Indonesia.
Email: abdee_eemam@yahoo.co.id

The Javan plover *Charadrius javanicus* is a resident shorebird to Indonesia and East-Timor (Iqbal *et al.* 2013, Trainor 2011). It is classified as Near Threatened (BirdLife International 2014), but currently suggested as Vulnerable, based on its estimated population that is less than 10,000 adults (Iqbal *et al.* 2013). There is a lack of information on potential threats like predation, that may be contributing to this vulnerability. Here I report my observation of predation by the Peregrine Falcon *Falco peregrinus* recorded in the delta of Progo river estuary (07°58′53.6″ S, 110°1244.2″ E) in Pantai Trisik, Yogyakarta province, Java, Indonesia.

On 26 October 2013, at around 8.30 am, I visited the river's delta. At that time, no shorebirds were seen except eight foraging Javan Plovers. About 30m from the plovers, I saw a Peregrine Falcon perched on a small branch lying on the ground. The Peregrine Falcon had a pale grey appearance with a thick moustache, characterising it as a member of the migratory race rather than of the local race *ernesti*, which has a full black area on its cheek. However, I could not determine with confidence the specific race of this bird.

When I tried to get closer to take some pictures of the falcon, it flew off at about 20-30 cm above the ground to the east, turned to the south and landed on the sand, approximately 20 m from its first position. Soon after, I saw the Peregrine Falcon grasping a plover and plucking the plover's feathers with its bill. I was able to take some photos and videos while the Peregrine Falcon was eating the plover (Figure 1), a process lasting less than ten minutes. After that, the falcon cleaned its bill with its talon. It remained stationary for about five minutes and then flew off to the north. I moved closer to the falcon's eating location and found only the head and feet of the plover remaining (Figure 2).

On December 1st, 2013 in the same area, I witnessed another attack on Javan Plover by a pale grey Peregrine Falcon. The plover was feeding when suddenly a falcon attacked. However, the plover noticed it immediately and successfully escaped, while the peregrine flew away and perched. In this failed attack, I was unable to determine whether the falcon was the same individual as the one I saw on October 26th.

The Peregrine Falcon is a well-known predator of birds including waders (Ferguson-Lees & Christie 2002). Various waders, such as Hooded Plover *Charadrius rubricollis* (Schulz 1992), Dunlin *Calidris alpina* (Buchanan *et al*. 1986), Grey Plover *Pluvialis*

Figure 1. Peregrine Falcon eating the Javan plover on the sand. Photo by Imam Kholil.

Figure 2. After being eaten, only the head and legs of the Javan Plover *Charadrius javanicus* were left by the Peregrine Falcon *Falco peregrinus*. Photo by Imam Kholil.

squatarola, Lesser Yellowlegs *Tringa flavipes*, Pectoral Sandpiper *Calidris melanotos* and Wilson's Phalarope *Phalaropus tricolor* (Dekker 1988) have been reported as being attacked by Peregrine Falcons. However, as far as I am aware, there have been no previous reports of predation by this species on Javan Plover.

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REFERENCES

Birdlife International. 2014. Species factsheet: *Charadrius javanicus.* Download from http://www.birdlife.org on 20/01/2014.

Buchanan, J.B., S.G. Herman & T.M. Thompson.1986. Success Rates of the Peregrine Falcon *(Falco peregrinus)* hunting Dunlin *(Calidris alpina)* during winter. *Raptor Research* 20: 130–131.

Dekker, D. 1988. Peregrine Falcon and Merlin predation on small shorebirds and passerines in Alberta. *Canadian Journal of Zoology* 66: 925-928.

Iqbal, M., I. Taufiqurrahman, K. Yordan & B. van Balen. 2013. The distribution, abudance and conservation status of the Javan Plover *Charadrius javanicus*. *Wader Study Group Bulletin* 120: 75-79.

Ferguson-Lees, J & D.A. Christie. 2002. Raptors of the World. Christopher Helm, London.

Schulz, M. 1992. Hooded Plover taken by a Peregrine Falcon. *Stilt* 21: 27.

Trainor, C.R. 2011. The waterbirds and coastal seabirds of Timor-Leste: new site records, clarifying residence status, distribution and taxonomy. *Forktail* 27: 63–72

MANNING ESTUARY POPULATION COUNTS 2008-2013

ALAN STUART

81 Queens Rd New Lambton NSW 2305 AUSTRALIA
almarosa@bigpond.com

INTRODUCTION

The estuary of the Manning River is one of approximately 20 sites in New South Wales regularly counted by the Australasian Wader Studies Group, coordinated by Shorebirds 2020 (BirdLife Australia). The Manning Estuary, with a waterways area of around 25 km^2 (D. Williams, *pers. comm*.), is located on the central coast between Forster and Port Macquarie, and has two main high tide roost sites for shorebirds (Figure 1). At the river's southern entrance, near Old Bar, shorebirds roost at Mudbishops Point and on sandy islands (formed from dredge spoil) in the adjoining lagoon. Much of the lagoon is shallow and most of the roosting shorebirds feed there when the tide drops. At Harrington, the northern entrance to Manning River, shorebirds originally roosted in sand dunes on a spit near Manning Point and on small sandbanks in the river. However, those sites were destroyed by successive severe storms and flooding events in June 2010 and January 2011. A large sandbank directly opposite the Harrington breakwater subsequently formed and this is now the main roost site for the Harrington shorebirds (which disperse through the estuary at low tide).

Prior to 2008, the only documented information about birds in the Manning Estuary related to threatened beach-nesting species (Beach Stone-curlew *Esacus giganteus,* Australian Pied Oystercatcher *Haematopus longirostris* and Little Tern *Sternula albifrons*). These species have been monitored since the 1996 / 1997 austral summer season, in regular surveys organised by local National Parks and Wildlife Service staff (Fawcett & Thomas 2012). A pair of Beach Stone-curlew has been resident at Old Bar since the mid-1990s and until 2012 was the southernmost breeding pair in New South Wales. Their breeding success has been high in the past decade (Fawcett & Thomas 2012). Several pairs of Australian Pied Oystercatchers also breed in and near the Manning Estuary each year. The maximum recorded was 17 breeding pairs, during the 2011 / 2012 season, although 5-10 pairs is more typical in other years (Fawcett & Thomas 2012). More than 100 pairs of Little Terns also breed in the Manning Estuary most years (Fawcett & Thomas 2012).

Aside from the above species, the only other knowledge of local shorebird populations in the Manning Estuary prior to 2008 came from opportunistic visits by birdwatchers. Such visits were made exclusively during the summer months, did not generate reliable counts of the actual numbers of shorebirds present and for the most part were not submitted to any database (Stuart 2008).

This report summarises the results of six years of monthly monitoring of the Manning Estuary. Average and maximum counts for the periods November to February ("summer") and May to July ("winter") are reported for each species. Data from these surveys in July 2009 and January 2010 were also published in Scholten *et al.* (2012).

