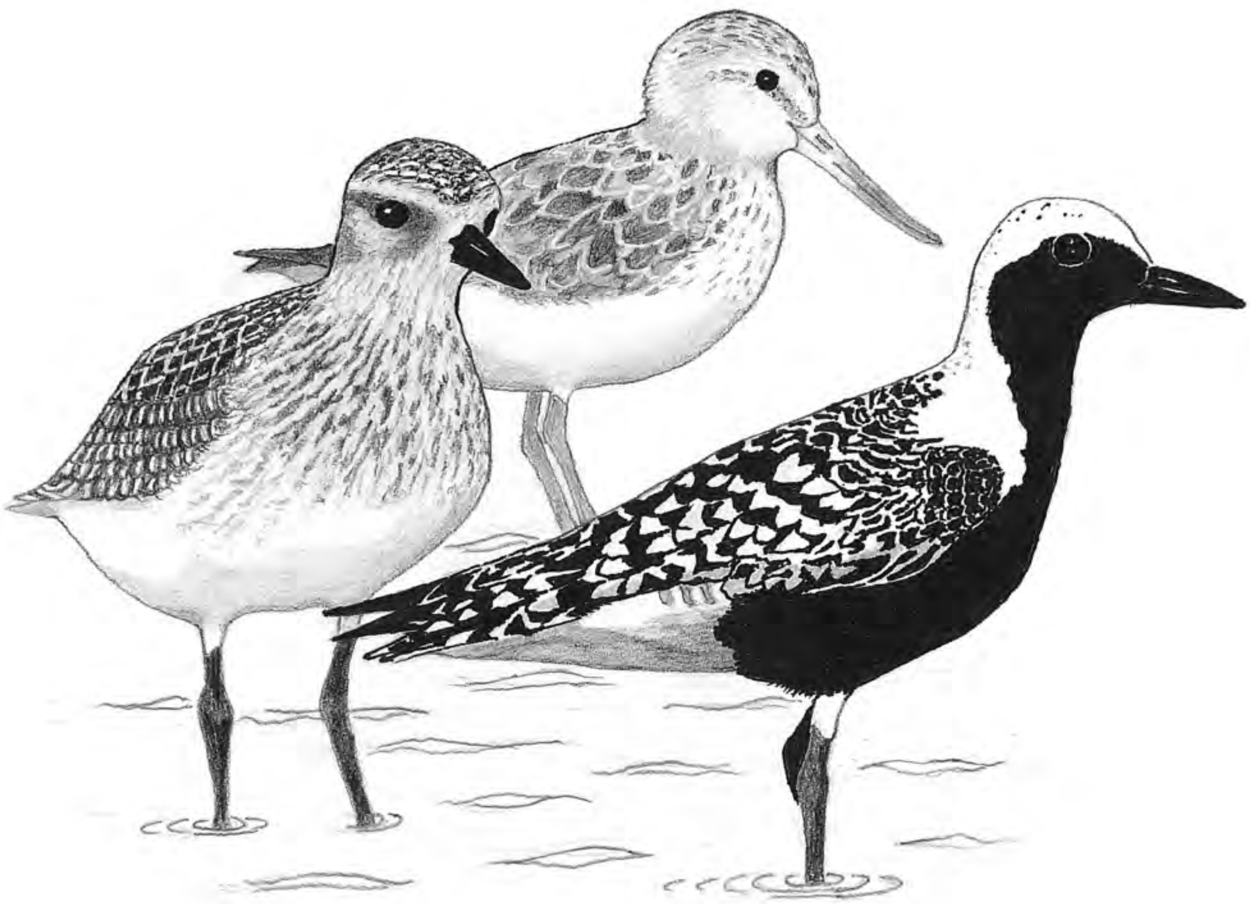
Stilt

The Journal for the East Asian-Australasian Flyway



Number 71 • November 2017

AWSG
Australasian Wader Studies Group

Australasian Wader Studies Group

Stilt

ISSN 0726-1888

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

- Monitor wader populations through a programme of counting and banding in order to collect data on changes on a local, national and international basis.
- Study the migrations of waders through a programme of counting, banding, colour flagging, collection of biometric data and use of appropriate scientific instruments.
- Instigate and encourage other scientific studies of waders such as feeding and breeding studies.
- Communicate the results of these studies to a wide audience through its journal *Stilt* and membership newsletter the Tattler, other journals, the internet, the media, conferences and lectures.
- 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.
- Actively participate in flyway wide and international forums to promote sound conservation policies for waders.
- Encourage and promote the involvement of a large band of amateurs, as well as professionals, to achieve these objectives.

MEMBERSHIP OF THE AUSTRALASIAN WADER STUDIES GROUP

Membership of the AWSG is open to anyone interested in the conservation and research of waders (shorebirds) in the East Asian–Australasian Flyway. Members receive the twice yearly bulletin *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 January 2017

EDITORIAL

Research into the natural history of shorebirds is tied to the skills, energy, commitment and organisation of community members both in Australia and along the East Asian-Australasian Flyway. This involvement long preceded the recent increase in projects involving citizen scientists (Silvertown 2009). Because of their very nature and extent of distribution it would be impossible to effectively monitor shorebirds in the medium to long-term without the efforts of thousands of community members. Indeed, citizen scientists underpinned – and continue to underpin – the efforts of the Australasian Wader Studies Group since its inception. The mission and objectives of *Stilt* recognise this.

Importantly there has been a trend of late for many of the leading amateurs in this field to publish papers in higher profile international journals, either independently or in collaboration with professional researchers. This reflects the importance of work being carried out and the significant level of threat to shorebirds. Because of the growing ability to analyse large data sets and through the involvement of professional researchers, analysis of data collected by citizen scientists from across the flyway is leading to a detailed understanding of populations and their habitat use. Such studies must continue as they underpin conservation efforts.

Despite the growing effort to monitor shorebirds and collect data throughout the flyway the number of papers written by community members that analyse and report on local shorebird ecology and population dynamics is declining. This is reflected in the medium-term decline in manuscripts being submitted to *Stilt*. Consequently, it has again been necessary to reduce the production of *Stilt* to one issue in 2017. Furthermore, the AWSG committee has decided to reduce the publication of *Stilt* to one issue in November of each year from this year onwards.

It is critical to the ongoing understanding of shorebird natural history that the local long-term data sets collected by the many groups of amateurs around the flyway are analysed and published to complement the higher-level publications. A citizen scientist is a volunteer who collects and / or **processes data** (my emphasis) as part of a scientific enquiry (Silvertown 2009). There are many local, long-term data sets sitting on the computers of individuals across the flyway that are crying out to be analysed and published.

This edition of *Stilt* presents several papers that demonstrate the best outcome of citizen science endeavour through collecting and analysing local long-term data sets. Alan Stuart looks at a fifty years data set on Red-necked Avocet in the Hunter Estuary to show the estuary provides important non-breeding habitat, probably as a drought refuge. Liz Crawford and Chris Herbert working on Red Knot data from the same estuary show its important role as a migratory stopover and staging site during southward migration. K. M Aarif *et al.* analyse a long-term data set from a Community Reserve in India show its conservation significance.

Mike Newman and Eric Woehler show benefits of a long-term banding project and demonstrate survival of Australian Pied Oystercatchers of over 34 years, but their analysis suggests that current accepted generation time for this species may be anomalously high. Andrew Crossland working with other authors demonstrates that existing distribution maps exaggerate the distribution of Grey-tailed Tattlers by including Sumatra, and with A. Sinambela provides important data from Papua Province in New Guinea, a region with few surveys, to show it is likely to be a key area for waders on the north coast of New Guinea.

An important note from Clive Minton *et al.* demonstrates for the first time the possibility of small-scale regular overseas migratory movements of White-headed Stilts from north-western Australia.

I'm looking forward to receiving manuscripts – that emulate these papers – from those who have been involved in collecting data over many years at local sites they now know well.

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Greg Kerr
Editor

TREASURER'S REPORT FOR 2016

At the end of 2016, invoices pending amounted to $27,273.95. The balance of $59,271.95 carried forward at 31 December 2016 includes commitments for 2016 contract expenditure of $23,917.21.

Australasian Wader Studies Group

Income and Expenses

1 January 2016 - 31 December 2016

INCOME			**EXPENSES**		
Item	**2016 $**	**2015 $**	**Item**	**2016 $**	**2015 $**
Balance brought forward	54,027.52	68,066.78	Printing	2,789.30	4,057.10
Subscriptions	8,337.43	8,077.46	Postage/courier	3,789.22	3,563.68
Contracts - State Govts.	23,328.47	38,205.86	Surveys/reports/monitoring	11,429.83	41,582.16
Contracts - Other			Donations	500.00	
Donations	8,728.00	32,142.37	Travel/accommodation/meals	8,197.43	14,819.82
Conference/meetings			Conference/meetings		
Other income	1,383.31	667.77	Equipment/consumables	8,000.00	26,353.41
			Consultant fees		
			Other expenses	1,827.00	2,756.55
Total income	41,777.21	79,093.46	Total expenses	36,532.78	93,132.72
Total accumulated funds	**95,804.73**	**147,160.24**		**95,804.73**	**147,160.24**
Balance carried forward	**59,271.95**	**54,027.52**			

Membership statistics:

Membership at the end of the year was:	**2016**	**2015**
Australia/New Zealand	231	264
Overseas (excl. NZ)	16	21
Institutions	12	18
Complimentary	77	85
Total	**336**	**388**

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 2015.

RED-NECKED AVOCET *RECURVIROSTRA NOVAEHOLLANDIAE* IN THE HUNTER ESTUARY OF NEW SOUTH WALES

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Analysis of more than 50 years of Hunter Estuary records shows that the Red-necked Avocet *Recurvirostra novaehollandiae* has been a regular visitor to the estuary since 1972. More than 1% of the total population was present during at least some part of 29 of the 32 years spanning 1985-2016. The peak counts were 6000-7000 birds representing up to 6.5% of the total population.

When in the Hunter Estuary, Red-necked Avocet exhibited predictable behaviour, using the same roosting and feeding sites for prolonged periods sometimes spanning several years. There has been no confirmed evidence of them attempting to breed in the estuary.

The three major periods of absence from the estuary since 2000 coincided with strong La Niña weather patterns delivering heavy inland rainfall. In those periods, birds were absent or mostly absent from the estuary for time spans of 12-18 months. However, there were many shorter-term absences involving periods of 2-4 months typically. These are shown to be linked with inland rain events.

INTRODUCTION

The Red-necked Avocet *Recurvirostra novaehollandiae* is mainly found at shallow ephemeral wetlands in inland Australia, but it is also known from some near-coastal habitats (Marchant & Higgins 1993; Hollands & Minton 2012, Cooper *et al.* 2014). It is an Australian endemic shorebird with occasional vagrant records from New Zealand (e.g. see Kaigler 1968). Mostly it is considered to be nomadic in Australia (Geering *et al.* 2007, Hollands & Minton 2012, Cooper *et al.* 2014).

In 2006 the total population was estimated to be 107,000 birds (Delany & Scott 2006); there appear to be no more recent estimates available. Although numbers in the Coorong declined by 75% between 1985 and 2007 (Rogers & Paton 2009), there seem to be no reports from elsewhere of population changes. It perhaps is not easy to estimate the population of a species which in general is characterised by transient appearances at remote and often inaccessible inland wetlands.

Since the mid-1980s, large numbers of Red-necked Avocet have often been present in the Hunter Estuary, centred on Newcastle in New South Wales (Figure 1). Here I detail those observations, place on record the international significance of the Hunter Estuary for the species and link presence in the Hunter Estuary with inland rainfall patterns.

METHODS

Records of Red-necked Avocet in the Hunter Estuary prior to 1999 were extracted from the NSW annual bird report series 1971-1999 and the Hunter Region annual bird report series 1993-1999 (e.g. Lindsey 1981, Morris 2002, Stuart 1999). The two bird report series include records of opportunistic sightings of the Red-necked Avocet from the Hunter Estuary. Some additional early records of Red-necked Avocet were sourced from a compilation of Hunter Estuary data spanning 1969-1976 (van Gessel & Kendall 2015) and from a study conducted over 1994-1997 (Kingsford *et al.* 1998).

Regular monthly monitoring of Hunter Estuary shorebird high tide sites commenced in April 1999. Twenty-five sites are visited during the same high tide event except when circumstances such as unfavourable weather or access restrictions (e.g. through privately-owned land) cause some sites to be surveyed on the day before, or the day after, the main survey day. Six teams survey sub-sections of the estuary, each team visiting 2-5 sites during a period of ~3 hours centred around the time of the peak tide. Details of the survey method and data management practices have been described elsewhere (Stuart *et al.* 2013). The monthly counts of Red-necked Avocet from April 1999 onwards were extracted from the main Hunter Estuary survey database.

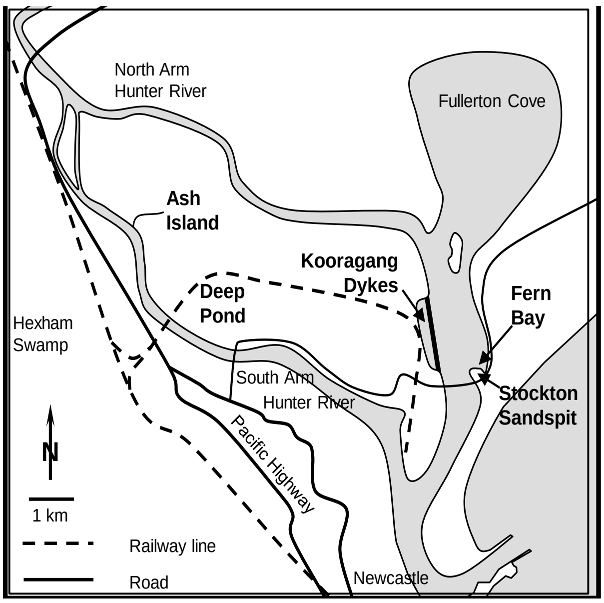

Figure 1. Main shorebird survey sites in the Hunter Estuary (reproduced from Stuart *et al.* 2013).

Data for Australian inland rainfall were sourced from the CHIRPS (Climate Hazards Group InfraRed Precipitation with Station data) dataset (Funk *et al.* 2014). CHIRPS is a quasi-global rainfall dataset spanning 50°S-50°N (and all longitudes) from 1981 to near-present. It incorporates 0.05° resolution satellite imagery with *in situ* station data to create gridded rainfall time series (as mm km^{-2}) for trend analysis and seasonal drought monitoring. The CHIRPS data are based on pentads, with each of first five pentads in a month having five days and the last pentad containing all the days from the 26th to the end of the month. An inland area of approximately 3.9 million km^2 was selected (see Figure 2) and the rainfall data for it from January 1999 to March 2017 were extracted. The data for pentads were converted into monthly rainfall aggregates and then the ratios to the monthly median inland rainfall were calculated.

Figure 2. The area used for extracting CHIRPS inland rainfall data.

RESULTS

Figure 3 shows the reported numbers for Red-necked Avocet from opportunistic observations in the Hunter Estuary over 1970-1999 with the 1970-1984 data expanded in the inset to the Figure. Results from the systematic surveys by Kingsford *et al.* (1998) are presented separately in Figure 4; those monthly surveys did not always record the peak annual counts of Figure 3.

Holmes (1970) reported that a group of five Red-necked Avocet were in the Hunter Estuary in May-December 1965 but there were no further reports until 1972 when a single bird was found on 21 May (van Gessel & Kendall 2015). The numbers in 1972 rose to a peak count of 19 birds in August; 10+ birds were regularly present over June-October (van Gessel & Kendall 2015). Then, apart from a single bird in February 1973, there were no more records until May 1975, after which up to 11 birds were present over May-September (van Gessel & Kendall 2015). There were no further records in the Hunter Estuary until November 1980, and then there were intermittent reports of 50-140 birds over 1980-1984 (Figure 3).

In 1985, Red-necked Avocet was present all year in the Hunter Estuary, with the peak count being 1200 birds in September (Cooper 1989). Large numbers were sometimes reported over 1985-1987 and again in 1992-1996 and 1998-1999 (Figure 3). The greatest count was of 4500 birds in June 1996 (Morris & Burton 1999). Because mostly these were opportunistic records, it is unclear if the counts always represented the peak numbers that were present. In 1996, birds were reported to have been present over March-September (Morris & Burton 1999) but mostly it is unclear whether the avocets remained in the estuary all the time or were only

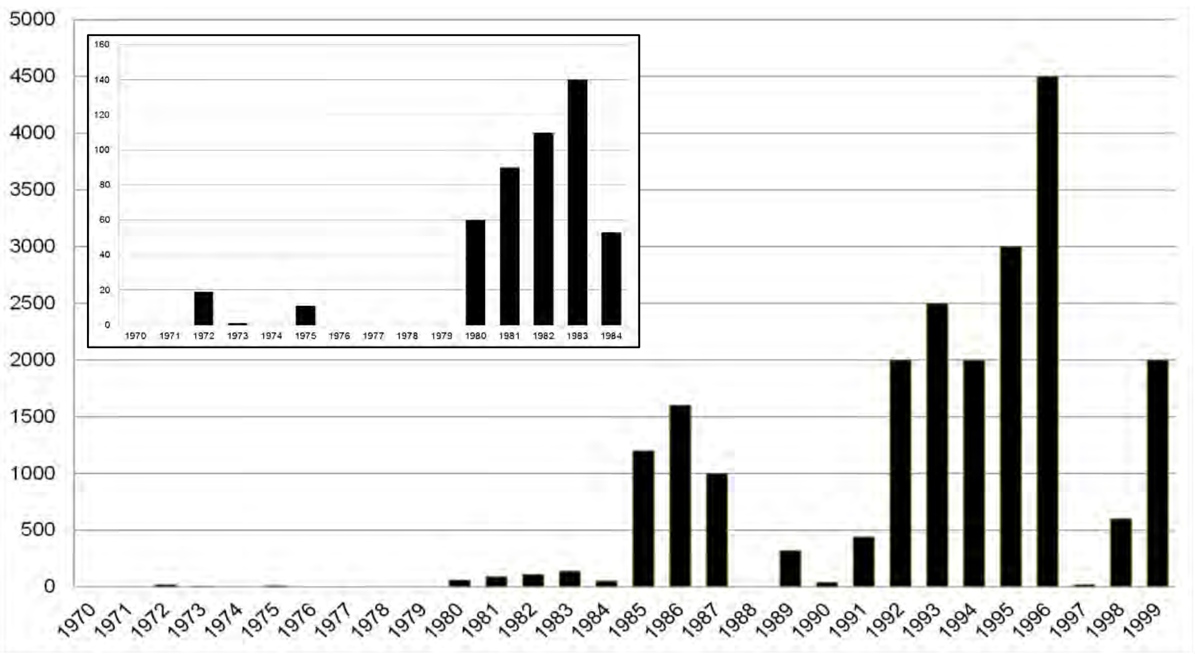

Figure 3. Red-necked Avocet opportunistic counts in the Hunter Estuary 1970-1999. Inset: 1970-1984 data in expanded view (sourced from van Gessell & Kendall 2015, the NSW annual bird report series 1972-1999 e.g. Lindsey 1981 and the Hunter Region bird report series 1993-1999 e.g. Stuart 2000).

present intermittently within each of the above three time frames. However, between May 1994 and September 1997, Kingsford *et al.* (1998) carried out monthly (summer) or bi-monthly (winter) counts of Hunter Estuary shorebirds and waterbirds. Their results for Red-necked Avocet are shown in Figure 4, (derived from Table 3 in Kingsford *et al.* 1998). In the 41-month period of their study, they carried out 29 high tide surveys of the Kooragang Dykes roost site, recording avocets on 25 of the surveys although sometimes only in low numbers. As Figure 4 shows, there were periods of several months (in particular, February-May 1995, January-March 1996 and February-September 1997) when most if not all of the avocets departed the estuary.

Figure 5 shows the data from the systematic monthly surveys carried out since 1999 by members of the Hunter Bird Observer Club, and the monthly rainfall aggregates for inland Australia as a ratio to the median monthly rainfall. Over 1999-2017, the peak counts for Red-necked Avocet from monthly surveys in the Hunter Estuary were 6000-7000 birds while counts of 3000-5000 birds were frequent. Whenever avocets were in the estuary, their numbers quickly rose to 2000 or more birds. There were three periods of prolonged absences of all or most birds: December 1999 – April 2001, January 2010 – May 2011 and February 2016 to March 2017 (> 600 birds by April 2017). There also were several shorter periods of absence, as discussed below.

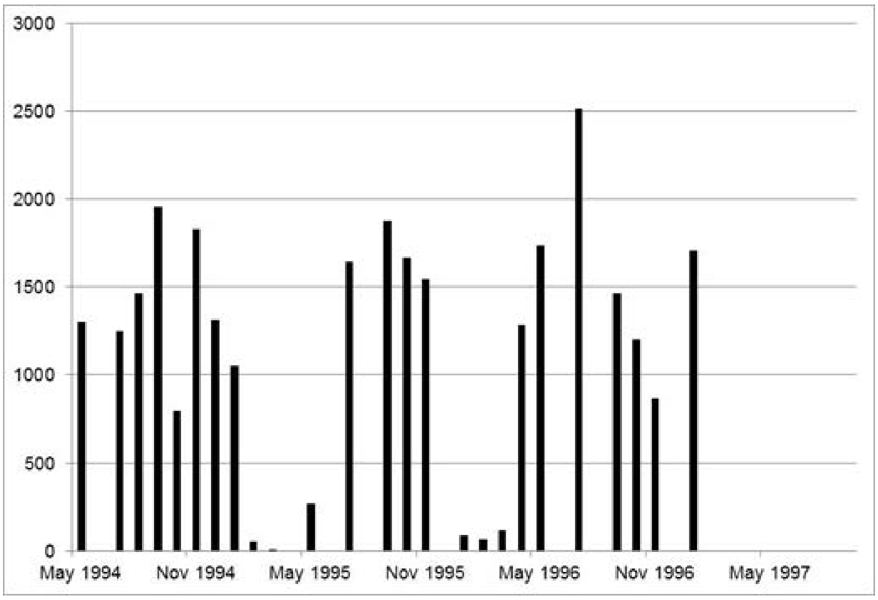

Figure 4. Red-necked Avocet numbers from systematic counts in the Hunter Estuary May 1994 to September 1997 (sourced from Kingsford *et al.* 1998).

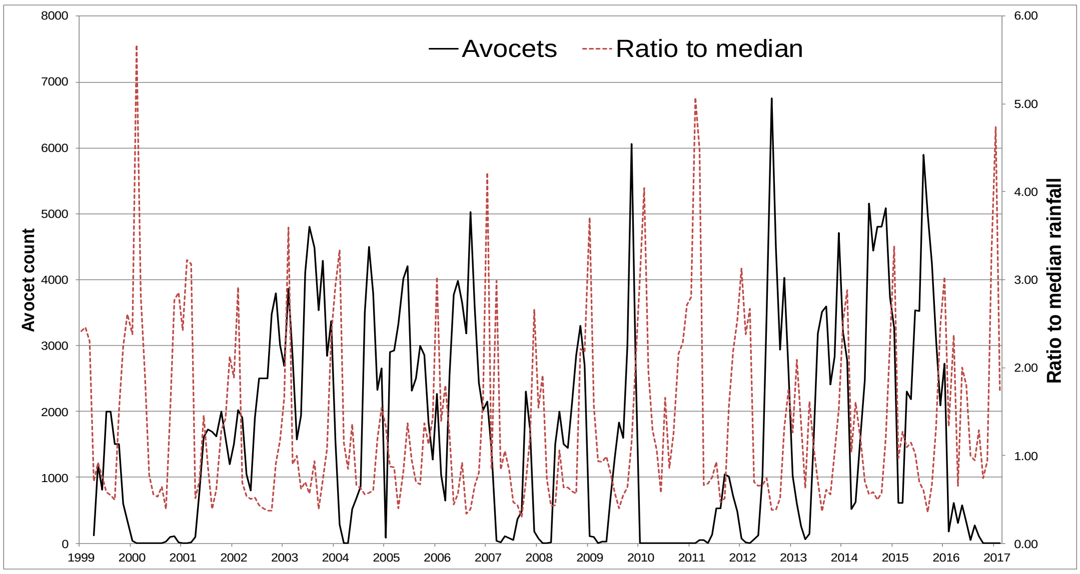

Figure 5. Red-necked Avocet numbers from monthly counts in the Hunter Estuary April 1999 to March 2017 *(sourced from Hunter Bird Observers Club)*, and monthly inland rainfall levels (sourced from CHIRPS).

Despite the frequent presence of large numbers of Red-necked Avocet in the Hunter Estuary for extended periods of time, there have been no confirmed breeding records. A report of them nesting in January 1988, subsequently considered dubious (Cooper 1992, Cooper *et al.* 2014), involved a bird which appeared to be nest building; however, no other breeding activity was observed (F. van Gessel *Pers. Comm.*).

When flocks of Red-necked Avocet were in the Hunter Estuary, their day-to-day behaviour was characterised by regular patterns. In the 1990s birds always roosted on the Kooragang Dykes at high tide and went to Fullerton Cove at low tide to feed (see Figure 1 for locations). In 2002, Stockton Sandspit (Figure 1) became the preferred high tide roost site, after completion of a major rehabilitation program there. Since then, the birds have preferred to roost within a tidal lagoon at the sandspit. Whenever they returned to the estuary after any absence, they immediately reverted to the previous feeding and roosting behaviour. However, in 2015-2016, a sub-set of the flock (up to *c.*1000 birds) began to both feed and roost at other sites within the estuary, for example at ponds on Ash Island.

DISCUSSION

Wetlands supporting more than 1% of the population of a shorebird species are considered internationally significant (Bamford *et al.* 2008). A rating as internationally significant certainly applies to the Hunter Estuary in the context of the Red-necked Avocet. The first records of more than 1% of the total population occurred in 1985. Since 1990, between 2-5% of the population have often been present, and with the peak counts of 6000-7000 birds representing up to 6.5% of the total population. More than 1% of the total avocet population was present during at least some part of 29 of the 32 years spanning 1985-2016 (in 2016 there were 2726 birds present in January, falling to 175 birds in February and the numbers remained relatively low for the remainder of the year).

Cooper *et al.* (2014) described the Red-necked Avocet as absent from the Hunter Estuary in warmer months. That description over-simplifies the pattern over 1999-2017 which was characterised by three long absences (time spans of 12-18 months) and many shorter duration absences or partial departures. The three periods of prolonged absence (2000-2001, 2010-2011 and 2016-2017) coincided with strong La Niña weather patterns in Australia (Bureau of Meteorology 2017). Heavy inland rainfall in those three periods would have created conditions suitable for avocets to breed inland, which could account for their lengthy absences at those times. The pattern for the shorter-term absences was not strongly seasonal although it was more closely associated with autumn than summer. For example, birds were absent or only present in low numbers in February-April 2004, March-July 2007, January-April 2008, March-May 2009 and January-March 2012. Kingsford *et al.* (1998) also noted autumnal absences in 1995-1997, as discussed earlier. However, the absences could not be considered solely to be seasonal because on many occasions between 1999 and 2017, Red-necked Avocet were in the Hunter Estuary in high numbers in autumn (Figure 5). It seemed more likely that shorter-term absences from the estuary coincided with isolated inland rainfall events e.g. associated with cyclones or thunderstorm activity or

Table 1. Changes to Red-necked Avocet numbers in the Hunter Estuary in response to inland rain.

Inland rainfall event			Hunter Estuary Avocets			
Period	Aggregate rainfall (m km^{-2})	Ratio to median rainfall	Original numbers	Final numbers	Period of reduced numbers	Comment
Oct '99 – Mar '00	6.0 x 10^6	2.7	1500-2000	<10	Dec '99 – Apr '01	La Niña period
Oct '00 – Mar '01	5.0 x 10^6	2.7				
Dec '01 – Feb '02	2.2 x 10^6	2.3	~2000	800	Apr '02 – May '02	
Jan '03 – Feb '03	1.6 x 10^6	2.6	~3000	~1500	Apr '03	
Dec '03 – Feb '04	2.7 x 10^6	2.9	~3000	<10	Feb '04 – Apr '04	
Nov '04 – Jan '05	1.3 x 10^6	1.4	3000-4000	<100	Jan '05	
Jan '06 – Mar '06	1.9 x 10^6	2.1	~3000	650	Feb '06 – Mar '06	
Dec '06 – Mar '07	3.0 x 10^6	2.4	2000-5000	<20	Mar '07 – Sep '07	
Dec '07 – Feb '08	1.9 x 10^6	2.0	~2000	<10	Jan '08 – Apr '08	
Nov '08 – Jan '09	2.5 x 10^6	2.7	~3000	<10	Jan '09 – May '09	
Dec '09 – Mar '10	3.5 x 10^6	2.8	2000-6000	<10	Jan '10 – May '11	La Niña period
Oct '10 – Mar '11	6.1 x 10^6	2.8				
Oct '11 – Mar '12	4.5 x 10^6	2.4	500-1000	<10	Jan '12 – May '12	
Nov '12 – Mar '13	2.4 x 10^6	1.6	4000-6000	<100	Feb '13 – May '13	
Dec '13 – Feb '14	2.2 x 10^6	2.3	2000-4000	500-600	Mar '14 – Apr '14	
Dec '14 – Jan '15	1.7 x 10^6	2.8	3000-5000	~600	Feb '15 – Mar '15	
Nov '15 – Mar '16	3.3 x 10^6	2.1	2000-4000	<10	Feb ' 16 – Mar '17	La Niña period
May '16 – Jun '16	1.2 x 10^6	1.9				
Dec '16 – Mar '17	3.5 x 10^6	2.8				

minor La Niña conditions.

To investigate this possibility in more detail, avocet numbers and inland rainfall data were directly compared (Figure 5). As expected, the La Niña periods in 2000-2001, 2010-2011 and 2016-2017 when avocets were absent from the Hunter Estuary or only present in low numbers corresponded with heavy inland rain. However, Figure 5 reveals that it was an annual event for at least some avocets to have departed the estuary for some part of the period December to May, with the departure occurring 1-2 months after substantial inland rain had fallen i.e. rain in the period October to February. However, in some years a sizable proportion of the population did not depart and / or the period for reduced numbers was small. Details of all the decreases in avocet numbers are summarised in Table 1.

With a few exceptions, there appear to have been two requirements before avocets departed the estuary after inland rain. Firstly, there needed to have been at least three continuous months with rainfall above the monthly median. Secondly, the aggregate rainfall for that period of months needed to have been at least twice the median for that number of months. In only three instances were these criteria not met. One instance involved the two-month period January - February 2003 which included heavy inland rain in February (3.6 times the monthly median). It is notable that although many avocets had departed the estuary in April 2003, 1500 birds had not, and the numbers quickly rose again, such that more than 4000 birds were in the estuary in June 2003. For November 2004 to January 2005 the aggregate rainfall was only 1.4 times the median for a three-month period. Although most avocets departed in January 2005 the low aggregate rainfall may explain why they returned so quickly to the estuary (only 82 birds were present in January 2005 but the counts in December 2004 and February 2005 were of ~3000 birds). In the third case, the period November 2012 to March 2013, the rainfall aggregate rainfall was only 1.6 times the median for that period, but there were five continuous months of above median rainfall, hence many inland waterbodies should have filled. In this case, almost all avocets departed the estuary, for three months.

The return of avocets to the Hunter Estuary was also linked with rainfall patterns. After two months of below-median inland rainfall in non La Niña periods, avocet numbers always began to rise. However, the rate of increase and the eventual peak counts varied. The amount of rain which fell immediately before the new dry period seemed to affect this. For example, the period April to October 2012 involved seven continuous months of below-median inland rainfall, and avocet numbers in the estuary peaked at 6753 birds. In the preceding year, there were six continuous months of below-median rain and the count peaked at 1048 birds. An important difference between these two examples is that February-March 2011 received much more rain (4.8 times the two-month median) compared with February-March 2012 (2.5 times the median).

CONCLUSIONS

Red-necked Avocet were first recorded in the Hunter Estuary in 1965. Birds began to visit the estuary more regularly in 1972, initially only in low numbers and for relatively short periods of time. In 1985, 1% of their total population was present in the estuary for the first time. From 1985, that became a regular event, and in many years, there were between 2-5% of the avocet population in the estuary. The peak counts of 6000-7000 birds represented up to 6.5% of the population.

When present, their feeding and roosting behaviour has been predictable, focussing on key sites within the estuary. There were three major periods of absence (all since 2000). These coincided with strong La Niña weather patterns delivering heavy inland rainfall. Several shorter-term absences, of a few months, occurred 1-2 months after substantial inland rain falling in the period between October and February.

ACKNOWLEDGEMENTS

The monthly surveys of the Hunter Estuary since 1999 are coordinated by the Hunter Bird Observers Club (HBOC), involving a core team of surveyors (including myself). Around 150 members and visitors have assisted at least occasionally. I thank HBOC for permission to publish the results for Red-necked Avocet. I also thank an anonymous referee and the Editor for the helpful comments they made on an earlier version of this paper. In particular, I thank the referee for downloading inland rainfall data from the CHIRPS satellite sensed rainfall dataset and suggesting a closer analysis of the links between inland rainfall and Red-necked Avocet presence/ absence in the Hunter Estuary.

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TRACKING EXTREME LONGEVITY IN THE AUSTRALIAN PIED OYSTERCATCHER

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A recent field observation of a colour-banded Australian Pied Oystercatcher *Haematopus longirostris* in its 33rd year is remarkable, not only for its age, but also for the resilience of its bands. This bird was banded as a pullus and thus its exact age is known. The chronology of the sightings of this and a second, even older, oystercatcher is discussed in terms of the demography of the species in southeast Tasmania. Monitoring the survival of banded oystercatchers at their breeding territories is an effective means of determining the longevity of oystercatchers. It is particularly advantageous with respect to addressing issues associated with the deterioration of the colour bands used to identify individual birds and of the probability that breeding birds are under-represented at communal roosts. However, small sample sizes and the study of anomalous populations may generate results that are not representative of the species. While the Australian Pied Oystercatcher is undoubtedly long-lived, the published generation time of 39 years is probably excessive.

INTRODUCTION

This paper records evidence for the extreme longevity of Australian Pied Oystercatchers *Haematopus longirostris* and discusses the difficulties associated with obtaining meaningful data on the survival rate of this long-lived species.

An Australian Pied Oystercatcher was recently found by EJW 32 years, two months and nine days after being banded as a pullus. This is currently the maximum longevity for the species in records submitted to the Australian Bird and Bat Banding Scheme (ABBBS: http://www.environment.gov.au/science/bird-and-bat-banding). There are several aspects of the recent visual confirmation of the survival of this bird of an exactly-known age that are remarkable, and provide insights into how the probability of finding and tracking the surviving banded birds can be enhanced.

METHODS

In 1977, a small team commenced the banding of Australian Pied Oystercatchers in southeast Tasmania with the objective of understanding the species life history by tracking the movements and survival of birds banded as runners (i.e. known-age chicks). The recently observed bird was one of the pulli banded in December 1984.

Figure 1 shows locations and main areas where shorebirds, including oystercatchers, form communal high tide roosts.

A pilot study in the 1977/78 breeding season involved banding all the runners on Gorringes Beach, Mortimer Bay in southeast Tasmania (Figure 1), and capturing three incubating adults using a drop trap. Runners were banded with a metal band on one leg and two Darvic® colour bands on the other leg. The pilot study was immediately successful, with the survival of the runners tracked through to their incorporation into flocks of immature and non-breeding adult oystercatchers.

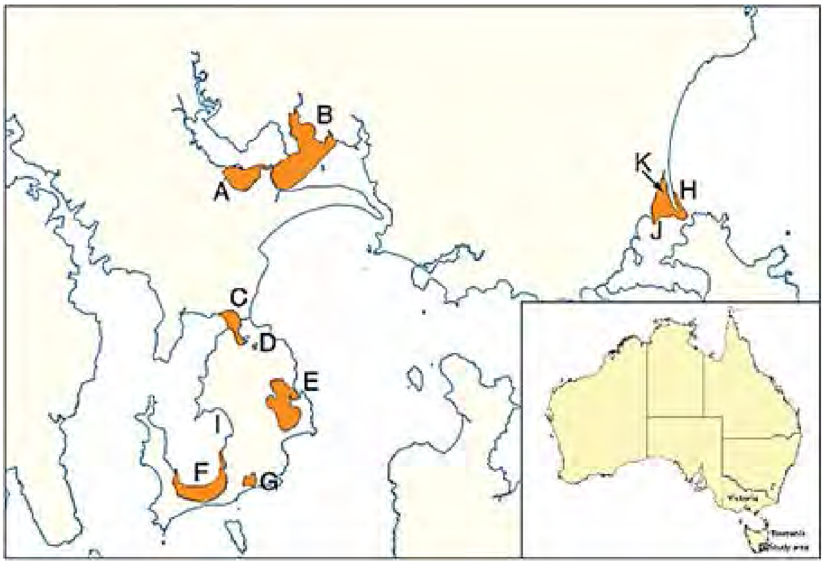

Figure 1. Map of southeast Tasmania showing main oystercatcher roost sites monitored since 1964: Barilla Bay (A), Pitt Water/ Orielton Lagoon (B), Lauderdale (C), Clear Lagoon (D), Pipeclay Lagoon (E), South Arm Neck (F), Calverts Lagoon (G) and Marion Bay (H) and the breeding territories of the oystercatchers discussed in this paper: Gorringes Beach, Mortimer Bay (I), Little Boomer (J) and the Porpoise Hole (K).