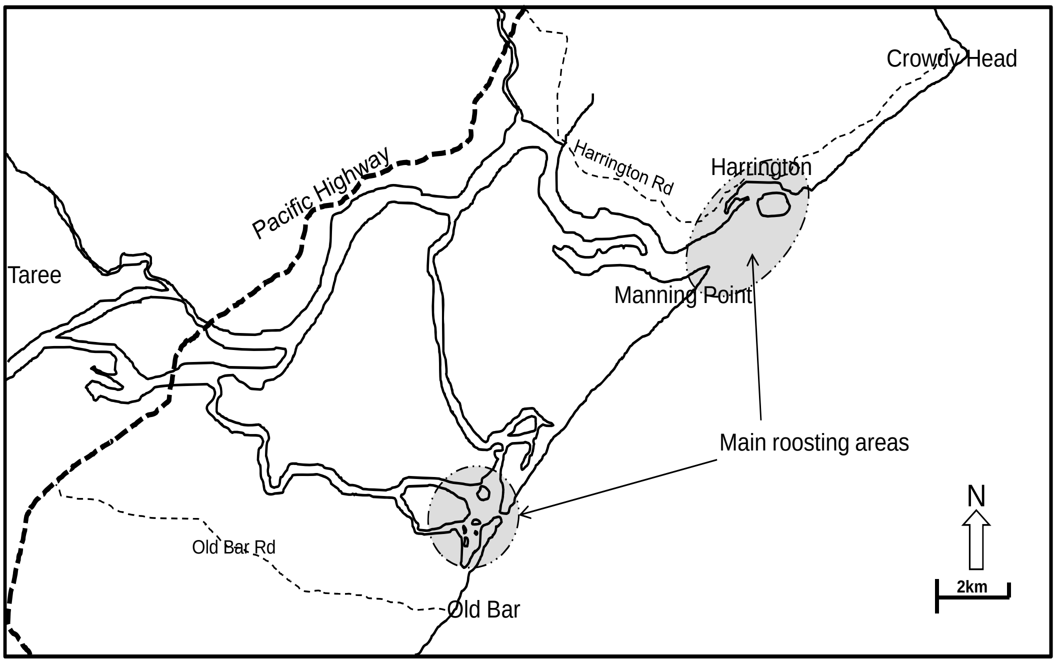

Figure 1. Main shorebird roosting sites in the Manning Estuary, on the central coast of New South Wales.

METHODS

Although the main high-tide roost sites in the estuary are only a few kilometres apart, it is an approximately 45 km journey by road between them and hence it is not possible for one person to survey both sites during the same high tide event. With a few exceptions, the sites have been surveyed on consecutive days, once per month. From 2008-2010, this was done exclusively from land. Since early 2011, the roost site near Old Bar has been surveyed partly by foot and partly by kayak (visiting the various sandy islands within the lagoon). At Harrington, some birds were visible from a breakwater opposite the sandbank and the remainder were counted by walking a circuit around the sandbank. Prior to the June 2010 storm event, a circuit was also walked through the sand dunes near Manning Point.

RESULTS

The Manning Estuary was surveyed in 70 out of 72 months between January 2008 and December 2013. Severe weather conditions in June 2010 prevented access to the sites, and there were also no surveys in April 2012. Overall, 23 shorebird species were recorded, with 22 species in the summer period and 16 species in winter (Tables 1 & 2). On average, 409 shorebirds were present in the Manning Estuary during summer, with a peak count of 722 birds, and 171 birds in winter, with a peak count of 232 birds.

In summer, the main species present were Bar-tailed Godwit *Limosa lapponica*, Pacific Golden Plover *Pluvialis fulva*, Eastern Curlew *Numenius madagascariensis*, Red-capped Plover *Charadrius ruficapillus* (with several pairs breeding each year) and Red-necked Stint *Calidris ruficollis*. Typically,

Table 1. Details of shorebird counts in Manning Estuary, New South Wales, between 2008-2013.

Species	Nov-Feb		May-Jul	
	Mean	Maximum	Mean	Maximum
Beach Stone-curlew *Esacus giganteus*	1	3	2	3
Australian Pied Oystercatcher *Haematopus longirostris*	14	26	10	18
Sooty Oystercatcher *Haematopus fuliginosus*	1	7	0	4
Red-necked Avocet *Recurvirostra novaehollandiae*	0	0	0	3
Pacific Golden Plover *Pluvialis fulva*	87	181	3	21
Grey Plover *Pluvialis squatarola*	0	1	0	0
Red-capped Plover *Charadrius ruficapillus*	21	49	23	52
Double-banded Plover *Charadrius bicinctus*	1	27	65	123
Lesser Sand Plover *Charadrius mongolus*	0	2	0	0
Black-fronted Dotterel *Elseyornis melanops*	0	1	0	5
Masked Lapwing *Vanellus miles*	3	10	4	20
Bar-tailed Godwit *Limosa lapponica*	156	295	51	99
Whimbrel *Numenius phaeopus*	7	29	0	4
Eastern Curlew *Numenius madagascariensis*	31	49	6	24
Common Sandpiper *Actitis hypoleucos*	0	1	0	0
Grey-tailed Tattler *Tringa brevipes*	1	8	0	1
Ruddy Turnstone *Arenaria interpres*	1	5	0	0
Great Knot *Calidris tenuirostris*	0	2	0	0
Red Knot *Calidris canutus*	1	12	0	0
Sanderling *Calidris alba*	13	40	0	1
Red-necked Stint *Calidris ruficollis*	70	268	10	55
Sharp-tailed Sandpiper *Calidris acuminata*	0	10	0	0
Curlew Sandpiper *Calidris ferruginea*	0	2	0	1

Table 2. A summary of shorebird numbers in Manning Estuary between 2008-2013.

	Mean	SD	Maximum
Nov-Feb all shorebirds	409	122	722
Nov-Feb migratory shorebirds	369	114	670
May-July all shorebirds	171	36	232
May-July migratory shorebirds	132	31	188

40-50 Red-necked Stints are present in summer; however, in early 2008 when the lagoon near Old Bar was much silted up, their numbers were substantially higher (with a peak of 331 birds present in March 2008). After the lagoon was dredged in late 2009 (when the river mouth was also re-opened), there was a considerable reduction in the numbers of Red-necked Stints in the Manning Estuary.

Although Sanderlings *Calidris alba* are quite uncommon in New South Wales and on the eastern seaboard more generally (Bamford *et al.* 2008, Scholten *et al.* 2012), Manning Estuary has been a reliable location for them in summer. Between 10 and 20 Sanderlings have usually been present in summer, with a peak count of 40 birds.In winter, the main species on Manning Estuary are Double-banded Plover *Charadrius bicinctus* and Red-capped Plover. Moderate numbers of immature Bar-tailed Godwits and Eastern Curlews are also present each winter with the occasional appearance of Red-necked Stints.

DISCUSSION

The Manning Estuary consistently hosts moderate numbers of shorebirds, with summer numbers of 400-700+ birds and winter number of 171-230 birds. It is an important breeding location for Beach Stone-curlews, which are classified as Critically Endangered in NSW under the *Threatened Species Conservation Act 1995*, and for Australian Pied Oystercatchers, which are classified as Endangered under the same law. No shorebird species in the Manning Estuary was recorded at 1% of their East Asian-Australasian Flyway population levels (Bamford *et al.* 2008). Eastern Curlews and Sanderlings were often present in summer at ≥0.1% of their Flyway population levels, as were Red-necked Stints in March 2008.

REFERENCES

Bamford, M., D. Watkins, W.G. Bancroft, G. Tischler & J. Wahl. 2008. Migratory Shorebirds of the East Asian – Australasian Flyway: Population Estimates and Internationally Important Sites. Wetlands International – Oceania. Canberra, Australia.

Fawcett, A. & M. Thomas. 2012. Manning Entrance's Endangered Shorebirds Colonies Annual Review 2011-2012 Breeding Season. Unpublished Report for NSW National Parks and Wildlife Service, Hunter Region.

Scholten, S., L. Costello, D.A. Milton & G. Maurer. 2012. Report on Australian shorebird population counts winter 2009 and summer 2009-10. *Stilt* 62: 33-53.

Stuart, A. 2008. A Preliminary Assessment of the Importance of the Manning River for Shorebirds and Other Waterbirds. *The Whistler* 2: 13-19.

NORTH-WEST AUSTRALIA WADER AND TERN EXPEDITION REPORT 16TH FEBRUARY TO 9TH MARCH 2014

CLIVE MINTON[1], ROSALIND JESSOP[2], CHRIS HASSELL[3]

[1] *165 Dalgetty Rd, Beaumaris, Victoria 3193, Australia. mintons@ozemail.com.au*
[2] *Phillip Island Nature Park, PO Box 97, Cowes, Victoria 3922, Australia.*
[3] *PO Box 3089, Broome, Western Australia 6725, Australia.*

INTRODUCTION

The highlights of this year's North-West Australia (NWA) Expedition were unprecedented; glorious fine hot weather (in the middle of the wet season!), the best catch total (3,830) since 2009, and new scheduling and operating procedures which all worked extremely well.