Subsequently, the banding of runners was expanded to other beaches in southeast Tasmania, with unique combinations of three colour bands used. The colour of uppermost band denoted the year of banding; e.g. black in 1984/85 when 43 pulli were banded. The banding team of MN, Priscilla Park, Bob Paterson, the late Bill Wakefield and Alan Fletcher worked independently while banding runners, each assigned a coastal area and a number of unique colour combinations for their area. For an experienced team the investment in banding both pulli and incubating adults was approximately four hours / bird in situations where the aim was to band every pullus (i.e. some were exceedingly difficult to locate).

Territories were located by breeding season searches of all easily accessible beaches and bays throughout the area shown in Figure 1. Over a number of years, the preferred nest sites and the strategies used by individual pairs to provision and protect their young were identified. This assisted the location of nest for the capture of incubating adults and of pulli for banding. For instance, knowing where a chick sheltered on a mud flat or above the high tide mark facilitated capture.

Three techniques were used to capture and band oystercatchers in southeast Tasmania:

1. Pulli were captured and banded when aged at least 14 days from hatching and before fledging, which typically takes between 40 and 50 days from hatching.
2. Adults were trapped on the nest with a drop trap using a method from New Zealand (Mills and Ryder 1979). Eggs were removed and replaced with wooden replicas. The front of the light weight box trap with metal frame covered in netting was supported by a split peg and the rear was pinned to the ground. A trip wire from the split peg to the rear of trap passed over the replica eggs. Adult birds returning to the nest triggered the trip wire when they attempted to incubate the replica eggs, dropping the trap around them. The real eggs were stored in warm environment until the adult had been banded and released. The eggs were then returned to the nest. There were no instances of nest desertion following the trapping of birds using this method.
3. Cannon netting of flocks containing a combination of breeding and non-breeding birds of unknown ages.

Inspection of bands during cannon netting, three years after first birds were banded, and visual observations in the field indicated rapid and ongoing deterioration of all bands. This involved the corrosion of metal bands, the fading of colour bands, particularly blue, and the overlapping and shedding/ loss of colour bands. To remedy this, the following measures were taken subsequently: Aluminium bands used at the start of the program were replaced by stainless steel alloy bands. Adjacent colour bands were fitted with spirals wound in opposite directions, and sealed with a glue - initially Araldite® and subsequently with Cyanoacrylate 'superglue'. Where necessary, bands were replaced during cannon netting efforts, and breeding adults were recaptured using the drop trap method.

During the breeding season, beaches were searched to establish whether banded adults had survived in previously occupied territories, and if birds banded as pulli had acquired a territory and entered the breeding population. At least one visit per season is required to confirm presence, while a second may be necessary to establish permanent absence.

RESULTS

Intermittent sightings of birds with colour bands still occur even though it is now 25 years since the banding in the area ceased (MN, EJW unpubl. data). This indicates that several potential known-aged birds are present in the local population. As colour bands often deteriorate with time and / or are shed, it is typically impossible to determine the individual identity of the bird reported or even its cohort without recapture or recovery.

However, that is not always the case. The histories of two Australian Pied Oystercatchers known to have lived more than 30 years are detailed below as examples of the information generated by the approaches used in this project.

Bird 1: Band number 100 86690 - Colour bands Black/Dark Green/Red

A pullus was captured by hand and banded by Bob Patterson at Barilla Bay (42°49′S; 147°29′E) on 18/12/1984 – mass 345 g, bill 46.6 mm, total head length 84.9 mm. It was the larger of two siblings.

Subsequent records of a bird with this colour band combination follow: Pipeclay Lagoon on 22 February 1986 (2nd year). Present on the Dunalley side of Little Boomer Spit in Blackman Bay in 1989/90 (6th year) and during 1991/92 (8th year) in the breeding season. On both occasions, it was paired and believed to be breeding, although this was not confirmed by the observation of a nest or young. Observed at the Porpoise Hole, Marion Bay (42°49′48″S; 147°51′36″E) by EJW on 27/02/2017, with photographic evidence (Figure 2). The bands were in good condition with no evidence of overlapping. The elapsed time from banding was 32 years, two months and nine days. The bird had moved 30 km with a bearing of 90°, i.e. east (ABBBS report data).

Figure 2. Colour-banded Australian Pied Oystercatcher (Bird 1) sighted at Porpoise Hole, Marion Bay on 22/2/2017 (photograph E.J. Woehler).

Bird 2: Band number 100 14477 – Colour bands Red/Light Green/Dark Green

This bird was banded by MN and others at Gorringes Beach, Mortimer Bay (42°58′S; 147°28′E) on 22/10/1977 as an adult male, which was trapped on the nest and recorded to be at least a 4th year bird. It was assigned as male based on biometric evidence, the shape and colour of the bill. This conclusion was confirmed by comparison with the larger dimensions of the female, which was subsequently captured (Newman 1992).

Subsequent records are summarised below:

Retrapped on 1/8/1982, during cannon netting at a South Arm Neck communal high tide roost site approximately 6 km S/SW from its breeding territory. The original bands were replaced with the stainless-steel band 100-84293 on the right leg and red/light green/dark green on the left leg.

This bird was observed on Gorringes Beach, Mortimer Bay at its territory annually until the 2007/08 breeding season, when it would have been in its 34th year at least – a comparable age to Bird 1 described above. However, on 29/12/1999, it was observed to have lost its dark green band. Its colour bands faded, and one was shed. Subsequent identification would have been impossible without knowledge of the provenance of territory occupancy (i.e. it was inferred that same bird was involved from the remaining sub-set of original colour bands). During the 29-year period (1977/78 – 2007/08) the territory was occupied by this bird, there was a dramatic increase in the human recreational use of the beach, and although many scrapes were constructed no nests with eggs were found in or after 1991/92. The male had apparent short-term partners (i.e. Bird 2 was seen accompanied by the same colour-banded oystercatcher on consecutive occasions within a breeding season).

DISCUSSION

When this study was initiated, it was not foreseen that it would be ongoing with observations of banded birds 40 years later. This paper reports the longest known survival of an Australian Pied Oystercatcher reported to the ABBBS (David Drynan *Pers. Comm*.), but also reflects on how such studies can be improved with the hindsight of experience gleaned from a long-term study on Australian resident shorebirds.

Bird 1

The recent sighting of Bird 1 (100-86690) is the greatest longevity for an Australian Pied Oystercatcher, according to the records of the ABBBS. However, there are several other aspects of this record that are exceptional and warrant additional discussion.

This bird was banded as a runner and therefore its age is known exactly. Indeed, from the body mass at the time of banding, we can state that when sighted on 22/2/2017 it was aged approximately 32 years 3 months and nine days from the date of hatching approximately 28 days before it was banded (based on MN's unpublished calibration curves for the rate of growth of pulli). As will be discussed in relation to Bird 2, such accuracy is impossible when a bird is free flying when first banded.

The sparse chronology of sightings, with no records over the 25-year period between 1992 and 2017, might seem surprising, but can be explained in terms of the known demographic patterns of Australian Pied Oystercatchers in southeast Tasmania (Fletcher and Newman 2010). Immature birds join non-breeding oystercatcher flocks that congregate at, and move among, the main high-tide roosts (Figure 1).

There have been very few sightings of these birds outside southeast Tasmania (MN unpubl. data), and most birds banded as runners eventually entered the breeding population at locations that were within 10 km of their natal site, with the mean distance between the acquired territory and their natal site a mere 7 km (Taylor *et al*. 2014). Australian Pied Oystercatchers demonstrate long-term fidelity to their established partners and territories (Newman 1992, 2008); exceptions are rare (Newman and Park 1986). The chronology of the sightings of Bird 1 is consistent with the known demography. As a second-year immature, it was observed in Pipeclay Lagoon approximately 18 km south from its natal site, a location where high numbers of immature, pre- and non-breeding oystercatchers congregate.

The subsequent sightings in its 6th and 8th years were on an assumed breeding territory on private land. Under normal circumstances, breeding adults don't leave breeding sites in sheltered bays, like the Little Boomer spit, unless extreme storm conditions and high tides eliminate all local roost options. Under these circumstances, they will join the non-breeding oystercatchers at more secure communal roosts. Thus, unless annual searches were made to confirm its presence at the breeding territory, which were not made at this territory after 1992, ongoing sightings would not be expected unless circumstances caused it to desert its territory. It is believed that rising sea levels may have recently inundated its Little Boomer territory, causing it to join the local non-breeding flock (EJW unpublished obs.). Alternatively, it could have failed in breeding or be senescent during the 2016/17 season and joined non-breeders at roost.

Another feature of the recent sighting is that the colour bands remain intact, allowing an unambiguous identification of the bird more than 32 years after banding, in contrast to other instances where band shedding, overlap and fading are known to have occurred within ten years of banding, or even sooner (e.g. Robinson and Oring 1997; Collins *et al*. 2002).

We believe that several factors likely contributed to the resilience of this band combination, including spiralling alternative bands in opposite directions and sealing each with superglue. In addition, the band colours black, dark green and red contrast well and have faded less than colours like dark blue, based on long term field experience (e.g. faded dark blue is exceedingly hard to distinguish from white, MN and EJW *Pers. Obs*.). Further, this band combination did not involve any colour bands being placed over metal bands, which was done towards the end of the study to increase the number of unique band combinations. Our long-term observations of territorial oystercatchers suggest that colour bands placed over metal bands experienced increased wear and were shed more rapidly and / or more frequently. Recent advances involving the availability of engraved flags have eliminated the need for the use of multiple band combinations for oystercatchers in Australia.

Bird 2

Bird 2, (100-14477) a male, was first banded as a breeding adult trapped on the nest. Its age at the time it was last seen on Gorringes Beach in the 2007/08 breeding season is unknown, but it would have been at least 34 years (Taylor et. al. 2014). It was conservatively assigned a minimum age of four years at the time of banding, a value determined by following the survival of birds banded as runners through to breeding in southeast Tasmania (Fletcher and Newman 2010). As the mean age at which males first bred is currently 7.6 years (Taylor *et al*. 2014) the bird may have been breeding for a number of years before it was first captured and banded. Hence, it may well have been considerably older than the minimum estimated 34 years when last seen.

The chronology of field observations of bird 2 is indicative of the life style of adult oystercatchers breeding in the sheltered bays of southeast Tasmania. During the breeding season, it was exclusively observed on its territory at Gorringes Beach, Mortimer Bay. However, during winter under storm conditions it moved on occasions around a headland to join a large flock of immature and non-breeding oystercatchers at a communal roost on South Arm Neck in Ralphs Bay, approximately 6 km from its breeding territory, where it was captured by cannon netting.

Even when its territory became unviable for successful breeding because of the loss of suitable nest sites and high rates of disturbance from recreational beach usage involving unrestrained dogs, Bird 2 continued to occupy the territory. Such examples of site fidelity increase confidence in the conclusion that when long-term breeding birds are no longer observed in their territory, they have most likely/almost certainly perished.

Longevity

The ages of the two birds discussed here are the highest recorded longevity of the Australian Pied Oystercatcher. However, the existence of birds of this age might be unsurprising given the current estimated generation time of 39 years (Ens and Underhill 2014). This estimate was derived from an annual survival rate of 97% for nine breeding pairs (including Bird 2) at Gorringes Beach, Mortimer Bay, where only four adults disappeared (assumed dead) during a period of 10 years.

However, with the benefit of hindsight it is possible that this value may be anomalously high. Continued monitoring of the surviving adults in Newman's study (2008), including Bird 2, indicated that they nearly all died during the next five years, suggesting that they may have all started breeding at Gorringes Beach at approximately the same time and at approximately the same age. If this hypothesis is correct, the sample monitored was biased to similarly aged birds, all in their prime between 10 and 20 years of age. For instance, if the average survival of these breeding oystercatchers is conservatively assumed to be 12.5 years, equivalent to an annual survival rate of 92%, the generation time for the southeast Tasmanian population falls to 19 years. This value lies toward the middle of the range (12 to 30 years) estimated for other oystercatcher species (Ens and Underhill 2014).

The generation time reflects both the age of first breeding and the annual survival rate (Lande *et al.* 2003).

$$G = A + (S / (1 - S))$$

where G is the generation time, A is the average age of first breeding and S is the expected adult survival rate.

Both the values of A and S are influenced by local environmental and anthropogenic factors. After the start of MN's breeding study in 1977, there have been adverse changes in both environmental and climatic factors affecting the breeding success and mortality of adult oystercatchers in southeast Tasmania. These include erosion of coastal features (e.g. sand spits) that provide viable nest and roost sites, and an increased recreational use of beaches in southeast Tasmania. In addition, acreage style coastal developments throughout southeast Tasmania have increased the risk of adult mortality by collisions with vehicles when roosting and breeding birds are forced onto roads by inundation of adjacent roosts at high tides and storm surges (Newman 2015), and from predation of incubating birds (e.g. by feral cats *Felis catus*). These factors are believed to have contributed to a decreased annual survival rate during the period in which the majority of the adult birds at Gorringes Beach, Mortimer Bay died.

A number of oystercatchers exceeding 20 years in age have been recorded by the Victorian Wader Study Group (VWSG) in the southeast of the Australian mainland, including one extant bird approaching a minimum age of 30 (Clive Minton, Pers. Comm.) The VWSG records reinforce the conclusion that the generation time of the Australian Pied Oystercatcher is high, which decreases any concerns that the conclusions reached from the relatively small population at Gorringes Beach, Mortimer Bay might be anomalous.

Factors favouring high(er) adult survival rates for Australian Pied Oystercatchers in southeast Tasmanian include a resident as opposed to a migratory breeding population, the absence of Red Foxes *Vulpes vulpes* and an equitable climate. In southeast Tasmania, the absence of foxes is an advantage providing an expectation of a higher adult survival rate and hence generation time compare to mainland Australia. Ens and Underhill (2014) cited starvation during harsh winters as an important cause of adult mortality in Eurasian Oystercatchers *H. ostralegus*; such conditions are rare in southeast Tasmania and thus much less likely to influence the calculations presented here.

Post-1970, several measures were implemented that have progressively improved the environmental quality of the Derwent Estuary. There was a concomitant spread of oystercatchers up-river (Fletcher and Newman 2010). Gorringes Beach, near the mouth of the Derwent Estuary may have been one of the first areas at which breeding became viable (due to improved environmental conditions) about the time banding commenced. This would explain why all the breeding adults were of similar age.

CONCLUSIONS

The ages of the two birds discussed in this paper (32 and 34+ years) demonstrates the longevity of Australian Pied Oystercatcher.

Australian Pied Oystercatchers are not migratory, and breeding adults often remain near their breeding territories for much of their lives. Therefore, breeding adults may be under-represented at communal roosts involving non-breeding flocks. Hence demographic data derived from sampling communal flocks may underestimate longevity and potentially introduce biases to demographic studies.

Annual monitoring of breeding adults is an effective method of measuring annual survival, as individual birds are faithful to their territories, even when the quality of a territory has become unviable for breeding, as exemplified by Bird 2 at Gorringes Beach.

Monitoring the survival of birds banded as runners through to breeding adult and ultimately death provides the exact longevity of birds. However, it requires great dedication as the generation time of an Australian Pied Oystercatcher approaches half that of *Homo sapiens*.

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RED KNOT ON MIGRATION THROUGH THE HUNTER ESTUARY, NEW SOUTH WALES

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Red Knot have been considered 'birds of passage' in the Hunter Estuary, generally passing through on southward migration. Red Knot utilize the foraging and roosting habitats in the estuary in a predictable manner, with the entire flock usually present at Stockton Sandspit at high tide and shortly after when foraging opportunities appear on exposing mudflats. This period provided excellent opportunities for observing flagged birds. Regular observations of birds with engraved leg flags revealed that they migrate through the estuary in waves, with significant influxes in late September and early October. Some birds stayed for a minimum of one day while others stayed for up to thirty-one days; the majority stayed for less than two weeks. Abdominal profiles of birds on arrival suggested that some may, perhaps, have staged in the Gulf of Carpentaria during southward migration. Profiles observed later in November indicated that some birds were refueling in the estuary prior to resuming southward migration. Re-sighting of flagged Red Knot in New Zealand within five days of last being seen in the Hunter Estuary and no re-sightings in Victoria of flagged birds observed in the estuary suggests that most Red Knot may fly directly from the Hunter Estuary across the Tasman Sea to New Zealand. Historical single monthly counts underestimate the true flux of Red Knot using the estuary as they are carried out both before and after the peak influxes occur. A further complication is that earlier arrivals leave as new birds arrive. The opportunistic use of the Hunter Estuary also means that in some years, Red Knot flocks may be much larger (or smaller) than in other years. Our results indicate that the Hunter Estuary is a significant stopover and staging site for between 2.3% and 4.6% of the southeast Australian and New Zealand population of Red Knot.

INTRODUCTION

Red Knot *Calidris canutus* have been recognized as 'birds of passage' in the Hunter Region (Stuart 2013) (Figure 1). They generally stay for only a short period as they pass through the Hunter Estuary on southward migration to non-breeding destinations, such as Victoria and New Zealand. Red Knot arrive as early as August and are usually gone by December. Occasionally a few Red Knot may stay in the Hunter Estuary over the summer months, but no Red Knot have been recorded passing through the Hunter Estuary on northward migration.

Counts of Red Knot in the Hunter Estuary have been conducted on an irregular basis since the 1970s, with winter (June/July) and summer (February) counts during the 1980s for the AWSG shorebird monitoring project and occasional counts in the 1990s (van Gessel & Kendall 1972; Herbert 2007; Stuart 1994–2015). Since April 1999, the Hunter Bird Observers Club has conducted monthly monitoring of shorebirds on high-tide roosts in the Hunter Estuary. During this study we counted Red Knot flocks weekly, or more frequently, at Stockton Sandspit during the 2012/2013, 2013/2014 and 2014/2015 non-breeding seasons.

Peak counts of Red Knot in the Hunter Estuary, generally less than 700 birds, have been recorded during September and October since the early 1970s (van Gessel & Kendall 1972; Herbert 2007; Stuart 1994–2014) (Figure 2). Occasionally, flocks of more than 1000 birds have been recorded, approximately every five years since 1996 when 2000 Red Knot were recorded (Stuart 1997) (Table 1). However, peak counts are only part of the picture as it is apparent from this study that Red Knot move through the estuary in waves on their way to their final non-breeding destinations.

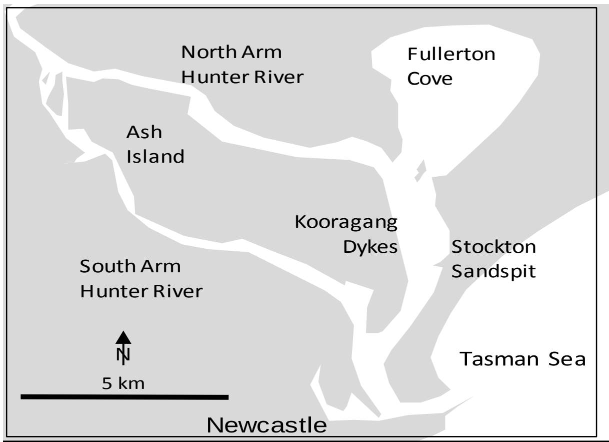

Figure 1. Red Knot roosting and foraging sites in the Hunter Estuary at Newcastle. Red Knot forage at Stockton Sandspit, on sandbanks in the North Arm of the Hunter River and on mudflats in Fullerton Cove. They roost on Kooragang Dykes, on Stockton Sandspit and occasionally on Ash Island.

Table 1. Peak counts in excess of 1000 Red Knot in the Hunter Estuary (1996–2013)

Date	Number of Red Knot
22 September 1996	2000 (Stuart 1997)
22 September 2001	1100 (Stuart 2002)
18 October 2006	1669 (Stuart 2007)
9 October 2011	1000 (Stuart 2012)

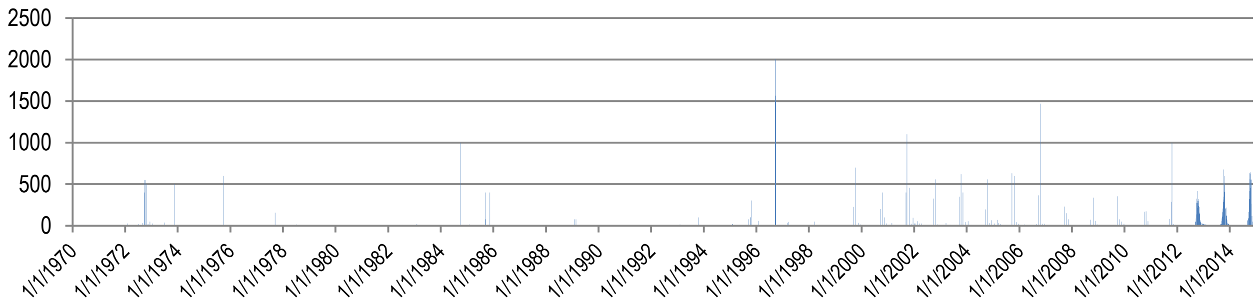

Figure 2. Counts of Red Knot in the Hunter Estuary from 1972 to 2014. Sporadic counts by Van Gessel and Kendall in the 1970s (van Gessel & Kendall 1972; van Gessel pers. comm. 2004 unpubl. data); by W. Barden in the 1980s (unpubl. data); and by various counters in the 1990s (Stuart 1994–1999). Regular monthly counts by HBOC since April 1999 (Stuart 2000–2014).

Red Knot have been banded (ringed) with uniquely numbered metal bands since 1960 in Australia and 1979 in New Zealand. Since colour banding and leg flags were introduced useful observations can be made without having to recapture the birds. New Zealanders were the first to individually mark Red Knot with colour bands in 2004, followed by banders in Western Australia in 2006. Leg flags engraved with letters and/or numbers were introduced in Western Australia and New Zealand in 2005 (Minton *et al.* 2010; Riegen 2013) and have been used on Red Knot in Victoria since 2009 (Minton *et al.* 2010). There has also been a huge expansion of wader marking in mainland China, particularly at Chongming Dao, near Shanghai, in the southwest Yellow Sea (Minton *et al.* 2011) where engraved leg flags have been used since 2006 (Chendong Tang *et al.* 2011). Each capture location has its own unique coloured flag and/or position of the flag on the bird's leg. Each bird also has a numbered metal band supplied by the relevant country's banding scheme (Hassell *et al.* 2013).

Observations of individually marked birds, bearing engraved leg flags (ELFs) or colour-band combinations, have allowed us to estimate how long each bird stays in the Hunter Estuary before moving on.

Red Knot destined for New Zealand apparently migrate from the breeding grounds in Siberia in four or five flights: first to the Sea of Okhotsk (2-3000 km), then to northeast China or Korea (2-3000 km), then to Irian Jaya or northern Australia (5-7000 km), then either direct to New Zealand (4-5000 km) or to eastern Australia (2-3000 km) before final flight (2-2500 km) across the Tasman Sea to New Zealand (Riegen 1999).

Geolocators attached to three adult males from the Chukotka breeding grounds have recently supported Riegen's (1999) conclusions and confirmed the Gulf of Carpentaria in northern Australia as a key staging area (Tomkovich *et al.* 2013). All three tracked birds stopped on the north coast of Australia to refuel but only two flew on to New Zealand for the non-breeding season, the third stayed in the Gulf of Carpentaria (Tomkovich *et al.* 2013). However, Battley & Lisovski (2016) stated that "Clarifying just where the staging took place is proving difficult, as there is little difference in predicted light conditions between West Papua and northern Australia".

In the Hunter Estuary, Red Knot generally follow a tide-dependent, anticlockwise pattern of foraging and roosting. After roosting on Kooragang Dykes or Stockton Sandspit over the high-tide period, the birds may begin foraging at Stockton Sandspit as the tide falls, then progress via exposing sandflats up the North Arm of the Hunter River and into Fullerton Cove where vast mudflats become exposed at low tide (Figure 1). They forage in Fullerton Cove until the rising tide forces the birds to fly out and often continue to forage in tidal ponds, created by construction of the Kooragang Dykes. Intertidal flats in the ponds are the last areas in the estuary to be covered by the rising tide. From these ponds, the birds move to the Dykes or Stockton Sandspit to roost over the following high-tide period. This pattern is consistent through both spring and neap tides; however foraging opportunities in the ponds behind the dykes may not be available as the mudflats may not be exposed during neap low tide. Occasionally Red Knot forage and/or roost in saltmarsh ponds on Ash Island, approximately 4 km further upstream from Fullerton Cove. As the tide begins to fall, usually the entire Red Knot flock will be present at Stockton Sandspit, providing an excellent opportunity to scan for flags.

This study aimed to assess the importance of the Hunter Estuary for Red Knot, to understand their likely final destinations for the non-breeding season, and to explore the implications of flag sightings.

METHODS

Red Knot in the Hunter Estuary were observed over four non-breeding seasons (between September 2011 and November 2014), and searched for flagged or banded birds. Flocks were also counted over three non-breeding seasons (between September 2012 and November 2014) to try to understand population dynamics.

Birds roosting on Kooragang Dykes were observed using binoculars from a small boat (Figure 1). Kooragang Dykes is a rock training wall built in the 1960s as part of a proposal to infill tidal areas on Kooragang Island for industrial development. The reclamation never proceeded, and the dykes are now a critically important high-tide roost for shorebirds in the Hunter Estuary. Birds roosting and foraging on Stockton Sandspit were observed using a high definition 30x Swarovski telescope. Flagged birds, particularly those bearing ELFs, were photographed using a Canon 550D with a

400 mm lens. Most observations were made at Stockton Sandspit. At high tide, Red Knot roosted on either Kooragang Dykes or Stockton Sandspit. From their roost on Kooragang Dykes the birds flew to Stockton Sandspit as the tide began to fall to continue roosting or to begin foraging on exposing mudflats. With the entire flock of less than a thousand Red Knot usually viewable at each observation session, we were able to systematically search for flagged birds and be reasonably confident of observing all the flagged birds present. Flock counts were included in our assessment only when we were confident of counting the entire flock.

The duration of stay for each flagged bird was defined by the first and last observations, thereby giving a minimum period of time spent in the Hunter Estuary.

During each September and October birds were observed two to three times a week. Observation frequency was reduced to approximately twice weekly from November to December and then generally weekly until April (except for the 2014-2015 season when observations terminated at the end of November 2014). All flag sightings were reported to the Australasian Wader Studies Group (AWSG) and in return Heather Gibbs and subsequently Roger Standen (AWSG database managers) provided banding data. Adrian Riegen of the New Zealand Wader Studies Group (NZWSG) provided re-sighting histories of Red Knot flagged in New Zealand and Chris Hassell and Clare Morton (AWSG) provided re-sighting histories of those flagged in northwest Australia.

On two occasions, abdominal profiles of individual birds were scored from a distance of 25 to 50 metres using a telescope, following the method described in Wiersma & Piersma (1995). Abdominal profiles provide an indication of the fat stored in the bird. Scores ranged from 1/5 (very lean, with a more or less concave abdomen) through 3/5 (abdomen slightly convex) to 5/5 (abdomen bulging).

RESULTS

Population Trends

In the 1970s, maximum documented counts of Red Knot in the Hunter Estuary were 500 to 600 (van Gessel & Kendall 1972; D. Gosper Pers. Comm. 2002; W. Barden unpubl. data). Occasional counts of 1000 to 2000 have been recorded since 1985, but most regular monthly counts by the Hunter Bird Observers Club (HBOC) were less than 600 (Figure 2) (Herbert 2007; Stuart 1994-2013). During this study, our observations did not commence early enough to detect the earliest arrivals for 2011 and detailed counts were not carried out until the subsequent three non-breeding seasons.

2012–2013 non-breeding period: Earliest arrivals were recorded on 29 August 2012 (four Red Knot). Numbers built rapidly during the second half of September, then declined briefly before reaching a peak count of 416 in early October, then declined rapidly until December when less than 30 birds were present (Figure 3). The decline continued until mid-February 2013 when less than three birds were present. Unusually, two Red Knot continued to stay in the estuary for the entire 2013 breeding period (May to July).

013–2014 non-breeding period: Earliest arrival was recorded on 22 August 2013 when a Red Knot in partial breeding plumage joined the two birds that had spent the entire breeding period in the estuary. Numbers built steadily to a peak count of 680 in early October then declined rapidly to zero by mid-January 2014 (Figure 3).

2014–2015 non-breeding period: Earliest arrivals were four Red Knot recorded on 23 August 2014. Numbers built steadily to a peak count of 642 in early October then declined to 34 by 22 November 2014 when observations ceased (Figure 3).

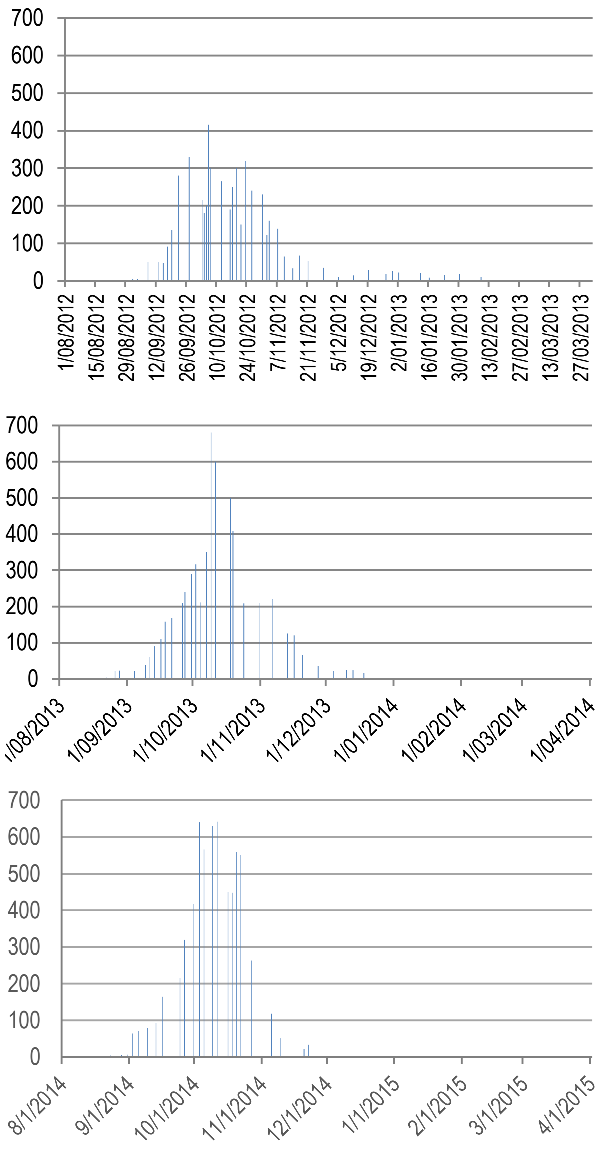

Figure 3. Red Knot counts in the Hunter Estuary from this study during southward migration in the 2012 to 2015 non-breeding seasons. Although there is a general increase in the counts of Red Knot arriving in the estuary from mid-September to mid-October, there is also a fluctuation in numbers, suggesting that birds are departing and arriving over this period. Observations of flagged Red Knot in Figure 4 suggest, in more detail, how waves of birds may arrive in and depart from the estuary.

During the above non-breeding periods, most of the buildup in numbers occurred during the last week in September and the first two weeks in October. Most birds departed the estuary by late November. However, the peak count which occurs in early October each year is often missed by the HBOC monthly shorebird counts which are usually conducted later, around the middle of the month. For reasons set out in the Discussion section we suggest that these single peak counts underestimate the total flux of Red Knot passing through the estuary.

Flag Observations

During this four-year study, the first arrival of *flagged or colour-banded* Red Knot in the Hunter Estuary was observed on 15 September 2011, 8 September 2012, 26 September 2013 and 28 August 2014. For each non-breeding season, the last date *flagged* Red Knot were seen in the estuary was 5 January 2012, 13 February 2013, 16 November 2013 and 22 November 2014. Although the majority of flagged birds passed through the estuary between mid-September and late October, there were some 'stragglers', which extended the 2012–2013 southward migration period to as late as February in 2013.

Observations of flagged Red Knot suggest that birds arrive in waves in the Hunter Estuary, with major influxes in late September and then in early October. Most flagged Red Knot that arrived in September departed or were departing by early October (Figures 4a, b, c, d) as a new wave of birds was arriving. This can also be seen by the fluctuating counts in Figure 3 during this period.

During the 2011–2012 non-breeding season 24 flagged Red Knot were observed, compared to 31 in 2012–2013, 34 in 2013–2014 and 34 in 2014–2015 (Table 2 and Figures 4a, b, c & d). The majority had been flagged in New Zealand and most of these were individually marked with white engraved leg flags

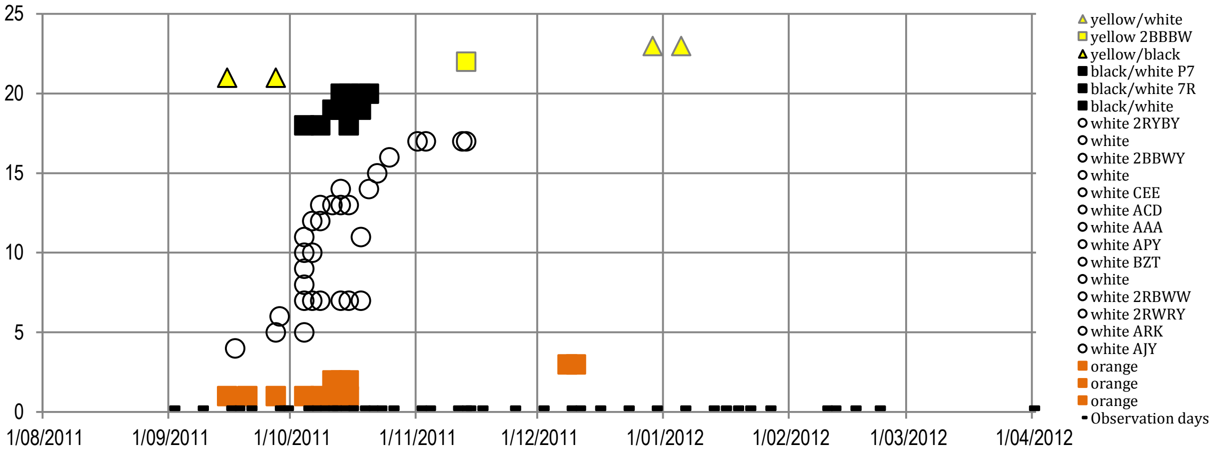

Figure 4a. Flagged Red Knot observed in the Hunter Estuary during southward migration in 2011–2012. Note that flagged birds arriving in late September are departing as new flagged birds arrive in early October.