The high catch total partly resulted from the settled weather conditions, with the only rain experienced being on the last afternoon after we had packed up the netting equipment for the last time on 80 Mile Beach. In addition, the continuity of the catching programme proved to be more efficient than breaking the Broome catching activities into two periods, as has usually occurred on previous NWA Wader Expeditions. Lastly, the scheduling of the Expedition into just two parts, with a complete 11-day series of spring tides at Roebuck Bay, Broome, followed by an extremely high further series of spring tides at 80 Mile Beach, was much more relaxing to the team.

The relatively new operating procedure of setting up keeping cages and overhead shade in the cool, early morning at the same time that the nets were set, was again implemented this year. This has been the standard procedure at Broome for the last couple of years, with the objective being to avoid putting birds into keeping cages newly set up on hot sand. At 80 Mile Beach, as long as the structure was at least 250m from the nearest cannon-net, the birds did not appear to be deterred from settling in front of the cannon-nets. It proved possible to quickly transport boxes of birds extracted from the net to the keeping cages on the back tray of vehicles, with negligible delay time. The birds were thus able to benefit from the advantage of cool keeping cages, instantly available.

MAIN ACHIEVEMENTS

Catching

Seven cannon-net catches were made in eight catching attempts at Roebuck Bay and at 80 Mile Beach. A total of 3,830 birds was caught, the highest total since 2009. Of these, 1,794 were at Roebuck Bay and a record 2,036 at 80 Mile Beach and Anna Plains (Tables 1 & 2).

Small-mesh 3-cannon nets were used throughout the Expedition. These facilitated rapid extraction of birds from the net, which was particularly necessary this year in view of the hot, sunny and cloudless conditions experienced throughout. Catch sizes ranged from a low of 36 to (next day) a high of 828 (Table 1). The average cannon-net catch size was 267. This excludes the catch of 287 at 80 Mile Beach on 4 March when approximately 400 Great Knot and 100 Greater Sand Plovers were released unbanded directly from the net because of the exceptional temperature conditions.

A feature of this year's catches was the good numbers of the sometimes more difficult to catch species present in almost every catch, right from the first catch in Roebuck Bay on 17 February. Sometimes towards the end of an expedition we are struggling to make up adequate numbers of species such as Curlew Sandpiper, Ruddy Turnstone and Red Knot. But obtaining adequate sample sizes of these species was not a problem in 2014 (Table 3). However, obtaining an adequate sample of Bar-tailed Godwit proved to be the most difficult in comparison to sampling of other species, with just a thin line of birds in most roosting flocks stretched along the tide edge on beaches at both Roebuck Bay and 80 Mile Beach. The days seem to be over when one of the problems was ensuring that we did not catch too many Bar-tailed Godwits at once! It seems that Bar-tailed Godwit numbers in NWA have declined significantly in recent years.

Terek Sandpipers seemed to be extremely scarce at Roebuck Bay this year with only two being caught there. However this deficiency was made up when we reached 80 Mile Beach, with good numbers of both Terek Sandpiper and Grey-tailed Tattler being caught. Pleasingly, Red Knot numbers seen and caught at both Roebuck Bay and 80 Mile Beach were higher than usual. In total 335 Red Knot were caught, with a catch of 157 at Roebuck Bay on 20 February being the highest single catch of this species for many years. The 80 Ruddy Turnstone caught in the same catch was also one of the highest ever totals for this species in north-west Australia.

A small innovation which seemed to assist cannon-netting on 80 Mile Beach was the repositioning of the catching area markers in order to make it more difficult for birds to detect the presence of a cannon-net. In the past we have often noticed that birds would not walk closer to the net, even when it was completely camouflaged, where shells or other debris have been placed at eight or ten metres from the corners of the net to delineate the catching area. Birds would persistently sit on both sides of and in front of the rectangle formed by the net and these two corner markers. This was particularly so on open beaches where no tide wrack or rocks were present to break up the pattern. After the first failed catch at 80 Mile Beach we placed the corner markers only 5 metres from the net and put just a single eight or ten yard marker out opposite the centre of the net. This irregular pattern seemed to overcome the detection problem but still gave the observers adequate information to judge when birds were in the catching area of the net and how many were likely to be caught. An added advantage was that the five-yard markers could still be seen even when there was a large flock of birds in front of the net, whereas with eight or ten metre corner markers they often become obscured.

Table 1. NWA 2014 Expedition catch totals.

Catches	Location	New	Recaptures	Total	Capture Method	
17/02/2014	Broome	49	23	72	cannon net	
18/02/2014	Broome	114	24	138	cannon net	
19/02/2014	Broome	24	12	36	cannon net	
20/02/2014	Broome	532	296	828	cannon net	
22/02/2014	Broome	268	106	374	cannon net	
23/02/2014	Broome	117	33	150	cannon net	
24/02/2014	Broome	125	71	196	cannon net	*including 2 terns*
Sub-total		***1229***	***565***	***1794***		
1/03/2014	80 Mile Beach	214	15	229	cannon net	
2/03/2013	80 Mile Beach	230	18	248	cannon net	*inducing 1 tern*
3/03/2013	80 Mile Beach	371	15	386	cannon net	
3/03/2014	Anna Plains	7	0	7	mist-net	
4/03/2014	80 Mile Beach	264	23	287	cannon net	*including 2 terns*
4/03/2014	Anna Plains	4	0	4	mist-net	
5/03/2014	80 Mile Beach	378	17	395	cannon net	
5/03/2014	Anna Plains	46	0	46	mist-net	
6/03/2014	80 Mile Beach	305	18	323	cannon net	*including 1 tern*
6/03/2014	Anna Plains	34	0	34	mist-net	
7/03/2014	80 Mile Beach	75	2	77	cannon net	*including 1 tern*
Sub-total		***1928***	***108***	***2036***		
TOTAL		**3157**	**673**	**3830**		

There were again fewer terns than usual on any of the beaches this year. Little Terns and Gull-billed Terns (*affinis* race) were the two most common species, with almost all individuals being from the Northern Hemisphere breeding populations. Terns were not targeted particularly on any catch and a total of only seven was caught (Table 1).

At least 50,000 Oriental Pratincole and 5 – 10,000 Little Curlew were present on Anna Plains and 80 Mile Beach during the Expedition. A few were cannon-netted. Very large flocks of Oriental Pratincoles were often present roosting on 80 Mile Beach but the majority of these lifted off and went inland over the dunes on each occasion when twinkling was commenced. However night-time mist-netting – led by the team from Russia plus Magda Remisiewicz from Poland and Amanda Lilleyman from Darwin University – was most successful in catching these species on flooded areas just north of Anna Plains Station. A total of 91 waders was mist-netted in four evenings (Table 1). Overall 48 Oriental Pratincoles and 27 Little Curlew were caught during the Expedition (Table 3).

Recaptures and Controls

Altogether 1,794 birds were caught at Roebuck Bay, Broome of which 565 already carried bands (Table 2). This 31% retrap rate was similar to other recent years. In contrast at Anna Plains and 80 Mile Beach, where 2,036 birds were caught, only 108 (5%) were already banded. This marked difference in retrap rates between our two catching sites is partly because only one banding visit per year is made to 80 Mile Beach whereas banding takes place regularly throughout many other parts of the year at Roebuck Bay. The wader population on 80 Mile Beach is also very much larger than that in the catching areas sampled on Roebuck Bay.

Chinese-banded birds dominated the controls. Altogether eight Chinese-marked Great Knot were caught plus one from Korea (Table 4). The Korean bird had already previously been captured three times in north-west Australia. One of the Chinese birds only carried leg flags, the metal band having presumably corroded away and fallen off. Metal bands being put on in China are now of a much more durable quality.

Banding data for these controls is currently being sought and will be circulated later.

Old birds

There was again a range of recaptures of birds of a variety of species, which had been banded around 20 years ago. A selection is shown in Table 5. The oldest was a Great Knot now in its 23rd year. There was also a Bar-tailed Godwit which was at least 22 years old and a Grey-tailed Tattler 21 years old.

Table 2. Comparison of catches made during this expedition (in bold) and previous expeditions (2006-2013).

Catches	Year	New	Re-trap	Total
Broome (1st period)	2006	857	174	1031
	2007	985	223	1208
	2008	807	184	991
	2009	1374	208	1582
	2011	6	3	9
	2012	48	27	75
	2013	168	80	248
	2014	***1229***	***565***	***1794***
80 Mile Beach	2006	1619	55	1674
	2007	1690	95	1785
	2008	1215	62	1277
	2009	604	28	632
	2011	1878	47	1925
	2012	1749	84	1833
	2013	1701	72	1773
	2014	***1928***	***108***	***2036***
Broome (2nd period)	2006	1120	176	1296
	2007	861	192	1053
	2008	567	88	655
	2009	1172	296	2068
	2011	1072	484	1556
	2012	1093	383	1476
	2013	741	398	1139
	2014	-	-	-
TOTAL	2006	3596	405	4001
	2007	3536	510	4046
	2008	2589	334	2923
	2009	3150	532	4282
	2011	2956	534	3490
	2012	2890	494	3384
	2013	2610	550	3160
	2014	**3157**	**673**	**3830**

Table 3. NWA 2014 Expedition - wader and tern catch details.

Species	New	Re-trap	Total
Asiatic Dowitcher	1	0	1
Bar-tailed Godwit	203	20	223
Black-winged Stilt	7	0	7
Broad-billed Sandpiper	16	6	22
Common Greenshank	1	0	1
Curlew Sandpiper	157	34	191
Great Knot	911	153	1064
Greater Sand Plover	644	142	786
Grey Plover	1	0	1
Grey-tailed Tattler	252	58	310
Lesser Sand Plover	3	2	5
Little Curlew	27	0	27
Oriental Pratincole	48	0	48
Pacific Golden Plover	3	0	3
Red Knot	265	70	335
Red-kneed Dotterel	4	0	4
Red-necked Stint	367	159	526
Ruddy Turnstone	83	21	104
Sanderling	4	0	4
Sharp-tailed Sandpiper	23	0	23
Terek Sandpiper	131	7	138
Sub-total	**3151**	**672**	**3823**
Gull-billed Tern	2	0	2
Little Tern	4	1	5
Sub-total	**6**	**1**	**7**
TOTAL	**3157**	**673**	**3830**

Table 4. Recaptures (controls) during NWA 2014 of waders banded elsewhere.

Species	Country of origin	Band number	Condition of band	Age at Capture	Recapture Date	Recapture location	Flags	Australian Band
Great Knot	Korea	050-01064 *	worn	2+	20/02/2014	Broome (Nicks Beach)	Yellow UKK	062-79632 (already)
Great Knot	China	Illegible **	worn & corroded	2+	20/02/2014	Broome (Nicks Beach)	BkW	062-57846 (already)
Great Knot	China	F130188	good	2+	22/02/2014	Broome (Eagles Roost)	BkW	
Great Knot	China	F126088	good	2+	1/03/2014	80 Mile Bch (9km S of Anna Plains entrance)	BkW	
Great Knot	China	band missing		2+	2/03/2014	80 Mile Bch (24km S of Anna Plains entrance)	WBk	063-22317 (added)
Great Knot	China	F127118	good	2+	2/03/2014	80 Mile Bch (24km S of Anna Plains entrance)	BkW	
Great Knot	China	F062956	worn & corroded	2+	2/03/2014	80 Mile Bch (24km S of Anna Plains entrance)	BkW	063-22466 (added)
Great Knot	China	F130113	good	2+	3/03/2014	80 Mile Bch (40km S of Anna Plains entrance)	BkW	
Red Knot	China	F126519	good	2+	4/03/2014	80 Mile Bch (41km S of Anna Plains entrance)	BkW	
Great Knot	China	F055925	worn & corroded	2+	6/03/2014	80 Mile Bch (20km S of Anna Plains entrance)	BkW	063-22871 (added)

* Korean 050-01064 originally banded as juvenile on 03/09/1997 at Kunsan, South Korea. Previously recaptured at Broome 04/08/2000, 02/03/2005 (flag W6) and 11/03/2011 (flag UKK). Also seen at Broome many times between 2005 and December 2013.
** Originally banded as age 2 on 31/05/2000 at Broome. No details received of subsequent capture, added band or flag change in China.

Table 5. Oldest recaptures during the NWA 2014 Expedition.

Species	Band	Date banded	Banding location	Age at banding	Re-trap date	Re-trap location	Min. age at re-trap
Bar-tailed Godwit	072-32934	5/03/1994	Broome	2+	24/02/2014	Broome (Wader Spit)	22+
Great Knot	062-13829	6/03/1996	Broome	1	20/02/2014	Broome (Nick's Beach) *	19
Great Knot	062-13844	6/03/1996	Broome	1	20/02/2014	Broome (Nick's Beach) *	19
Great Knot	062-44294	28/08/1998	Broome	3+	20/02/2014	Broome (Nick's Beach)	18+
Great Knot	061-90557	12/10/1992	Broome	2	24/02/2014	Broome (Wader Spit)	23
Greater Sand Plover	051-85866	23/03/1996	Broome	1	18/02/2014	Broome (Wader Beach)	19
Grey-tailed Tattler	062-08852	16/03/1994	Broome	1	22/02/2014	Broome (Eagle's Roost)	21

* Same catch 18 years apart.

Table 6. Percentage juveniles in cannon net catches during the NWA 2014 Expedition.

Species	Total catch	Juveniles	% juveniles	Mean % juv. 1996/99 to 2012/13	2013 breeding success
Ruddy Turnstone	104	34	32.7	N/A	Good
Curlew Sandpiper	191	48	25.1	17.0	Good
Greater Sand Plover	784	164	20.9	23.6	Average
Bar-tailed Godwit	223	38	17.0	10.5	Average
Red-necked Stint	526	87	16.5	20.9	Average
Grey-tailed Tattler	310	49	15.8	20.9	Average
Terek Sandpiper	138	21	15.2	13.6	Average
Red Knot	335	28	8.4	17.8	Average
Great Knot	1045	52	5.0	12.4	Average
Broad-billed Sandpiper	22	0	0.0	N/A	Poor

Proportion of Juveniles

The proportion of juveniles in cannon-net catches of the 10 wader species which we attempt to sample each year is shown in Table 6. Ruddy Turnstone (33% juveniles) and Curlew Sandpiper (25%) had by far the best breeding outcomes in the 2013 Arctic breeding season. This is particularly welcome as both species had near complete breeding failures in the preceding two Arctic breeding seasons and Curlew Sandpiper numbers have been widely declining over a prolonged period. Five other species had “average” breeding outcomes with the proportion of juveniles in the range 15 – 21%. Red Knot had a relatively poor breeding year and Great Knot an extremely bad one with only 5% juveniles. This is the second consecutive poor breeding year for Great Knot.

Broad-billed Sandpiper appeared to fare even worse with no juveniles recorded in 22 birds caught (three small samples). However in contrast 2012 was an exceptionally good breeding year for Broad-billed Sandpiper. Although these sample sizes are small they represent a significant proportion of the Broad-billed Sandpiper population at Roebuck Bay, where all were caught.

Geolocators and Satellite Transmitters

No new geolocators were deployed in the 2013 / 2014 non-breeding season. However three geolocators put on in previous years were retrieved during the expedition – one each from Red Knot, Great Knot and Greater Sand Plover. The batteries had ceased to operate and so the units had to be sent back to the manufacturer in England for downloading. We have subsequently learned that the Great Knot geolocator successfully provided a complete northward and southward migration cycle.