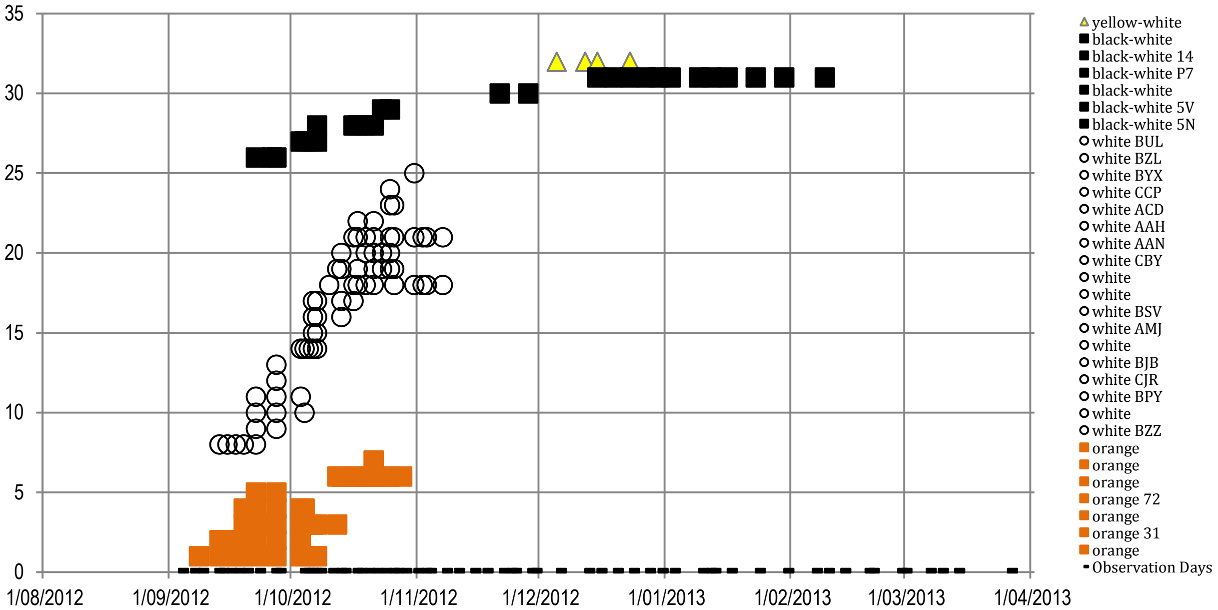

Figure 4b. Flagged Red Knot observed in the Hunter Estuary during southward migration in 2012–2013.

(ELFs). Red Knot flagged in Victoria with orange were the next most common flagged birds, followed by those flagged in Chongming Dao, China, with black-over-white flags. During the four observation years only four Red Knot flagged with yellow in Western Australia, two flagged with green in Queensland and one flagged with orange over yellow in South Australia were seen. Single Red Knot flagged in Kamchatka, Russia with yellow over black; in Sakhalin Island, Eastern Russia with yellow over white; in Chukotka, Eastern Siberia with lime green over white; and in Republic of Korea with white-over-orange flags were also seen (Table 2).

A total of 123 flagged birds was observed passing through the estuary from September 2011 to 2014 (Table 2). Of these, 52 were individually marked. Fourteen of those birds made repeat visits resulting in the total of 68 observations of individually marked birds in Table 2. Ten of these made repeat visits in consecutive years while repeat visits for the other four birds were two or four years apart (Table 3).

Re-sighting histories show that after departing the Hunter Estuary, 11 individually-marked Red Knot were subsequently observed in New Zealand (Tables 3 & 4). Two of these, white engraved AAA and AMJ, were

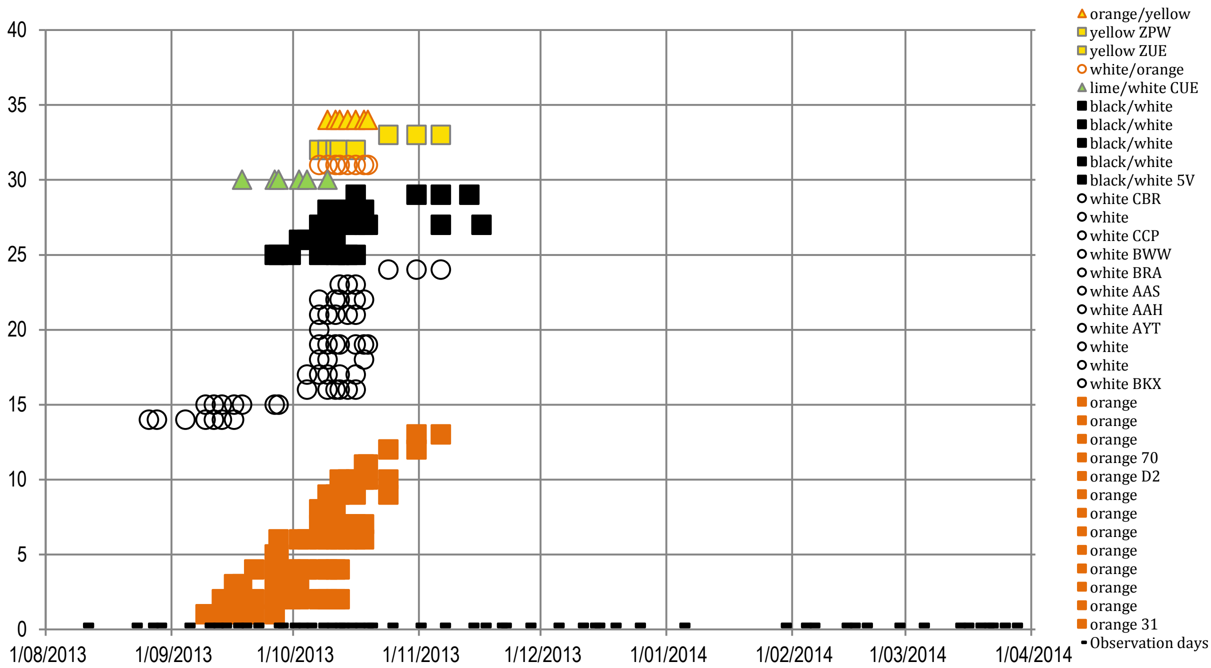

Figure 4c. Flagged Red Knot observed in the Hunter Estuary during southward migration in 2013–2014.

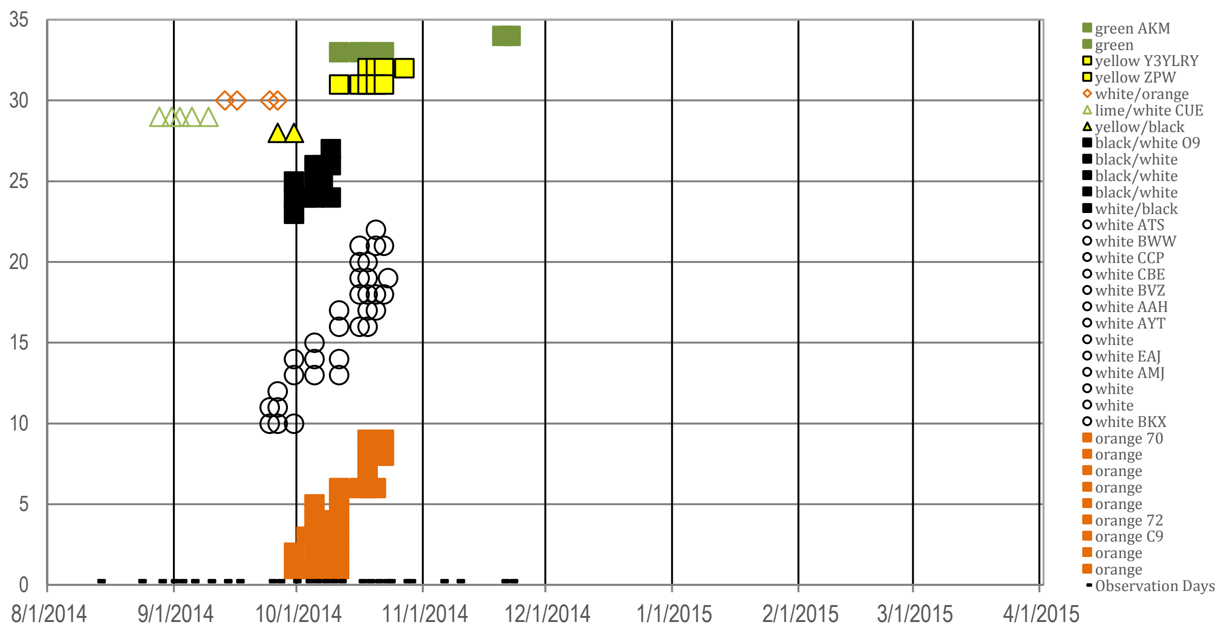

Figure 4d. Flagged Red Knot observed in the Hunter Estuary during southward migration in 2014–2015.

sighted in New Zealand only five and seven days respectively after last being seen in the Hunter Estuary (Table 4).

Red Knot flagged in Victoria are occasionally re-sighted in Victoria, with 70 re-sightings of orange engraved leg flags since 5 April 2013 (Joris Driessen Pers. Comm. March 2017, AWSG database manager). However, none of the orange engraved leg flags seen in the Hunter Estuary has been seen subsequently in Victoria.

Red Knot flagged in Chongming Dao with ELFs were caught in April or May, during northward migration and have been subsequently seen in the Hunter Estuary (Table 3). None of these flagged birds has ever been seen in Victoria (R. Standen Pers. Comm. 2014).

Several individually marked Red Knot seen in the Hunter Estuary have also been seen in Bohai Bay (Tables 3 & 4) while on northward migration. Flag searches and counts by the Global Flyway Network have established that Bohai Bay is a critically important staging area for Red Knot (Rogers *et al*. 2010, Hassell *et al*. 2012, 2013, 2014).

One Red Knot (white engraved BZT) has been sighted in the Gulf of Carpentaria on southward migration (Table 4).

Two Red Knot flagged in Western Australia prior to their first northward migration (yellow engraved WD and yellow engraved ZUE) relocated to New Zealand before their first northward migration (Table 4). One of these (WD) was recorded when it passed through the Hunter Estuary on its first flight to New Zealand from Western Australia.

Abdominal Profiles

Although we did not record abdominal profiles of arriving flagged Red Knot in 2012, we did assess abdominal profiles of the entire Red Knot flock on 2 November 2012, when 123 birds were present. Of these, 86 (70%) were assessed as being 4/5 fat and 37 as being 2/5 fat. In 2013 we recorded abdominal profiles on arrival for eleven flagged Red Knot; one was 1/5 fat; eight were 2/5 fat; and two were 3/5 fat.

Duration of Stay

Flagged Red Knot observed in the Hunter Estuary stayed for minimum periods of one to 31 days, although the majority stayed for less than two weeks (Figure 5). These observations were made at Stockton Sandspit where Red Knot came to roost and forage as the tide began to fall, on both neap and spring tides. There were no reports of Red Knot elsewhere in the estuary during these observation sessions.

DISCUSSION

Red Knot Population Trend and Duration of Stay

Red Knot begin to arrive in the Hunter Estuary in late August and there is a turnover in the population as birds depart while others arrive, resulting in changing counts during late September and early October (Figure 3). Most Red Knot have passed through the estuary by January; only small numbers remain into February. On occasions, large flocks of Red Knot (in excess of 1000 birds) have been recorded in the Hunter Estuary (Stuart 1997, 2002, 2007, 2012) (Figure 2).

Raw count data for the Hunter Estuary since the 1970s (Figure 2) shows large fluctuations in peak counts during September-October, ranging from 100 to 2000, with no clear trends over time. Most of those counts did not target the peak passage time through the estuary of late September and early October, as shown by our detailed study. For example, from the 1980s to the late 1990s summer counts were generally conducted in February when most Red Knot had departed the estuary months before. Only a few counts were made in October. Even the higher frequency monthly counts carried out by HBOC from 1999 to the present often missed the peak numbers of Red Knot as the counts were usually conducted around the middle of each month, immediately after the peak numbers occurred in the first two weeks of October. Therefore, most formal counts under-estimate the number of Red Knot using the estuary.

From detailed flock counts herein there appears to be a steady build up and decline (Figure 3) but observations of *flagged* Red Knot show that birds are arriving and departing quite separately or may overlap in time. This means that earlier arrived birds are departing as new birds arrive and that some birds may stay and overlap with newly arriving birds (Figures 4a, b, c & d). There appear to be two major influxes of Red Knot - the first in late September and the second in early October (Figures 4a, b, c & d). Overall, most *flagged* Red Knot spent less than two weeks in the estuary – 92% in 2011, 66% in 2012, 64% in 2013 and 94% in 2014 – it is assumed that the majority of the *unflagged* flock behave in a similar fashion. The nature of southward migration, with birds moving through in waves, means that a single peak count does not include the total flux of Red Knot passing through the estuary each year on southward migration. The opportunistic use of the Hunter Estuary also means that in some years, Red Knot flocks may be much larger (or smaller) than in other years.

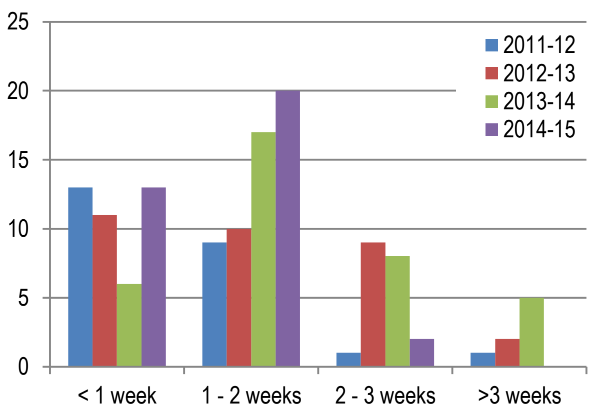

Figure 5. Minimum duration of stay for flagged Red Knot in the Hunter Estuary.

Table 2. Flagged Red Knot sightings in the Hunter Estuary

Banding Country	Banding Season	2011–2012 Total Flags	2011–2012 ELFs* & colour bands	2012–2013 Total Flags	2012–2013 ELFs	2013–2014 Total Flags	2013–2014 ELFs	2014–2015 Total Flags	2014–2015 ELFs* & colour bands	Total Flags	Total ELFs & colour bands
New Zealand	Non-breeding	15	11	17	15	11	8	13	10	56	44
Victoria	Non-breeding	3	0	7	2	13	3	9	3	32	8
N Western Australia	Over-wintering & Non-breeding	1	1			2	2	2	2	5	5
South Australia	Non-breeding					1				1	0
Queensland	Non-breeding							2	1	2	1
Chongming Dao, China	Northward migration	3	2	6	4	5	1	5	1	19	8
Republic of Korea	Migration (direction unknown)					1		1		2	0
Chukotka, Siberia	Breeding ground					1	1	1	1	2	2
Sakhalin Island, E. Russia	Migration (direction unknown)	1		1						2	0
Kamchatka,E. Russia	Migration (direction unknown)	1						1		2	0
Totals		**24**	**14**	**31**	**21**	**34**	**15**	**34**	**18**	**123**	**68**

Note: *ELFs are engraved leg flags - engraved with alphanumeric characters.

Table 3. Red Knot that have made repeat visits to the Hunter Estuary

Engraved Leg Flag (ELF)	Date, Location & Age when banded	Location observed	Dates observed	Migration phase
Orange 31	12/01/2011	Hunter Estuary, NSW	13/09/2012 - 3/10/2012	Southward
	Corner Inlet, Vic	Bohai Bay, China	30/04/2013 - 3/05/2013	Northward
	Aged 1	Hunter Estuary, NSW	9/09/2013 - 26/09/2013	Southward
		Farewell Spit, NZ	16/02/2014	Non-Breeding Period
Orange 70	6/05/2012	Manukau, NZ	21/02/2013	Non-Breeding Period
	Westernport, Vic	Hunter Estuary, NSW	12/10/2013 - 24/10/2013	Southward
	Aged 1	Manukau, NZ	2/01/2014 - 22/03/2014	Non-Breeding Period
		Hunter Estuary, NSW	18/10/2014 - 22/10/2014	Southward
		Manukau, NZ	26/01/2015	Non-Breeding Period
Orange 72	6/05/2012	Hunter Estuary, NSW	19/09/2012 - 4/10/2012	Southward
	Westernport, Vic, Aged 1	Hunter Estuary, NSW	5/10/2014 - 11/10/2014	Southward
Yellow ZPW	19/09/2011	Kaipara Harbour, NZ	17/12/2011 - 11/01/2012	Non-Breeding Period
	Roebuck Bay, Broome, WA	Kaipara Harbour, NZ	9/12/2012 - 29/03/2013	Non-Breeding Period
	Aged 3+	Bohai Bay, China	30/05/2013	Northward
		Hunter Estuary, NSW	24/10/2013 - 6/11/2013	Southward
		Bohai Bay, China	16/05/2014	Northward
		Hunter Estuary, NSW	11/10/2014 - 22/10/2014	Southward
White AAH	25/11/2006	Hunter Estuary, NSW	13/10/2012 - 25/10/2012	Southward
	Miranda, NZ	Hunter Estuary, NSW	7/10/2013 - 18/10/2013	Southward
	Aged 3+	Hunter Estuary, NSW	11/10/2014 - 20/10/2014	Southward
White ACD	22/10/2005	Hunter Estuary, NSW	2/10/2009	Southward
	Miranda, NZ, Aged 3+	Hunter Estuary, NSW	6/10/2011 - 8/10/2011	Southward
White AMJ	22/10/2005	Hunter Estuary, NSW	3/10/2012 - 7/10/2012	Southward
	Miranda, NZ, Aged 3+	Miranda, NZ	14/10/2012	Southward
		Bohai Bay, China	18/05/2013	Northward
		Hunter Estuary, NSW	30/09/2014 - 11/10/2014	Southward
White ARK	25/11/2006	Hunter Estuary, NSW	28/09/2007	Southward
	Miranda, NZ	Miranda, NZ	15/12/2007	Non-Breeding Period
	Aged 3+	Miranda, NZ	26/02/2011	Non-Breeding Period
		Hunter Estuary, NSW	27/09/2011 - 4/10/2011	Southward
White AYT	25/11/2006	Hunter Estuary, NSW	4/10/2013 – 16/10/2013	Southward
	Miranda, NZ, Aged 3	Hunter Estuary, NSW	11/10/2014 – 18/10/2014	Southward
White BKX	18/10/2008	Hunter Estuary, NSW	26/08/2013 – 16/09/2013	Southward
	Miranda, NZ	Bohai Bay, China	15/04/2014	Northward
	Aged 2	Hunter Estuary, NSW	24/09/2014 – 30/09/2014	Southward
White BWW	9/07/2011	Hunter Estuary, NSW	7/10/2013 – 16/10/2013	Southward
	Miranda, NZ	Hunter Estuary, NSW	16/10/2014 – 22/10/2014	Southward
White CCP	14/03/2009	Hunter Estuary, NSW	17/10/2012 - 21/10/2012	Southward
	Miranda, NZ	Hunter Estuary, NSW	7/10/2013 - 18/10/2013	Southward
	Aged 3+	Hunter Estuary, NSW	16/10/2014 – 18/10/2014	Southward
Black/white	15/05/2006	Miranda, NZ	23/01/2007 - 16/02/2007	Non-Breeding Period
P7	Chongming Dao, China	Hunter Estuary, NSW	13/10/2011 - 20/10/2011	Southward
		Hunter Estuary, NSW	23/10/2012 - 25/10/2012	Southward
		Miranda, NZ	26/01/2013	Non-Breeding Period
Black/white	13/05/2010	Hunter Estuary, NSW	3/10/2012 - 7/10/2012	Southward
5V	Chongming Dao, China	Hunter Estuary, NSW	26/09/2013 - 16/10/2013	Southward

Table 4. Re-sighting histories of flagged Red Knot seen once in the Hunter Estuary

Flag & Band No.	Date banded, Location banded, Age when banded	Location observed	Dates observed	Migration phase
Yellow 2BBBL*	7/06/2009	Auckland, NZ	30/10/2009	Non-Breeding Period
05254360	Broome, WA, Aged 2	Nan Pu, Bohai Bay, China	27/04/2011	Northward
		Hunter Estuary, NSW	13/11/2011	Southward
		Kaipara Harbour, NZ	22/03/2012	Non-Breeding Period
Yellow WD	3/07/2010	Hunter Estuary, NSW	17/09/2010 - 30/09/2010	Southward
05265252	Broome, WA, Aged 1	Foxton Estuary, NZ	10/10/2010	Non-Breeding Period
		Nan Pu, Bohai Bay, China	22/04/2012 - 4/05/2013	Northward
Yellow ZPW	19/02/2011	Kaipara Harbour, NZ	17/12/2011 - 11/01/2012	Non-Breeding Period
05268211	Broome, WA, Aged 3+	Kaipara Harbour, NZ	9/12/2012 - 29/03/2013	Non-Breeding Period
		Bohai Bay, China	30/05/2013	Northward
		Hunter Estuary, NSW	24/10/2013 - 6/11/2013	Southward
Yellow ZUE	28/08/2011	Broome, WA	13/09/2011	Southward
05267829	Broome, WA, Aged 2	Karaka, NZ	27/12/2011 - 12/02/2012	Non-Breeding Period
		Karaka, NZ	16/12/2012 - 27/01/2013	Non-Breeding Period
		Hunter Estuary, NSW	7/10/2013 - 16/10/2013	Southward
		Karaka, NZ	15/12/2013 - 16/02/2014	Non-Breeding Period
White AAA	25/11/2006	Nan Pu, Bohai Bay, China	13/05/2011	Northward
C78125	Miranda, NZ, Aged 3+	Hunter Estuary, NSW	4/10/2011 - 18/10/2011	Southward
		Miranda, NZ	23/10/2011	Non-Breeding Period
White AMJ	22/10/2005	Kaipara Harbour, NZ	4/12/2010	Non-Breeding Period
C74720	Miranda, NZ, Aged 3+	Kaipara Harbour, NZ	25/03/2012 - 26/03/2012	Non-Breeding Period
		Hunter Estuary, NSW	3/10/2012 - 7/10/2012	Southward
		Miranda, NZ	14/10/2012	Non-Breeding Period
White APY	22/10/2005	Nan Pu, Bohai Bay, China	2/05/2011	Northward
C74576	Miranda, NZ, Aged 3+	Hunter Estuary, NSW	4/10/0211 - 6/10/2011	Southward
White BZT	21/11/2009	Karaka, NZ	7/02/2010 - 4/03/2010	Non-Breeding Period
C87266	Miranda, NZ, Aged 3+	Karaka, NZ	27/12/2010 - 12/02/2011	Non-Breeding Period
		Nan Pu, Bohai Bay, China	15/05/2011	Northward
		Hunter Estuary, NSW	4/10/2011	Southward
		Karaka, NZ	31/10/2011	Non-Breeding Period
		Karumba, Gulf of Carpentaria, Qld	28/09/2012	Southward
Lime/white CUE	7/07/2012	S. Chukotka, Russia	13/07/2012	Breeding ground
MOSKVA HS009614	S. Chukotka, Russia	Hunter Estuary, NSW	18/09/2013 - 9/10/2013	Southward
	Aged 4 days	Karaka, NZ	24/03/2014	Non-Breeding Period

Note: * The colour-banding abbreviation starts with the flag position (1= upper left leg; 2=upper right leg; 3= lower left leg; 4=lower right leg); then the colour bands are described starting with the left leg. For Yellow 2BBBL, the yellow flag is on the upper right leg with blue over blue bands on the left leg and blue over lime bands on the right leg.

From detailed flock counts herein there appears to be a steady build up and decline (Figure 3) but observations of *flagged* Red Knot show that birds are arriving and departing quite separately or may overlap in time. This means that earlier arrived birds are departing as new birds arrive and that some birds may stay and overlap with newly arriving birds (Figures 4a, b, c & d). There appear to be two major influxes of Red Knot - the first in late September and the second in early October (Figures 4a, b, c & d). Overall, most *flagged* Red Knot spent less than two weeks in the estuary – 92% in 2011, 66% in 2012, 64% in 2013 and 94% in 2014 – it is assumed that the majority of the *unflagged* flock behave in a similar fashion. The nature of southward migration, with birds moving through in waves, means that a single peak count does not include the total flux of Red Knot passing through the estuary each year on southward migration. The opportunistic use of the Hunter Estuary also means that in some years, Red Knot flocks may be much larger (or smaller) than in other years.

Rogers *et al.* (2010) provided revised estimates of Red Knot numbers at the main non-breeding sites in Australia and New Zealand, based on the most recent count data then available. They estimated a total population of 104 986 Red Knot, of which 63 059 occurred in Australia and 41 927 in New Zealand. It is interesting to note that 23 657 occurred in the south-eastern Gulf of Carpentaria, 23 123 on Eighty Mile Beach in Western Australia, 2131 at Roebuck Bay in Western Australia and only 894 at Corner and Shallow Inlets, Victoria.

As Red Knot passing through the Hunter Estuary are destined for Victoria (894) and New Zealand (41 927), they are part of a total population of 42 821 birds (i.e. 894 plus 41 927) (Rogers *et al.* 2010). Thus, the maximum counts of 1000 to 2000 Red Knot recorded in the Hunter Estuary (Table 1) represent 2.3 to 4.6% of the southeast Australian and New Zealand population of Red Knot.

Southward Migration Route

Red Knot in the East Asian-Australasian Flyway (EAAF) depart their breeding grounds in Chukotka, eastern Siberia (*C. c. rogersi*) during July and August (Tomkovich *et al.* 2013). Tracking, using geolocators, of three adult males from Chukotka showed that on southward migration they stopped in the Sea of Okhotsk and then the Yellow Sea before making a long flight south to the Gulf of Carpentaria where they again stopped to replenish fat stores before two of the three made their final flight to New Zealand (the third stayed in the Gulf for the entire non-breeding period) (Tomkovich *et al.* 2013). Battley & Lisovski (2016) stated that Papua / Northern Australia is an important staging site on southward migration. This implies that perhaps most Red Knots from Chukotka follow this course, even those heading for Victoria rather than New Zealand.

Our flag observations show that the Hunter Estuary is also used by Red Knot on southward migration when heading for New Zealand. But, as there is a relatively low demonstration of site faithfulness with only 27% of individually marked birds (14 out of 52 between 2011/12 and 2014/15) making repeat visits to the Hunter Estuary, it seems likely that the Hunter Estuary is an opportunistic stopover and/or staging site. The estuary is located approximately half way between the Gulf of Carpentaria and New Zealand, thus providing a stopover for those birds that wish to break their journey into two shorter 2000 km flights rather than one long 4000 km flight (Table 5). Also, a direct flight from the Gulf of Carpentaria to New Zealand would initially encounter strong headwinds (southeast trade winds) until south of the latitude of Brisbane (British Admiralty 2014). An overland flight from the Gulf of Carpentaria to the Hunter Estuary would avoid the strong south-easterlies and then provide an opportunity to await a favourable wind for the flight across the Tasman Sea to New Zealand. It is also possible that Red Knot with sufficient fat reserves could fly direct from Bohai Bay to the Hunter Estuary, bypassing the northern coast of Australia. This is a comparable distance to that flown by Red Knot on northward migration from New Zealand to the Yellow Sea, which is known to be accomplished in a single direct flight (Tomkovich *et al.* 2013).

Although none of the Red Knot with Victorian orange engraved leg flags seen in the Hunter Estuary has been sighted in Victoria, this may be partly due to the frequency of re-sighting efforts. However, it is likely that those birds observed in the Hunter Estuary with orange flags are, in fact, destined for New Zealand where they are often recorded (Table 3). In addition, Red Knot flying from the Gulf of Carpentaria to Victoria may gain little advantage from a stopover in the Hunter Estuary as they would have to divert from the more direct great circle route, thereby considerably extending their total flying distance (Table 5). Victoria is the final destination for only about 1000 Red Knot, with, on average, 56.7% of them being first-year juveniles (Minton *et al.* 2012). Thus, although there is no direct evidence that birds destined for Victoria pass through the Hunter Estuary it is still possible that a proportion of un-flagged mature and first-year immature Red Knot may use the estuary on southward migration to Victoria.

The almost complete absence of white NZ-flagged Red Knot sightings in Victoria (A. Riegen & R. Standen Pers. Comm. 2014) indicates that the Hunter Estuary is possibly the southern-most significant staging site for these Red Knot in southeastern Australia before they make their final southward migration flight to New Zealand. The two waves of Red Knot arrivals in the estuary (Figures 4a, b, c & d) could indicate that the first September arrivals may have made a direct flight from the Yellow Sea to the Hunter either with no intermediate stopover, or only a very short stopover, perhaps in the Gulf of Carpentaria. The second wave of arrivals in October may indicate Red Knot that spent several weeks staging in the Gulf of Carpentaria before proceeding to the Hunter. The New Zealand sighting of white ELFs AAA and AMJ, five and seven days respectively after they were last seen in the Hunter Estuary, strongly suggests that these birds flew directly across the Tasman Sea to New Zealand and did not go via Victoria (Table 4).

It is possible that some Victorian-flagged birds passing through the estuary may be returning to Victoria for the non-breeding period; however, the absence of engraved leg flag re-sightings in Victoria to date suggests this is not the case. As suggested above, most of these birds are probably *en route* to New Zealand and flying directly across the Tasman Sea from the Hunter Estuary. Band recoveries and flag sightings sent to AWSG have established that many of the Red Knot that spend their first year in south-east Australia migrate to New Zealand in their second year and from then on become New Zealand 'citizens', migrating from and returning to New Zealand (Riegen 1999, Minton *et al.* 2011), some of them via the Hunter Estuary as our observations indicate.

Table 5. Great Circle Route distances and estimated flight times for Red Knot on southward migration.

Great Circle From	Route To	Distance (km)	Time to fly at 50 kph	
Bohai Bay, Yellow Sea	Gulf of Carpentaria[1]	6700 km	134 h	5.6 days
Bohai Bay, Yellow Sea	Hunter Estuary	8704 km	174 h	7.2 days
Bohai Bay, Yellow Sea	Corner Inlet, Victoria	9110 km	182 h	7.6 days
Bohai Bay, Yellow Sea	North Is, New Zealand	10 250 km	205 h	8.5 days
Gulf of Carpentaria	Hunter Estuary	2037 km	41 h	1.7 days
Gulf of Carpentaria	North Is, New Zealand	3948 km	79 h	3.3 days
Gulf of Carpentaria	Corner Inlet, Victoria	2370 km	47 h	2 days
Gulf of Carpentaria	Corner Inlet, Victoria via Hunter Estuary	2855 km	57h	2.4 days
Roebuck Bay, WA	Hunter Estuary	3333 km	67 h	2.8 days
Hunter Estuary	Corner Inlet, Victoria	818 km	16 h	0.7 days
Hunter Estuary	North Is, New Zealand	2148 km	43 h	1.8 days

Note: [1] All three adult male Red Knot, tracked with geolocators from Chukotka in Eastern Siberia, flew direct to the Gulf of Carpentaria from the Yellow Sea. Two staged there before flying on to New Zealand. The third bird stayed in the Gulf of Carpentaria for the entire non-breeding period (Tomkovich *et al.* 2013).

However, as can be seen from Tables 3 & 4**,** many of both the Victorian and New Zealand-flagged Red Knot, after having been last seen in the Hunter Estuary in September or October, have been first seen subsequently in New Zealand as late as January, February and even March – a gap of several months! As there are several dedicated flag observers in New Zealand, this suggests that those birds were not detected in New Zealand because they may have staged in Victoria after leaving the Hunter Estuary, before proceeding to New Zealand later in the non-breeding season. Alternatively, if the birds had actually flown direct from the Hunter to New Zealand they may have arrived in less monitored parts of New Zealand before they were detected in the more intensely surveyed parts of the North Island later. Also, it is not clear whether the lack of flagged Red Knot sightings in Victoria is a result of the lack of observations or the absence of the birds. More definitive observations from Victoria may help to resolve some of the speculations outlined above.

Data generated in recent years has shown that some juvenile Red Knot marked in northwest Australia in the June to August period have subsequently been sighted in New Zealand (Minton *et al.* 2011). Those northwest Australian-flagged birds, as for Victorian-flagged birds, then migrate to and from New Zealand having adopted New Zealand as their final non-breeding destination. Although the Hunter Estuary is directly on the great circle route from 80 Mile Beach / Roebuck Bay in northwest Australia to New Zealand, to date only one northwest Australian-flagged Red Knot has been seen on its first flight from northwest Australia to New Zealand (yellow engraved WD - Table 4). The other three northwest Australian-flagged birds seen in the estuary have appeared during southward migration after having been recorded previously in Bohai Bay on northward migration from New Zealand (Table 4). This suggests that the northwest Australian-flagged Red Knot may sometimes use the Hunter Estuary on their first flight to New Zealand from northwest Australia, and sometimes use the Hunter as a brief stopover during subsequent southward migration. In addition, the three northwest Australian-flagged birds that have been seen in the estuary on southward migration arrived with the second October influx (one bird) or much later (two birds, Figures 4a & 4c) indicating that they may have staged on southward migration, perhaps in the Gulf of Carpentaria. These birds were more than four years old when they passed through the Hunter Estuary.

A Red Knot flagged (lime/white CUE) as a chick on the Chukotka breeding grounds in July 2012 arrived in the Hunter Estuary in September 2013, aged 14 months. It had not been seen since it left the breeding grounds (Pavel Tomkovich Pers. Comm. 2013) and may well have spent the previous non-breeding season in the Gulf of Carpentaria. The father of this bird was one of three tracked using geolocators from July 2011 to June 2012 (No. 179 in Tomkovich *et al.* 2013), and it had spent the 2011/12 non-breeding season in New Zealand after staging in the Gulf of Carpentaria. We expected that the chick might follow in its father's footsteps and after departing the Hunter Estuary would turn up in New Zealand. Indeed, it was subsequently sighted in New Zealand in March 2014 (Tony Habraken Pers. Comm. 2014), in company with a flock of Red Knot preparing to depart on its first northward migration.

Site Fidelity

Although many shorebirds are renowned for their site fidelity, Red Knot passing through the Hunter Estuary appear to be using the site opportunistically as only 14 out of 52 different individually-marked Red Knot observed over four non-breeding periods have made repeat visits and for two of these birds, the visits were more than two years apart, showing that they were not obligate estuary-users. The fact that most of the *flagged* Red Knot passing through the estuary are different each year suggests that the *total* population passing through the estuary may also have a large proportion of different birds each year.

Northward Migration

Red Knot have not been observed passing through the Hunter Estuary on northward migration. This is consistent with the conclusions of Tomkovich *et al.* (2013) that Red Knot accomplish their flight from New Zealand to the Yellow Sea in a single direct flight.

Stopover versus Staging Site

Abdominal profiles on flagged Red Knot *arriving* in the Hunter Estuary provide clues about the length of their previous flight. Birds with abdominal profiles ranging from 1/5 to 3/5, with most at 2/5, have been observed arriving in the estuary, suggesting that some may have flown direct to the Hunter Estuary from the Yellow Sea while others, with abdominal profiles greater than 3/5, may have staged in the Gulf of Carpentaria for varying lengths of time before continuing on to the Hunter Estuary.

Red Knot using the Hunter as a *stopover* may not change their abdominal profiles significantly before flying on, but we would expect those using the estuary as a *staging* site to increase their abdominal profiles by refueling prior to departure. In early November 2012, two to three weeks after the second wave of arrivals in the Hunter Estuary, 70% of the declining population of Red Knot had abdominal profiles of 4/5, indicating substantial refuelling, presumably for the flight across the Tasman Sea to New Zealand.

CONCLUSIONS

The Hunter Estuary can be considered internationally important as both a stopover and staging site for Red Knot as about 2.3 to 4.6% of the southeast Australia and New Zealand population have been observed to transit the estuary during southward migration. The Hunter Estuary is approximately half way between the Gulf of Carpentaria and New Zealand, making it a viable choice as a stopover or staging site for those Red Knot determined to avoid flying against the southeast trade winds *en route* to New Zealand.

There is evidence for at least two influxes (late September and early October) of Red Knot coming to the estuary during southward migration with additional minor influxes and departures. The second influx indicates that delayed arrivals may be caused by a period of staging, perhaps in the Gulf of Carpentaria, *en route* to the Hunter Estuary. Red Knot have not been recorded using the Hunter Estuary on northward migration. The majority of individual *flagged* Red Knot spent less than two weeks in the estuary and it is assumed that this applies also to individuals in the unflagged population.

Observation of flagged Red Knot in New Zealand within a week of their last sighting in the Hunter Estuary lends support to the idea that most Red Knot that visit the Hunter Estuary fly directly across the Tasman Sea to New Zealand on the final leg of their southward migration.

Based on Warnock's (2010) definitions, the Hunter Estuary can be regarded as both a stopover and staging site for Red Knot. Those birds which stay for less than a week and do not change their abdominal profile significantly are using the estuary as a stopover site while those birds which stay for longer and build up their fat reserves, possibly to as much as 4/5 prior to flying across the Tasman Sea to New Zealand, are using the estuary as a staging site.

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AVIAN FAUNA OF KADALUNDI-VALLIKKUNNNU COMMUNITY RESERVE, WEST COAST OF INDIA

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Kadalundi-Vallikkunnu Community Reserve (KVCR) is the first "Community Reserve" in Kerala, India. It is a wintering ground and stop-over site for transcontinental migrant shorebirds in the west coast of India (Aarif *et al*., 2011b). To assess the conservation significance of this reserve, surveys were undertaken over 11 years. Of the 106 bird species recorded, there were 49 winter visitors, 35 residents, 14 local migrants and eight vagrants. Three species recorded merit a globally significant conservation rating – two Endangered, one Vulnerable, with seven Near Threatened**.** Based on the diversity, abundance and species of conservation significance it supports, the reserve merits a significant conservation rating.