The Red Knot did not depart from Roebuck Bay until the extremely late date of 16 May. It flew non-stop to Taiwan (5,000 km in 5 days) and after a short stopover there and at Bohai Bay, in the Yellow Sea, crossed inland Siberia to its arctic breeding grounds. It commenced incubation on 18 June, only just over a month after it left Broome! Unfortunately the logger failed before the southward migration had commenced.

Surprisingly the geolocator from the Greater Sand Plover also provided some migration information even though it had ceased to function nearly three years ago. The bird followed a similar north-north-westerly migration route to Mongolia to other Greater Sand Plovers bearing geolocators in Broome in 2010 and 2011. Like many other units the geolocator failed when it reached the Chinese-Mongolian border, on 23 May. It is thought that these failures are caused by the presence of strong electromagnetic fields in that region.

A further chapter was added to the “satellite transmitters on Little Curlew” story. Satellite transmitters were deployed on five Little Curlew in north-west Australia during the austral spring 2013. Prior to the NWA expedition three birds still bearing transmitting devices had moved south-westwards from Roebuck Plains when these flooded due to heavy rain in late January. Two were on the southern part of Anna Plains Station and one near Port Hedland at the time the expedition commenced on 16 February. Amazingly, one of these birds was seen on the beach about 30 km south of Anna Plains Station on 27 February. Even its engraved leg flag (BD) was read, by Broome volunteer and scanner Kerry Hadley. The satellite transmission coincided with this observation and also told us that both of the Anna Plains birds had moved about 30 km northwards by 6 March. This also fitted with the sighting of up to 2,000 Little Curlew moving north over the ocean in what looked like 'migration or a long distance movement' on 2 March. The location of a second sighted bird was exactly where we had seen a flock of 1,000 Little Curlew the day before and where our mist-nets were currently set. Unbelievably, just prior to darkness, the mist-netting team observed this Little Curlew flying past carrying a satellite transmitter on its back. It was not, however, one of the 20 Little Curlew subsequently mist-netted.

When we returned to Broome across Roebuck Plains on 8 March we noticed that most of the flooding had gone down and that the habitat again looked suitable for Little Curlew. It was not surprising therefore that Inka Veltheim, who is monitoring the satellite telemetry transmissions, reported that both the Little Curlew from Anna Plains had returned to Roebuck Plains by 13 March. In late March the Port Hedland bird moved north to Anna Plains Station. We now eagerly await these Little Curlew setting off on northward migration back towards their central Siberian breeding grounds.

Flag Sightings

Good numbers of Red Knot carrying the Global Flyway Network's colour-band combinations and smaller numbers carrying yellow-engraved leg flags were recorded during systematic scanning on most days when we were catching at 80 Mile Beach. Additionally several Chinese-flagged birds, mostly Great Knot, were noted. An unusual sighting was a Red Knot carrying an orange flag from Victoria, which was seen on 80 Mile Beach.

Table 7. Results of mist-netting at Broome Bird Observatory and Anna Plains Passerine Bore during the NWA 2014 Expedition.

Species	New	Re-trap	Total
Broome Bird Observatory 18th February 2014			
Brown Honeyeater	5	1	6
Bar-shouldered Dove	4	0	4
Peaceful Dove	3	1	4
Grey-crowned Babbler	2	1	3
Little Friarbird	1	0	1
TOTAL	**15**	**3**	**18**
Broome Bird Observatory 19th February 2014			
Brown Honeyeater	11	1	12
TOTAL	**11**	**1**	**12**
Broome Bird Observatory 21st February 2014			
Brown Honeyeater	9	0	9
Willy Wagtail	1	0	1
TOTAL	**9**	**0**	**9**
Anna Plains Bore Stream 27th February 2014			
Brown Honeyeater	10	0	10
Spiny-cheeked Honeyeater	1	0	1
TOTAL	**11**	**0**	**11**

Passerine Banding

A total of 50 birds was caught during passerine banding operations around Broome Bird Observatory and at Anna Plains (Table 7). This provided some useful mist-netting training for those who are seeking to obtain a mist-netting endorsement to their banding permit. Birds were attracted less to water areas than during the dry season but nevertheless sufficient were caught to make the exercise worthwhile.

OTHER MATTERS

Participants

A total of 25 people attended the NWA 2014 Expedition for its full duration, with an additional seven people participating for shorter periods. The full list of participants is provided at the end of this report but their origins are summarised below.

22 Australia (4 VIC, 12 WA, 2 QLD, 3 ACT, 1 NT)
5 Russia
1 Poland
1 China (Hong Kong)
1 China (mainland)
1 Canada
1 UK

Part-time participants were all from WA except for one who came from England. Three were Rangers with the WA Department of Wildlife in Broome. In addition approximately 10 people from the Karajarri Traditional Owner rangers at Bidyadanga and one from the Nyangumarta Traditional Owners joined us at 80 Mile Beach for two and four days, respectively.

Itinerary

As already mentioned the two-part itinerary seemed to be very satisfactory for all participants, giving eight catching days at each of Roebuck Bay and 80 Mile Beach. Participants also enjoyed the two "rest days" we had at the start of our visit to Anna Plains when the tides on 80 Mile Beach were of insufficient height to provide catching opportunities.

Talks

Evening talks were again a feature of the expedition, with 12 members making presentations (14 in total) on a wide range of topics - from wader moult to Siberian breeding birds to Atlantic Puffins.

Finances

The total direct cost of the expedition to participants was $35,491, all of which was input by the participants themselves (except that WA Parks and Wildlife paid the costs of their Rangers and the two participants from China). Individuals also financed their own travel costs to and from Broome and their accommodation costs at Broome Bird Observatory.

Preliminary calculations suggest the expedition will again be able to satisfactorily cover its costs. The average cost of food worked out at $19 per person per day – close to the budget estimate. The final outcome for the NWA 2013 Expedition was a surplus of $1,291.

NEXT EXPEDITION

A final decision has not yet been made on the dates for the next North-west Australia Wader and Tern Expedition, in **2015.** The most likely dates are **Friday 6 February** to **Saturday 28 February**. The expedition would follow the same format as in 2014, with the first half being spent at Broome and the second half at 80 Mile Beach. Confirmation of the dates plus a detailed itinerary etc. will be circulated to the 2014 Expedition participants as soon as they are available.

ACKNOWLEDGEMENTS

Huge thanks are again due to everyone who, directly or indirectly, made the NWA 2014 Expedition so successful and so enjoyable. The core team of 25 people – half of whom had never met each other before – worked really hard and welded into a most effective but happy and efficient unit.

Within the team particular thanks go to Mike Dawkins for taking on this year the role of organising and coordinating food purchasing, menus and, especially, everything that needed to be taken down for the 11 days at Anna Plains. Helen MacArthur once again provided enormous help with the menus, with putting in food orders, and in making many cakes and biscuits to keep the team going in the field. Chris Hassell again did a wonderful job of masterminding the fieldwork, strongly supported by a small team who worked daily on sorting the equipment, cleaning cartridges, reloading cannons etc.

The AWSG would like to acknowledge the Karajarri and Nyangumarta Traditional Owners for permission to conduct research on their lands and for their participation and help during the Anna Plains leg of the expedition.

The AWSG would also like to acknowledge Nyamba Buru Yawuru Limited for permission to catch on the shores of Roebuck Bay, traditional lands of the Yawuru people. Thanks also to the Yawuru ranger staff at DPaW who assisted with several of the cannon net catches at Roebuck Bay.

The West Australian Department of Parks and Wildlife is greatly thanked for funding the expedition participation costs and BBO accommodation costs of Tan Kun from Fudan University in Shanghai and Katherine Leung from Worldwide Fund for Nature, Hong Kong. They also generously loaned a 4WD vehicle for the duration of the expedition and two trailers. George Swann also kindly again loaned his trailer.