INTRODUCTION

KVCR has been officially declared as South India's first community reserve (Aarif & Prasadan, 2015) after considering many factors including the diverse avifauna and strong livelihood dependency of locals. The wetland is owned by two villages *viz.,* Kadalundi and Vallikkunnu. The community reserve is composed of eight hectares of mudflats and small patches of mangrove forests & sand beaches. During the post monsoon season (October to January), density of waders may go up to between 200-500 birds ha^{-1} (Aarif *et al.,* 2011b). Lesser Sand Plover *Charadrius mongolus*, Whimbrel *Numenius phaeopus*, Common Redshank *Tringa totanus* and Pallas's Gull *Larus ichthyaetus* (Aarif *et al.,* 2011a) were reported to over-summer in KVCR (Kurup, 1991; Aarif *et al.,* 2001b). The high dependency of locals on wetland for their livelihood sustenance has resulted in over exploitation of the wetland, with tremendous pressure on the associated wetland fauna and flora. Because of indiscriminate sand-mining, uncontrolled fishing, occasional hunting, threats from foxes *Vulpes vulpes* and domestic dogs *Canis familiaris* on shorebirds (Aarif & Prasadan, 2014), and human encroachment for developmental activities (construction of bridges and roads) this unique wetland became more vulnerable. Studies pertaining to wetland and/or associated birds of KVCR are meagre, however, through intensive study Kurup (1991) assessed the population status and habitat use of migratory and resident waterbirds. After a lapse of several years, we have been monitoring the abundance and diversity of birds in this reserve since 2005. There is a dearth of information on the diversity and species richness of birds of this important wetland. Hence, this compilation was initiated based on primary and secondary observations.

METHODS

The present study followed total count method (Hoves & Bakewell, 1989) for counting waterbirds. The study was carried out from January 2005 to December 2015. Birds were surveyed once in a week during low tide from 6.00 am to 12 noon. The area was surveyed from two scanning points (mudflats and mangroves). In the study, a sand beach - around 2 km away from the reserve-was also surveyed.

Observations were made with a 10 x 50 Nikon binocular and a Spotting Scope. For accurate counting of shorebirds a Sony CX 130 E video camera was used. The check list was prepared by compiling primary (2005-2015) data with the support of secondary data (Kurup 1991). The current IUCN status of each species was obtained from IUCN red list 2012 (Birdlife International, 2011). Manakadan & Pittee (2000) nomenclature of birds was followed throughout the text.

Study Area

Kadalundi River is one of the 41 west flowing rivers of Kerala; 20 of them drain directly into the Arabian Sea forming estuaries, while the rest empty into backwaters. The Kadalundi River forms the wetland and estuary. This

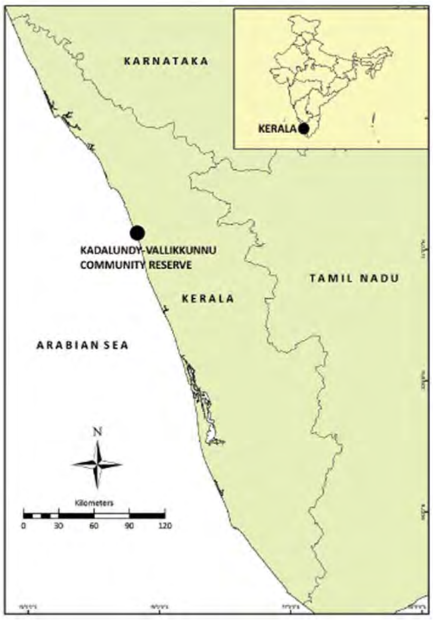

Figure 1. Map of study area

wetland is located in Tirur Taluk and comes under the Vallikkunnu Panchayat (14º 49' 36" & 11º 8' 28" N and 75º 49' 36" & 75º 51' 20" E) (Figure 1). The community reserve possesses four habitat types: mudflats, mangroves, sand beaches and shallow water. The sand beaches are located approximately 1.5 km away from the KVCR. The sand beach is an important alternate foraging ground for shorebirds, gulls and terns during high and low tides. The Northern border of the sand beaches is a boat landing site and the southern border is a Panchayath road. Local fishermen live in settlements adjacent to the sampling area. Two railway over-bridges intersect the estuary, one each over the eastern and western sides of the mudflats. On the western side of the railway track, about eight hectares of mudflats get exposed during low tide and serve as an important foraging ground for several thousand wintering migrant shorebirds.

RESULTS

Altogether 106 species of birds belonging to 29 families and 14 orders were recorded (Table 1). Among them 49 species were winter visitors, 35 residents & local migrants, 14 local migrants and eight species were stragglers. IUCN listed threatened species recorded from the study area comprised: Black-bellied Tern (Endangered), Great Knot (Endangered), and Eurasian Oystercatcher (Vulnerable). A further seven species merit a Near Threatened status: Curlew Sandpiper, Bar-tailed Godwit, Black-tailed Godwit, Eurasian Curlew, River Tern, Oriental Darter and Oriental White Ibis.

The most dominant species among shorebirds is the Lesser Sand Plover (Table 2). The presented data clearly pointed out the significant declining trend of Lesser Sand Plovers across the years, however, certain other species like Greater Sand Plovers showed fluctuations in population. The Common Greenshank and Whimbrel showed a slight increasing trend over the years and such increasing trends are predominantly noticed at Sand beaches (Table 2, Figure 2).

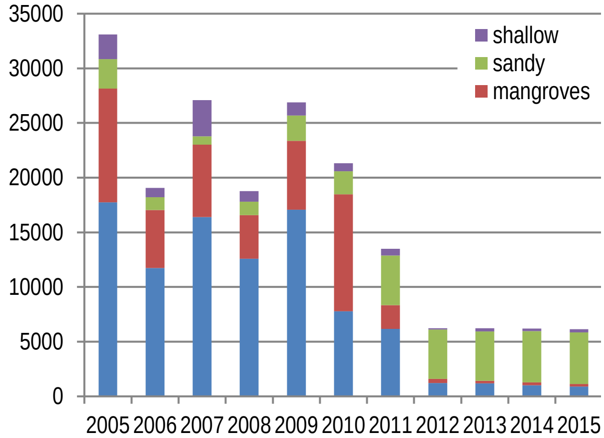

Figure 2. Summary of habitat usage by shorebirds in KVCR 2005 to 2015.

Table 1: List of birds recorded from the Kadalundi-Vallikkunnu Community Reserve (MF=Mudflat; MG=Mangrove; SW=Shallow water; SB=Sand beach)

Common name	Scientific Name	IUCN Status	MF	MG	SW	SB	Local Status in KVCR
Little Grebe	*Tachybaptus ruficollis*	LC	N	Y	N	N	R/LM
Red-billed Tropicbird	*Phaethon aethereus*	LC	N	Y	N	N	S
Masked Booby	*Sula dactylatra*	LC	N	N	N	Y	S
Little Cormorant	*Phalacrocorax niger*	LC	N	Y	Y	N	R/LM
Large Cormorant	*Phalacrocorax carbo*	LC	N	Y	Y	N	R/LM
Oriental Darter	*Anhinga melanogaster*	NT	N	N	Y	N	LM
Lesser Frigate bird	*Fregata ariel*	LC	N	Y	N	N	S
Little Egret	*Egretta garzetta*	LC	Y	Y	Y	Y	LM
Western Reef Egret	*Egretta gularis*	LC	Y	Y	Y	Y	LM
Grey Heron	*Ardea cinerea*	LC	Y	Y	Y	Y	LM
Purple Heron	*Ardea purpurea*	LC	N	N	Y	N	LM
Great Egret	*Ardea alba*	LC	Y	Y	Y	Y	LM
Median Egret	*Mesophoyx intermedia*	LC	Y	Y	Y	Y	LM
Cattle Egret	*Bubulcus ibis*	LC	N	Y	N	N	LM
Indian Pond Heron	*Ardeola grayii*	LC	Y	Y	Y	Y	LM
Little Green Heron	*Butorides striatus chloriceps*	LC	N	Y	N	N	R/LM
Black-crowned Night-Heron	*Nycticorax nycticorax*	LC	N	Y	N	N	R/LM
Yellow Bittern	*Ixobrychus sinensis*	LC	N	Y	N	N	R/LM
Chestnut Bittern	*Ixobrychus cinnamomeus*	LC	N	Y	N	N	R/LM
Black Bittern	*Dupetor flavicollis*	LC	N	Y	N	N	R/LM
Asian Openbill Stork	*Anastomus oscitans*	LC	Y	Y	Y	N	LM
Black Stork	*Ciconia nigra*	LC	Y	N	Y	N	LM
Glossy Ibis	*Plegadis falcinellus*	LC	N	N	Y	N	WV
Oriental White Ibis	*Threskiornis melanocephalus*	NT	Y	Y	Y	N	LM
Bar-headed Goose	*Anser indicus*	LC	Y	Y	N	N	S
Eurasian Spoonbill	*Platalea leucorodia*	LC	N	N	Y	N	R/ LM
Northern Shoveller	*Spatulas clypeata*	LC	N	N	Y	N	WV
Lesser Whistling-Duck	*Dendrocygna javanica*	LC	N	N	Y	N	R/LM
Cotton Pygmy-goose	*Nettapuscoro mandelianus*	LC	N	N	Y	N	WV

Table 1: Continued.

Common name	Scientific Name	IUCN Status	MF	MG	SW	SB	Local Status in KVCR
Black Kite	*Milvus migrans*	LC	Y	Y	Y	Y	LM
Brahminy Kite	*Haliastur indus*	LC	Y	Y	Y	Y	R/LM
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	LC	N	N	N	Y	LM
Western Marsh-harrier	*Circus aeroginosus*	LC	N	Y	N	N	WV
Shikra	*Accipiter badius*	LC	N	Y	N	N	R/LM
White-breasted Waterhen	*Amaurornis phoenicurus*	LC	Y	Y	N	N	R/LM
Purple Swamphen	*Porphyrio porphyrio*	LC	N	Y	N	N	R/LM
Common Coot	*Fulica atra*	LC	N	N	Y	N	WV
Pheasant-tailed Jacana	*Hydrophasianus chirurgus*	LC	N	Y	N	N	R/LM
Bronze-winged Jacana	*Metopidius indicus*	LC	N	Y	N	N	R/LM
Eurasian Oystercatcher	*Haematopus ostralegus*	VU	Y	N	N	Y	WV
Pacific Golden Plover	*Pluvialis fulva*	LC	Y	Y	N	Y	WV
Grey Plover	*Pluvialis squatarola*	LC	Y	Y	N	Y	WV
Little Ringed Plover	*Charadrius dubius*	LC	Y	Y	N	N	R/LM
Kentish Plover	*Charadrius alexandrines*	LC	Y	Y	Y	Y	WV
Lesser Sand Plover	*Charadrius mongolus*	LC	Y	Y	Y	Y	WV
Greater Sand Plover	*Charadrius leschenaultia*	LC	Y	Y	Y	Y	WV
Yellow-wattled Lapwing	*Vanellus malabaricus*	LC	N	Y	N	N	R/LM
Common Snipe	*Gallinago gallinago*	LC	N	Y	N	N	WV
Black-tailed Godwit	*Limosa limosa*	NT	N	Y	Y	Y	WV
Bar-tailed Godwit	*Limosa lapponica*	NT	Y	Y	Y	Y	WV
Whimbrel	*Numenius phaeopus*	LC	N	Y	Y	Y	WV
Eurasian Curlew	*Numenius arquata*	NT	N	N	Y	Y	WV
Spotted Redshank	*Tringa erythropus*	LC	N	N	Y	N	WV
Common Redshank	*Tringa tetanus*	LC	Y	Y	Y	Y	WV
Marsh Sandpiper	*Tringa stagnatillis*	LC	N	Y	Y	N	WV
Common Greenshank	*Tringa nebularia*	LC	Y	Y	Y	Y	WV
Green Sandpiper	*Tringa ochropus*	LC	N	N	Y	N	WV
Wood Sandpiper	*Tringa glareola*	LC	N	N	Y	N	WV
Terek Sandpiper	*Xenus cinereus*	LC	Y	Y	N	Y	WV
Common Sandpiper	*Actitis hypoleucos*	LC	Y	Y	N	Y	WV
Ruddy Turnstone	*Arenaria interpres*	LC	N	Y	N	Y	WV
Great Knot	*Calidris tenuirostris*	EN	Y	Y	Y	Y	WV
Sanderling	*Calidris alba*	LC	Y	N	N	Y	WV
Little Stint	*Calidris minuta*	LC	Y	N	N	Y	WV
Temminck's Stint	*Calidris temminckii*	LC	Y	Y	N	Y	WV
Dunlin	*Calidris alpine*	LC	Y	N	Y	Y	WV
Curlew Sandpiper	*Calidris ferruginea*	NT	N	N	Y	Y	WV
Broad-billed Sandpiper	*Calidris falcinellus*	LC	Y	Y	Y	Y	WV
Black-winged Stilt	*Himantopus himantopus*	LC	N	N	Y	N	R/LM
Pied Avocet	*Recurvirostra avosetta*	LC	N	N	Y	N	WV
Crab- Plover	*Dromas ardeola*	LC	N	N	Y	N	WV
Brown Skua	*Catharacta antartica*	LC	N	Y	N	N	S
Pomarine Jaeger	*Stercorarius pomarinus*	LC	N	Y	N	N	S
Heuglin's Gull	*Larus heuglini*	LC	Y	Y	Y	Y	WV
Pallas's Gull	*Larus ichthyaetus*	LC	Y	Y	Y	Y	WV
Brown-headed Gull	*Larus brunnicephalus*	LC	Y	Y	Y	Y	WV
Black-headed Gull	*Larus ridibundus*	LC	Y	Y	Y	Y	WV
Slender-billed Gull	*Larus genei*	LC	Y	Y	Y	Y	WV
Black-legged Kittiwake	*Rissa tridactyla*	LC	Y	N	N	N	S
Gull-billed Tern	*Gelochelidon nilotica*	LC	Y	Y	Y	Y	WV
Caspian Tern	*Hydroprogne caspia*	LC	Y	Y	N	N	WV
River Tern	*Sterna aurantia*	NT	Y	Y	Y	Y	R/LM
Lesser Crested Tern	*Thalasseus bengalensis*	LC	Y	Y	Y	Y	WV
Greater Crested Tern	*Thalasseus bergii*	LC	Y	Y	Y	Y	WV
Sandwich Tern	*Thalasseus sandvicensis*	LC	Y	Y	Y	Y	WV
Common Tern	*Sterna hirundo*	LC	Y	Y	Y	Y	WV
Saunders's Tern	*Sterna saundersi*	LC	Y	N	N	N	WV
Black-bellied Tern	*Sterna acuticauda*	EN	Y	N	N	N	R/LM
Sooty Tern	*Onychoprion fuscatus*	LC	N	Y	N	N	S
Whiskered Tern	*Chlidonias hybrid indicus*	LC	Y	Y	Y	Y	WV
Blue rock Pigeon	*Columba livia intermedia*	LC	N	Y	N	Y	R/LM
Greater Coucal	*Centropus sinensis parroti*	LC	N	Y	Y	Y	R/LM

Table 1: Continued.

Common name	Scientific Name	IUCN Status	MF	MG	SW	SB	Local Status in KVCR
Common Kingfisher	*Alcedo atthis*	LC	Y	Y	Y	N	R/LM
Stork-billed Kingfisher	*Pelargopsis capensis*	LC	N	Y	N	N	R/LM
White-breasted Kingfisher	*Halcyon smyrnensis fusca*	LC	N	Y	Y	N	R/LM
Black-capped Kingfisher	*Halcyon pileata*	LC	N	Y	N	N	WV
Lesser Pied Kingfisher	*Ceryle rudis travancoreensis*	LC	Y	Y	Y	N	R/LM
Blue-tailed Bee-eater	*Merops philippinus*	LC	N	Y	N	N	WV
Red-rumped Swallow	*Hirundo daurica erythropygia*	LC	N	Y	Y	N	R/LM
White-browed Wagtail	*Motacilla maderaspatensis*	LC	Y	Y	N	N	R/LM
Ashy Prinia	*Prinia socialis*	LC	N	Y	N	N	R/LM
Tricoloured Munia	*Lonchura malacca*	LC	N	Y	N	N	R/LM
Common Myna	*Acridotheres tristis*	LC	N	Y	N	N	R/LM
Rufous Treepie	*Dendrocitta vagabunda*	LC	N	Y	N	N	R/LM
House Crow	*Corvus splendens*	LC	Y	Y	Y	Y	R/LM
Jungle Crow	*Corvus macrorhynchos*	LC	Y	Y	Y	Y	R/LM

Migration Status: R (Resident) = Seen throughout the year but no breeding records; LM (Local Migrant) = Some birds are resident and breed on different habitats of Kerala but in Kadalundi wetland they are seen only for a limited period of time. Here they act as migrants; WV (Winter Visitor) = Winter visitors are from the other region of Indian Sub-continent; S (Straggler) = Orientation lost species.
IUCN Status: CR=Critically Endangered; EN= Endangered; VU=Vulnerable; NT= Near-Threatened; LC= Least Concern.