Huge thanks are due to Broome Bird Observatory for hosting us for half the expedition and to Anna Plains Station, where we were based for the other half. John, David and Helen Stoate are especially thanked for allowing us to invade their home and for all the kindnesses and facilities made available to us during our stay (including a newly-cleaned and filled swimming pool). We also greatly appreciated the freedom to roam at will around the 400,000 hectare station to look at birds.

The WA Parks and Wildlife Department and the Australian Bird and Bat Banding Scheme are thanked for providing research and banding permits.

LIST OF PARTICIPANTS

Australia

VIC: Clive Minton, Roz Jessop, Mike Dawkins, Prue Wright

WA: Chris Hassell, Maurice O'Connor, Jill Rowbottom, Peter Crighton,
Grace Magelio, Kerry Hadley, Frank O'Connor, John Roberts,
Craig Williams, Erina Young, Augustine Badal, Adrian Boyle

QLD: Robert Bush, Mandy Soymonoff (BBO warden)

ACT: Peter Fullagar, Chris Davey, Terry Bell

NT: Amanda Lilleyman

China (Mainland) Tan Kun

China (Hong Kong) Katherine Leung

Russia Alexander Yurlov, Victor Glupov, Igor Chupin, Vladimir Morozov, Nadya Morozova

Poland Magda Remisiewicz

Canada John Geale

England Richard Else (BBO assistant warden)

Expedition Leaders

Clive Minton, Roz Jessop, Chris Hassell, Mike Dawkins, Prue Wright.

WADER BREEDING SUCCESS IN THE 2013 ARCTIC SUMMER, BASED ON JUVENILE RATIOS OF BIRDS WHICH SPEND THE NON-BREEDING SEASON IN AUSTRALIA

CLIVE MINTON[1], ROZ JESSOP[2] & CHRIS HASSELL[3]

[1] *165 Dalgetty Road, Beaumaris, Victoria 3193, Australia. E-mail: mintons@ozemail.com.au*
[2] *Phillip Island Nature Park, PO Box 97, Cowes, Victoria, 3922, Australia. E-mail: rjessop@penguins.og.au*
[3] *PO Box 3089, Broome, Western Australia 6735, Australia. E-mail: turnstone@wn .com.au*

INTRODUCTION

The Victorian Wader Study Group (VWSG) has been collecting data on the proportion of first-year waders in cannon-netting catches (percentage juvenile data) in south-east Australia annually since the 1978 / 1979 non-breeding season. Similar data has been collected by the Australasian Wader Studies Group (AWSG) in Broome and 80 Mile Beach in north-west Australia since 1998 / 1999. These data are used as a proxy for measuring the annual breeding success for a range of migratory wader species, which spend their non-breeding season in these regions of Australia.

The data collected each year has been published annually since 2000 in the Arctic Birds and in the AWSG Bulletin (*Stilt*) (Minton *et al*. 2000, Minton *et al*. 2013). It has also been analysed regularly with results being published in scientific papers (Boyd *et al*. 2005, Minton *et al*. 2005, Rogers & Gosbell 2006), or in preparation for publication (Aharon-Rotman *et al*., *in prep.*).

The principal purpose of this note is to summarise the data collected in Australia during the 2013 / 2014 non-breeding season so that this is available at any time in the future to wader researchers worldwide.

METHODS

Data collection and presentation has been done in the same way throughout this long-term study (Minton *et al*. 2005). Only birds caught by cannon-netting are included. Only birds caught in defined periods (see footnotes to Tables 1 & 2) are used. These periods are determined for each species in each area by using banding data to show when both adult and juvenile birds have largely completed their southward migration and when adult birds have not yet set off again on their northward migration.

Birds were aged by conventional methods involving both diagnostic body plumage (mostly wing coverts), and the wear and moult of the primary feathers. In most species the experience in wader banding groups now enables ageing to be carried out with a high level of accuracy in most species throughout the defined periods. The greatest difficulties are encountered late in the season, in Sanderling in south-east Australia and in Terek Sandpiper and Grey-tailed Tattler in north-west Australia, when some first-year individual birds have almost completely lost all traces of their original juvenile plumage.

The shortcomings of this method of measuring breeding success have been fully elaborated in earlier papers (Minton *et al*. 2005, Minton *et al*. 2012). It needs to be stressed that the data is a measurement of the proportion of first-year birds in the population some months after the end of the breeding season, and after completion of the southward migration. The true reproductive rate, measured by the number of young at fledging, is likely to be higher. The numerical figure obtained is therefore more of an annual index of breeding success rather than an absolute measure. Since the greatest interest is in comparing relative differences between years and looking for any long-term trends in breeding success, the use of an index rather than an absolute measure is not considered a problem. At the present time these measurements of percentage juveniles in cannon-netting catches are the only practical method of collecting long-term reproductive rate data on a range of migratory wader species.

Note that for the data from south-east Australia, both the median (for the 35 year data set) and the average (for the last 15 years of data) are presented. In all cases the median is lower than the average, indicating that the data are not normally distributed. A small number of years with exceptionally high percentage juvenile shifted the average. However in most species the difference between the median and the average is minor.

Classification of the breeding success in a particular year is made by reference to the average figures for that species. The classification is only in broad terms.

RESULTS

Adequate samples were obtained in the 2013 / 2014 non-breeding season for all the main study species in south-east Australia except the Red Knot. A total of 45 days were spent in banding fieldwork, producing 47 samples of the seven study species (Table 1). Good coverage was also achieved in north-west Australia, except on Sanderling, with 32 catching days producing 104 samples of the 11 listed species (Table 2).

Exceptionally high percentage juvenile figures were obtained for Curlew Sandpiper (39.8%), Bar-tailed Godwit (44.7%) and Ruddy Turnstone (37.7%) in south-east Australia. These three species were classified as having had “very good” breeding success in 2013 and no species was classified lower than

Table 1. Percentage of juvenile (first-year) waders in cannon-net catches in south-east Australia in 2013 / 2014.

Species	No. of catches		Total caught	Juveniles		Long term median* % juvenile (years)	Assessment of 2013 breeding success
	Large (>50)	Small (<50)		No.	% †		
Red-necked Stint *Calidris ruficollis*	8	6	2185	379	**17.3**	14.8 (35)	Average
Curlew Sandpiper *C. ferruginea*	3	2	251	100	**39.8**	9.6 (34)	Very good
Bar-tailed Godwit *Limosa lapponica*	2	1	152	68	**44.7**	18.5 (24)	Very good
Red Knot *C. canutus*	0	2	19	18	**(94.7)**	58.0 (18)	(Very good?)
Ruddy Turnstone *Arenaria interpres*	0	18	475	179	**37.7**	9.3 (23)	Very good
Sanderling *C. alba*	2	1	157	33	**21.0**	10.0 (22)	Good
Sharp-tailed Sandpiper *C. acuminata*	2	0	126	24	**19.0**	11.5 (32)	Average

All birds cannon-netted in the period 2nd November to 25th March except Sharp-tailed Sandpiper and Curlew Sandpiper to end February only and some Ruddy Turnstone and Sanderling to early April.
* Does not include the 2013 / 2014 figures
† Brackets indicate small sample sizes meaning that percentage juvenile estimates are likely to be unrepresentative.

Table 2. Percentage of juvenile (first-year) waders in cannon-net catches in north-west Australia in 2013 / 2014.

Species	No. of catches		Total caught	Juveniles		Assessment of 2013 breeding success
	Large (>50)	Small (<50)		No.	%	
Great Knot *Calidris tenuirostris*	8	3	1049	53	5.0	Very poor
Bar-tailed Godwit *Limosa lapponica*	2	7	224	38	17.0	Good
Red-necked Stint *C. ruficollis*	4	7	676	131	19.4	Average
Red Knot *C. canutus*	3	10	392	31	7.9	Very poor
Curlew Sandpiper *C. ferruginea*	1	14	281	66	23.5	Average (Good?)
Ruddy Turnstone *Arenaria interpres*	1	7	133	41	30.8	Very Good
Sanderling *C. alba*	0	4	5	1	-	-
Non-arctic northern migrants						
Greater Sand Plover *Charadrius leschenaultii*	4	9	843	181	21.5	Average
Terek Sandpiper *Xenus cinereus*	1	9	139	21	15.1	Average
Grey-tailed Tattler *Heteroscelus brevipes*	2	8	314	51	16.2	Average
Broad-billed Sandpiper *Limicola falcinellus*	0	4	29	2	(7.4)	(Very poor)

All birds cannon-netted in the period 1st November to mid-March

"average". It is likely that if a larger sample of Red Knot had been obtained then it would also have shown an unusually high level of breeding success. Small flocks of juvenile Red Knot were seen (but not caught) at a number of non-regular sites, including Werribee Sewage Farm (D. Rogers, *pers. comm.*). This is usually the case after "good" breeding years.

Only Ruddy Turnstone, with a juvenile percentage of 30.8%, was classified as "very good" in north-west Australia. Two species – Great Knot and Red Knot – were classified as "very poor" (5.0% and 7.9% juveniles) and it is likely that Broad-billed Sandpiper would have fallen in this category if the sample size had been large enough to make a judgement against the longer-term average. The best performance amongst the other species monitored was by Bar-tailed Godwit (17.0%) and this was the only species classified as above "average".

Comparisons between annual percentage juveniles in catches in the 2013 / 2014 non-breeding season and those from previous years are provided in Table 3 (for SEA) and Table 4 (for NWA) The average figure gives an estimate of typical percentage juveniles in catches since the 1998 / 1999 non-breeding season against which the most recent results can be compared.

DISCUSSION

After the abysmal 2012 breeding success of most of the migratory wader species which spend the non-breeding season in south-east Australia (Table 3) it was particularly welcome that all species had a much improved performance in 2013, with half the species being classed as "very good". In Curlew Sandpiper, Bar-tailed Godwit and Ruddy Turnstone the 2013 / 2014 percentage juvenile figure had only been exceeded twice in the 35 years of this study. Curlew Sandpipers achieved 45.3% juveniles in 1991 / 1992. In the same year, well known worldwide for its incredible productivity, Ruddy Turnstones produced 80.3% juveniles. High figures in Bar-tailed Godwits occurred in 1981 / 1982 (60.5%) and 2007 / 08 (36%). These are a far cry from the single figure numbers obtained in these three species in 2011 / 2012 and the 2012 / 2013 non-breeding seasons.

Table 3. Percentage of juvenile birds in wader catches in south-east Australia 1998 / 1999 to 2013 / 2014.

Species	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	***Average (15yrs)***
Ruddy Turnstone *Arenaria interpres*	6.2	29	10	9.3	17	6.7	12	28	1.3	19	0.7	19	26	10	2.4	37.7	*13.1*
Red-necked Stint *Calidris ruficollis*	32	23	13	35	13	23	10	7.4	14	10	15	12	20	16	22	17.3	*17.4*
Curlew Sandpiper *C. ferruginea*	4.1	20	6.8	27	15	15	22	27	4.9	33	10	27	(-)	4	3.3	39.8	*15.7*
Sharp-tailed Sandpiper *C. acuminata*	11	10	16	7.9	20	39	42	27	12	20	3.6	32	(-)	5	18	19.0	*18.7*
Sanderling *C. alba*	10	13	2.9	10	43	2.7	16	62	0.5	14	2.9	19	21	2	2.8	21.0	*14.7*
Red Knot *C. canutus*	(2.8)	38	52	69	(92)	(86)	29	73	58	(75)	(-)	(-)	78	68	(-)	(94.7)	*58.1*
Bar-tailed Godwit *Limosa lapponica*	41	19	3.6	1.4	16	2.3	38	40	26	56	29	31	10	18	19	44.7	*23.2*

All birds cannon-netted between 15th November and 25th March, except Sharp-tailed Sandpiper and Curlew Sandpiper to end February only and some Ruddy Turnstone and Sanderling to early April. Averages (for previous 15 years) exclude figures in brackets (small samples) and exclude 2013 / 2014 figures.

Table 4. Percentage of juvenile birds in wader catches in north-west Australia 1998 / 1999 to 2013 / 2014.

Species	**98/99**	**99/00**	**00/01**	**01/02**	**02/03**	**03/04**	**04/05**	**05/06**	**06/07**	**07/08**	**08/09**	**09/10**	**10/11**	**11/12**	**12/13**	**13/14**	**Average (15yrs)**
Red-necked Stint *Calidris ruficollis*	26	46	15	17	41	10	13	20	21	20	10	17	18	24	15	19.4	*20.8*
Curlew Sandpiper *C. ferruginea*	9.3	22	11	19	15	7.4	21	37	11	29	10	35	24	1	1.9	23.5	*17.0*
Great Knot *C.tenuirostris*	2.4	4.8	18	5.2	17	16	3.2	12	9.2	12	6	41	24	6	6.6	5.0	*12.2*
Red Knot *C. canutus*	3.3	14	9.6	5.4	32	3.2	(12)	57	11	23	12	52	16	8	1.5	7.9	*17.7*
Bar-tailed Godwit *Limosa lapponica*	2.0	10	4.8	15	13	9.0	6.7	11	8.5	8	4	28	21	8	7.6	17.0	*10.4*
Non-arctic northern migrants																	
Greater Sand Plover *Charadrius leschenaultii*	25	33	22	13	32	24	21	9.5	21	27	27	35	17	19	28	21.5	*23.6*
Terek Sandpiper *Xenus cinereus*	12	(0)	8.5	12	11	19	14	13	11	13	15	19	25	5	12	15.1	*13.6*
Grey-tailed Tattler *Heteroscelus brevipes*	26	(44)	17	17	9.0	14	11	15	28	25	38	24	31	20	18	16.2	*21.0*

All birds cannon netted in the period 1st November to mid-March. Averages (for previous 15 years) exclude figures in brackets (small samples) and exclude 2013 / 2014 figures.

The 2013 breeding outcomes for migratory wader species in north-west Australia were also generally an improvement on the previous year (Table 4), but overall they were not as good as the results from south-east Australia. It was interesting that Ruddy Turnstone breeding success was of the same unusually high level in both areas suggesting that conditions were suitable for their breeding in 2013 across a wide area of their arctic breeding habitat. Red-necked Stint outcomes were also similar in the two areas (17.3% juveniles in south-east Australia and 19.4% in north-west Australia).

It is of particular concern that both Red Knot and Great Knot in north-west Australia again had a low percentage of juveniles, with both species now having had similar low percentage juvenile figures for each of the last three years. It is tempting to wonder whether the extensive losses of habitat at their major stopover sites in the Yellow Sea, used especially on northward migration to the breeding grounds, are now having an effect on the subsequent breeding success when birds reach the arctic.

CONCLUSION

As the length of the data sets on the percentage of the juveniles in wader populations in the non-breeding areas in south-east and north-west Australia continues to grow, this study becomes progressively more valuable. Some of the previous analyses did not indicate any noticeable change over time in the breeding success of various species during the earlier years of the study. However, the rate of loss of intertidal habitat in the Yellow Sea has grown enormously in the last 10 years, and the overall losses of habitat in the last 30 years now reach 50%. This data set will become even more valuable in the future in assessing the consequences of this habitat loss on breeding success in some wader species. Annual monitoring wader populations in south-east Australia and north-west Australia will therefore be continued as a high priority for the foreseeable future by the VWSG & AWSG.

ACKNOWLEDGEMENTS

The dedication of VWSG and AWSG fieldwork teams, and their efforts and perseverance in sometimes extremely adverse weather conditions, is fundamental to the success achieved in obtaining adequate samples of all the main study species each year. Everyone is greatly thanked for their efforts and their considerable input of time (and cost).

Many land owners kindly granted access through their land to shorelines where we catch birds. Anna Plains Station and Broome Bird Observatory in north-west Australia, and Rosemary Davidson at Yanakie in south-east Australia, also very kindly provided accommodation for fieldwork teams based there. The wildlife authorities in Victoria, South Australia, Tasmania and Western Australia kindly provided the necessary permits, with some financial support also from the WA Parks Department. The Australian Bird Banding Scheme is thanked for providing banding permits and bands.

REFERENCES

Aharon-Rotman, Y., M. Soloviev, C. Minton, P. Tomkovich, C. Hassell & M. Klaassen. Loss of periodicity in breeding success of waders supports a circumpolar loss of grip of lemming cycles on Arctic ecosystems. *In preparation.*

Boyd, H., C. Minton & K. Rogers. 2005. Has the timing of snowmelt in eastern Siberia affected the numbers of juvenile waders wintering in South-East Australia? *Stilt* 48: 2-9.

Minton, C., R. Jessop, P. Collins & K. Gosbell. 2005. Monitoring Wader Breeding Productivity by the proportion of first year birds in wader populations in S.E. Australian non-breeding areas. Pp. 73-85. *In:* Straw, P. (Ed.) Status and Conservation of Shorebirds in East Asian-Australasian Flyway. Proceedings of the Australian Shorebirds Conference, Canberra, Dec. 2003. IWSG Special Publication 17 and Wetlands International Global Series 18.

Minton, C., R. Jessop, P. Collins & C. Hassell. 2000. 1999 Arctic breeding success from Australian perspective *Arctic Birds* 2: 19-20.

Minton, C., R. Jessop & C. Hassell. 2013. Wader breeding success in the 2012 Arctic summer, based on juvenile ratios of birds which spend the non-breeding season in Australia. *Stilt* 63-64: 56-58.

Rogers, K.G. & K. Gosbell. 2006. Demographic models for Red-necked Stint and Curlew Sandpiper in Victoria. *Stilt* 50: 205-214.

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AUTHORS NAME AND ADDRESS - JOHN SMITH[1], STEPHEN BROWN[2] AND MAX WELL[3]

[1] 1 Main St., Melbourne 3001 Victoria, AUSTRALIA
[2] Department of Biology, University of Queensland, St Lucia 4068 Qld. AUSTRALIA
[3] Birds Singapore, National University, Jurong N4321 SINGAPORE

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ABSTRACT - This will summarise the main findings of the study, preferably in fewer than 200 words.

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METHODS - This will describe the methods used in the study in sufficient detail to enable the work to be repeated

RESULTS - The key findings of the study are provided here. Where feasible, data should be presented in figures and/or tables.

DISCUSSION - This section explains the significance of the major results obtained, their relevance to other work, and implications for future research.

ACKNOWLEDGEMENTS - In this section the author(s) should thank others who have contributed to the work. If applicable, ethics committee approvals and funding sources should be detailed.

REFERENCES - This section gives details of all the literature cited in the paper. References should be in alphabetic and chronological order with multi-authored references after single author citations by the same author. Examples of the required format follow:

Single author papers: **Smith, F.T.H.** 1964. Wader observations in southern Victoria, 1962-1963. *Australian Bird Watcher* 2: 70-84.

Multi-authored papers: **Dann, P., R.H. Loyn & P. Bingham**. 1994. Ten years of water bird counts in Westernport Victoria 1973-83. II. Waders, gulls and terns. *Australian Bird Watcher* 15:351-67.

Books: **Kershaw, K.A.** 1964. Quantitative and dynamic ecology. Edward Arnold, London.

Reports: **Noor, Y.R**. 1994. A status overview of shore birds in Indonesia. Pp. 178-88. *In:* Wells, D.R. & T. Mundur. (Eds.) Conservation of migratory water birds and their wetland habitats in the East Asian-Australia Flyway. Asian Wetland Bureau, Malaysia.

Online material: **Dutson G., Garnett S. & Gole C.** 2009. Australia's Important Bird Areas: Key sites for bird conservation. Birds Australia (RAOU) Conservation Statement Number 15. Available at http://www.birdlife.org.au/document/OTHPUB-IBA-supp.pdf (accessed 10 August 2012).

TABLES - There should be no lines in the table except at the top and bottom of the table and below the column headings. All tables should be prepared using the word processing table function and included after the Reference section. Please do not produce tables created as lists using tab stops.

FIGURES - Figures should be placed after Tables. All maps should have a border, distance scale, reference latitude and longitude and/or inset map to enable readers unfamiliar with the area to locate the site in an atlas. Google Maps and Google Earth images will be accepted but are discouraged as they reproduce poorly in print. Line figures are preferred. At their minimum, Google Earth images should retain the Google trademark device and year of image publication.

APPENDICES - Appendices should supplement but not repeat material elsewhere (i.e. in tables and figures). Appendices should be accompanied by a self-explanatory caption. Formatting should follow that for other manuscript components. At this time, *Stilt* does not have the capacity to accommodate Supplmentary Material Online.

SHORT COMMUNICATIONS

These will present material, insufficient for a research paper, on any matters relating to the flyway and the shorebirds in it. They are not usually subdivided like research papers and do not require an abstract. Generally, short communications should be word documents less than 6 pages 1.5-spaced including all tables, figures and photographs.

REPORTS

Reports are intended to provide updates on wader group activities, regular monitoring and related topics. Reports will not usually be subject to peer-review, although the editor and editorial board reserve the right to send reports out for review if they feel another opinion on content is required. Reports should be written in the same style as research papers with the exception that an abstract is not required. Results and Discussion may be combined into a single section "RESULTS AND DISCUSSION". All other formatting should follow that described under Research Papers.

STILT STYLISTIC MATTERS

The terms "summer" and "winter" should be avoided, if possible. Instead, it is recommended that authors use the terminology "breeding" and "non-breeding". If this is not possible, a clear explanation of the month(s) referred to are necessary. East Asian-Australasian Flyway (**not** East-Asian Australasian Flyway) should be spelt out in full on first mention and then subsequently written as EAAF. Subsequent mention of the EAAF as the flyway should be title case, as in, Flyway. Directions should be lower case and hyphenated, as in "north-west" not "North West". Coordinates should be listed in degrees and minutes, usually with the northing (or southing) first followed by the easting, as in Bagan Serdang (3^{o}42' N, 98 ^{o}50'E)

OTHER MATTERS

In general, nomenclature of Australian birds should follow **Christidis, L. & W. Boles.** 2008. Systematics and Taxonomy of Australian Birds. CSIRO Publishing, Australia. The first reference to a species in the text should have the scientific name in *italics* after the common name. Where alternative nomenclature is used, the appropriate reference(s) should be clearly cited.

For all manuscripts, first level headings should be **BOLD and UPPERCASE**, second level headings should be **Bold and lower case** and further subheadings in *italics.*

All measurements should be in metric units (e.g. mm, km, °C etc) and rates should be recorded as, for example, d^{-1} rather than /day or per day. Authors are encouraged to examine previous recent issues of *Stilt* for examples of the presentation of different types of material. The editor is happy to advise on issues that cannot be so resolved.

Please note:

- Views and opinions expressed in *Stilt* are those of the author(s) and not necessarily those of the AWSG or BirdLife Australia.
- Publication of data in *Stilt* does not constitute permission for the commercial use of those data. All such inquiries should be directed to the Editor.
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- The Editorial Team does its best to ensure the accuracy of information published in *Stilt*, but it is recommended that anyone wishing to cite material within *Stilt* contact the relevant authors.

Back Issues:

All back issues are available in PDF format from the AWSG website <www.awsg.org/stilt.php>. Most volumes are also available in print as back issues. Please contact the Secretary for details of costs and availability.

Deadlines:

The closing dates for submission of material are **1 February and 1 August** for the April and October editions respectively.

Extensions to these dates must be discussed with the Editor. Contributors of research papers and notes are encouraged to submit well in advance of these dates to allow time for refereeing. Other contributors are reminded that they will probably have some comments to consider, and possibly incorporate, at some time after submission. It would be appreciated if this could be done promptly

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