Table 2: Total number of shorebirds across the year from 2005 to 2015 at Kadalundi Vallikkunnu Community Reserve

Species	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Lesser Sand Plover	23768	12786	19191	14112	19447	15559	11436	4736	3152	2571	2062
Greater Sand Plover	1857	1889	1359	1538	1696	1953	213	372	492	437	525
Kentish Plover	2066	1343	2097	715	2064	1673	458	231	315	443	385
Pacific Golden Plover	1720	1296	798	845	1813	985	194	25	134	85	64
Common Redshank	1806	769	2581	786	993	434	325	188	208	220	230
Common Greenshank	334	108	295	216	340	136	146	368	865	1042	1379
Whimbrel	291	246	171	121	120	106	239	277	468	487	549
Eurasian Curlew	128	55	41	20	35	51	14	168	260	333	350
Broad-bellied Sandpiper	8	0	3	6	14	9	0	0	0	0	0
Black-winged Stilt	7	22	0	15	5	10	2	0	0	0	0
Bar-tailed Godwit	97	36	36	69	48	87	30	15	30	25	26
Black-tailed Godwit	41	0	18	18	42	34	9	3	9	7	6
Grey Plover	39	1	7	7	7	6	12	9	13	56	61
Common Snipe	17	0	0	1	4	3	0	0	0	0	0
Common Sandpiper	95	69	65	49	43	55	36	24	50	50	52
Green Sandpiper	17	2	2	7	4	1	4	0	0	0	0
Dunlin	98	0	68	11	26	5	7	0	40	43	39
Great Knot	21	41	1	6	10	4	2	0	0	0	0
Curlew Sandpiper	122	65	61	37	32	6	26	0	8	0	5
Ruddy Turnstone	74	3	5	5	4	26	21	15	31	42	59
Wood Sandpiper	18	23	4	5	8	6	7	0	29	0	0
Terek Sandpiper	152	132	114	55	51	102	221	21	0	51	59
Sanderling	215	129	98	70	45	49	81	41	132	296	263
Little Stint	72	44	70	43	33	18	23	3	3	3	2
Temminck's Stint	32	0	0	0	7	0	2	0	0	0	0
Marsh Sandpiper	4	12	0	0	2	0	3	0	0	0	0
Spotted Redshank	0	0	1	0	0	0	0	0	0	0	0
Eurasian Oystercatcher	0	0	2	2	0	0	0	0	2	0	0
Pied Avocet	0	0	0	2	0	0	0	0	0	0	0
Crab Plover	0	0	0	2	0	0	0	0	0	0	0
Little Ringed Plover	0	0	0	0	0	0	0	3	0	0	0

DISCUSSION

Fifteen percent of the regional population of Black-headed Gull and 10% of Brown-headed Gull were recorded from this reserve (Aarif *et al.,* 2015). Pelagic birds such as Red-billed Tropicbird *Phaethon aethereus,* Masked Booby *Sula dactylatra,* Lesser Frigate bird *Fregata ariel*, Brown Skua *Catharacta antartica* and Pomarine Jaeger *Stercorarius pomarinus* were also recorded. All the threatened shorebird populations fluctuated across the years.

Mudflats were the most used habitats during 2005-11 whereas a significant increase in shorebird numbers was noted in sandy areas during 2012-15. During the same period, the total number of shorebirds counted in mudflats was placed in second highest position. A declining trend was evident in the number of shorebirds that prefer mudflats, mangroves and shallow water areas (Figure 2). At the sand beach an increasing trend of many shorebirds species was noticed. This is attributed to birds shifting to a better alternate foraging and roosting rather than the Community Reserve. Recently the studies made by Aarif *et al.* (2014) revealed that many species of shorebirds have been showing a declining trend. Declining trend of shorebird population in KVCR that make use of Central Asian Flyway (CAF) and the habitat loss in KVCR (where these shorebirds refuel during their long-distance flight) suggest that habitats in the CAF are under threat.

Species Accounts

1. Black-bellied Tern ***(****Sterna acuticauda)* Endangered

Threatened by the high pressure on its breeding sites. Presence of its nests was reported from Bharathapuzha estuary (approximately 30 kilometres away from KVCR). There is no recent breeding record along the west-coast of Kerala, however, few sporadic sight records exist. On 16th April 2009, a Black-Bellied Tern was observed resting at the edge of mudflats (Aarif *et al.,* 2009). Being an endangered bird, mere sighting itself is important. The disappearance of the breeding individuals from the Bharathapuzha estuary may be attributed to the gradual loss of sand beds and the consequences of sand mining.

2. Great Knot (*Calidris tenuirostris***)** Endangered

An uncommon winter visitor to KVCR, prefers shallow water and mudflats. Peak count observed in KVCR during our study was nine individuals. The recorded arrival time of Great Knot is early November to early December and the departure time is middle of January to early February. Great Knot has been observed regularly from the KVCR and the highest number recorded was 12 individuals during 1987 (Uthman & Namassivayan, 1991).

In India, at the Marine National Park, Gulf of Mannar, Tamil Nadu**,** there was a decline of 60% from 350 in 1985-86 to 140 in 2006-2007 (Daniel & Balachandran, 2002) with a recovery to 450 in 2012, perhaps due to redistribution from sites east of India. Similarly, in recent years, numbers have increased on the east coast (300 at Chilika Lake, 1200 at Point Calimere in 2012). However, numbers remain higher on the west coast with more than 1500 in the Gulf of Kachchh.

3. Eurasian Oystercatcher ***(Haematopus ostralegus)*** Vulnerable

Populations are fully migratory, inland breeders moving to the coast for the winter (del Hoyo *et al.*1996). This species is an uncommon winter visitor to KVCR and prefers shallow water sand beaches. The peak count was two individuals from sand beach.

4. Curlew Sandpiper *(Calidris ferruginea)* Near Threatened

Common winter visitor to KVCR. It prefers mudflats, mangroves and shallow water. Highest count recorded from KVCR was 41 individuals. The arrival time is early October to early November and the departure time is early February to the end of March. According to Balachandran (2006), the species is threatened in the south-east coast of India (Point Calimere) due to illegal hunting (bird trapping), alteration of natural reservoir and marshland habitat by salt-industries, and habitat degradation because of diminishing rainfall.

5. Bar-tailed Godwit *(Limosa lapponica)* Near Threatened

A Common winter visitor to KVCR. Peak count observed was 39 individuals from the sand beach. Probable arrival time is the middle of November to the first week of December and the departure time is the first week of March to early April. According to Uthaman & Namassivayan (1991), Bar-tailed Godwits are common at the Kadalundi estuary and about a dozen birds were seen with other migrant shorebirds.

6. Black-tailed Godwit (*Limosa limosa*) Near Threatened

At present this species is not common in Kadalundi, except during November to February in the shallow water of mangroves. Uthaman & Namasivayam (1991) recorded up to 150 individuals from Kadalundi. Black-tailed Godwit generally prefers muddy (silty) sediment (Moreira, 1993) but in Kadalundi, maximum number was observed at shallow water region. The highest number (166 individuals) was observed in shallow water. From the mangroves and sand beach, the sight record was nine each. The lowest number (one) was recorded from mudflats during our study. Recorded arrival time is the middle of October to the first week of December and the departure time noted is the first week to the last week of March.

7. Eurasian Curlew (*Numenius arquata***)** Near Threatened

It is a regular winter visitor to KVCR. Peak count recorded was 24 individuals. This species is usually seen with small groups of Whimbrel at the shallow water or sand beach. Arrival time is the first week of October to the middle of November and the departure time is the last week of March to the middle of April. Kelin & Qiang (2006), observed that the species is threatened because of the degradation of migrational staging areas due to land reclamation, pollution, and/or reduced river flows.

8. **River Tern** *(Sterna aurantia)* Near Threatened

Threatened because of anthropogenic disturbances in their habitats. This may result in a rapid population decline over the next three generations (Birdlife International, 2013). The population trend was not found declining in Kadalundi. In the KVCR, the birds were found resting with Saunder's Tern, Lesser-crested Terns and Large-crested Terns, on the sand beds, during the hot hours of the day. The overall population in their breeding ground was reported to decline (Narwade & Fartade, 2013).

9. Oriental Darter (*Anhinga melanogaster***)** Near Threatened

Few individuals of Oriental Darter along with Little Cormorant were observed in the shallow water. It is not a common species at KVCR. The highest number of 11 individuals was observed once in 2010.

10. Oriental White Ibis (*Threskiornis melanocephalus*) Near Threatened

Resident, uncommon and nomadic Ciconiiform waterbird of the Indian subcontinent (Kazmierczak & Perlo, 2000), gregariously frequenting shallow wetland habitats (Balakrishnan & Thomas, 2004). In KVCR it is a common winter visitor and locally migrant usually seen feeding on shallow water along with other waterbirds. One-time peak count (221) was recorded from mudflats in 2007.

11. Black-legged Kittiwake (*Rissa tridactyla***)**

A rare visitor to the coastal region of Kerala (Figure 3). The first record of Black-legged Kittiwake was from Morjim, Goa, about 500 km north of KVCR, on 16thJanuary, 2005. Later the bird was recorded from Alibaug, Maharashtra on 25th November 2012, Majuli Island, Assam on 30th November 2012, Chavakkad Beach, Kerala on 25th December 2012 and Maharashtra on 3rd January 2013. In KVCR it was sighted on 18th February 2008.

12. Asian Openbilled Stork *(Anastomus oscitans)* Least Concern

The present study at KVCR recorded only two sightings. According to Kurup (1991), arrive in flocks of 10-40 individuals and when the number is greater they get evenly distributed along the edges of the mudflats. The Openbill storks had been arriving at the estuary regularly for the past three winters during the study period (Kurup, 1991). Global population trend of this species is not known, yet, the species is believed yet to reach the thresholds for the population decline criterion (a decline of more than 30% in ten years or three generations) of the IUCN Red List. This species is native of and breeds in Bangladesh, India, Bhutan, Cambodia, Thailand, Vietnam, Laos, Myanmar, Nepal, Pakistan and Sri Lanka (Birdlife International, 2006).

Gulls and terns

Kadalundi-Vallikkunnnu Community Reserve is identified as one of the ideal sites for Gulls and Terns (Aarif & Prasadan, 2015). Once, 10% of the global population of Brown-headed Gull *Larus brunnicephalus* and 15 % of the global population of Black-headed Gull *Larus ridibundus* were recorded from here. KVCR attracts five species of Gulls and 11 Tern species. The population of few Gull species showed an increasing trend (Aarif *et al*., 2015) with respect to 1989 data. However, the population of few species of Terns, such as Sandwich Tern *Thalasseus sandvicensis,* has drastically declined in Kadalundi (Aarif & Prasadan, 2015; Aarif *et al.,* 2017). According to Uthaman & Namassivayan (1991) Sandwich Terns were common winter visitors during 1990. Up to 500 individuals were observed with other Terns at the edges of mudflats. The common name of Sandwich Tern is Kadalundi Aala because this species was first recorded at Kadalundi estuary during 1980 in Kerala. Sandwich Terns inhabit a variety of habitats including sandy or rocky oceanic beaches, oceanic cliff sides, estuaries and large inland lakes. Preferred nesting sites are sand beaches with little or sparse vegetation or bare rock outcrops. (Visser & Peterson, 1994; Birdlife International, 2009).

As a part of our observations on the behaviour of shorebirds along the sandy beaches at KVCR, on March 2013, we observed an adult Brahminy Kite *Haliastur Indus* chasing a Little Tern *Sternula albifrons.* The entire sequence lasted for 5 min and the hunting sequence happened in the flight over the sea (around 40 meters from the shoreline/observation point). The tern flew very close to the surface of the sea and it took maximum efforts to escape from the attack of the adult Brahminy Kite. On the fifth attempt, it captured the prey in flight and subsequently landed on the nearby coconut tree with the prey. This was the first observation of hunting a tern in ten years of continuous monitoring and four years of behavioural observations in the reserve.

Pelagic birds

An adult Red-billed Tropic bird *Phaethon aethereus*, was recorded near the coastal highway bridge in October 2008. The Masked Booby *Sula dactylatra,* was spotted

Figure 3. Black legged Kittiwake

Figure 4. Sooty Tern

while it was resting on sand flat near the coastal highway bridge in August 2008. The Lesser Frigate bird *Fregata ariel* was spotted in 2008, resting on a mangrove tree. Sooty Tern *Onychoprion fuscatus* (Figure 4) (one adult and two immature) were recorded in 2008 near the Railway Bridge in Kadalundi estuary. Brown Skua *Catharacta antartica* was recorded in 2008, resting on a log in the sand flats near the coastal highway bridge. Two sightings of adult Pomarine Jaeger *Stercorarius pomarinu* were recorded from the sand flats (Aarif & Narayanan, 2009).

Over-summering species

A small population each of seven species of shorebirds namely, Lesser Sand Plover, Greater Sand Plover, Kentish Plover, Whimbrel, Common Sandpiper, Pacific Golden Plover and Ruddy Turnstone were found over-summering in KVCR. This is an indication that the food resources for the migrant shorebirds are available throughout the year. Aarif & Prasadan (2015) found that most of the over-summering individuals were sub-adults. A few injured birds were also observed during the non-wintering months.

THREATS AND CONSERVATION ISSUES

Even though the west coast of India is a refuge for millions of wintering migratory birds, data on continuous monitoring of their population is meager and is restricted to the annual waterbird count. Therefore, it is imperative that continuous monitoring throughout the wintering season is undertaken. Shorebirds can be regarded as global sentinels of environmental changes due to their migratory ecology and habitat use patterns (Aarif & Prasadan, 2015). For long-distant migrants, the ecological quality of wintering ground appears to be of key importance (Aarif & Prasadan, 2015). The west coast of India faces environmental threats due to anthropogenic activities – habitat destruction, solid waste dumping and sand mining (Aarif, 2009; Aarif *et al* 2014). Man-made infrastructures in/near the habitat like roads, bridges, mobile towers etc. also create inconveniences to the normal life of foraging shorebirds in KVCR (Aarif & Prasadan, 2015). The dominance of humans and their population explosion are likely to competitively exclude many species of migrant shorebirds. Declining food resources and reduced suitability of stopover sites have far reaching implications on the reproduction and survival of migrant shorebirds (Aarif & Prasadan, 2015). Climate change due to anthropogenic activities may exacerbate the situation (Aarif & Prasadan, 2015).

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SECOND MAINLAND RECORD OF GREY-TAILED TATTLER *TRINGA BREVIPES* AND CONFIRMATION OF THE SCARCITY OF THIS SPECIES IN SUMATRA

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The Grey-tailed Tattler *Tringa brevipes* is a rare vagrant to Sumatra with a small number of sightings. Here we report the second record for the mainland and the first record for North Sumatra Province. A review of past wader surveys in Sumatra confirms the scarcity of this species throughout and indicates that both its northward and southward migration routes do not appear to overfly the island. We recommend that field guides and other literature reviewing the national and international distribution of waders be amended as many erroneously show a widespread distribution of Grey-tailed Tattler in Sumatra.

INTRODUCTION

The Grey-tailed Tattler *Tringa brevipes* migrates between its breeding grounds in Siberia and its principal wintering grounds in Australia by following a route that transits Japan and Taiwan and appears to track well to the east of Sumatra (Higgins & Davies 1996; Minton *et al.* 2006; Bamford *et al.* 2008; Branson *et al.* 2010; Minton *et al.* 2011). Notwithstanding an unsubstantiated pre-1935 record with no locality nor precise date (Chasen 1935; van Marle & Voous 1988), there were no records of Grey-tailed Tattler within the Sumatra realm until 1999-2000 when a bird was observed twice on Pulau Siberut (Grantham & Kemp 2000). This was followed by a sighting of seven birds on Pulau Belitung in February 2014 (Iqbal *et al.* 2014), and then by two sightings at Pantai Panjang, Bengkulu City, in October and November 2014 which constituted the first record of the species in Bengkulu Province and the first record on the Sumatran mainland (Rahmansyah & Iqbal 2015).

OBSERVATIONS

First record for North Sumatra Province

On 24 March 2017 we found three Grey-tailed Tattlers at Pantai Jono (3°23'N, 99°25'E), Batu Bara Regency, on the east coast of North Sumatra Province. This locality is 860 km NNW of the previous mainland location at Pantai Panjang, Bengkulu, and on the east coast of Sumatra rather than the west. The birds were easily recognised as juvenile-plumaged tattlers by the combination of uniform grey upperparts, grey neck and breast, white chin, white underparts and bright orangey-yellow legs. We identified them as Grey-tailed Tattlers (c.f. Wandering Tattler *Tringa incanus*) based on the white superciliary extending behind the eye and meeting over the bill to form a broad, unbroken stripe (Hayman *et al.* 1986; Pratt *et al.* 1987). They fed and roosted together and were easily distinguished through direct comparison from potential confusion species such as Red Knot *Calidris canutus* (200 present) and Terek Sandpiper *Xenus cinereus* (130 present). The tattlers were initially found feeding amongst other waders on mudflats near the end of a sand spit. As the tide rose they flew to the inner estuary and roosted on the edge of mangroves amongst Bar-tailed Godwits *Limosa lapponica*, Red Knots, Curlew Sandpipers *Calidris ferruginea*, Pacific Golden Plovers *Pluvialis fulva* and Lesser Sand Plovers *Charadrius mongolus*.

We returned to Pantai Jono on 25 March 2017 and briefly relocated two Grey-tailed Tattlers before they flew off with other waders in response to disturbance. Although viewed well, three times, at distances of 50-200 m through spotting scopes, they remained too far away to photograph. However, as we could observe the birds for a cumulative period of over 20 minutes and are very familiar with both tattler species from New Zealand and the Pacific Islands, we were able to recheck field marks and confirm their correct identity.

DISCUSSION

Rare Status in Sumatra Verified

These sightings of Grey-tailed Tattler at Pantai Jono comprise the first record for North Sumatra Province, the second record for the Sumatran mainland and the first record in Sumatra north of the equator. Iqbal *et al.* (2014) and Rahmansyah & Iqbal (2015) both commented that it is strange that the species should be so scarce in Sumatra. A pertinent question is whether this scarcity is genuine or whether the species has simply been overlooked? To answer this, we assembled data from 36 published and unpublished coastal wader surveys conducted in various parts of Sumatra between 1984 and 2017 (Table 1, Figure 1). These surveys totalled 827 212 waders of more than 30 species. Grey-tailed Tattlers were found on just one of the 36 surveys, totalling three birds (0.00036 %). This confirms that the species is extremely rare and has not factored as a component of wader species assemblages recorded to date on most Sumatran coastal wetlands. Most surveys however have been on inter-tidal mudflats, river estuaries or coastal ricefields and marshes. Sandy beaches, rocky shorelines and coral reef on both the mainland and islands have received much less coverage and future investigation of these habitats may find that small numbers of Grey-tailed Tattler do indeed occur.

Table 1. Coastal wader surveys in Sumatra 1984-2017.

Province	Date	No. of sites	No. species	Total waders	Total tattlers	Source
Aceh	Nov-Dec 1995	3	12	546	0	Crossland 2000
Aceh	Dec 08-Jan 09	8	13	716	0	Iqbal *et al.* 2010a
North Sumatra	Dec 95	2	22	10 771	0	Crossland *et al.* 2009, 2012
North Sumatra	Mar-May 1997	4	22	42 621*	0	Crossland *et al.* 2012
North Sumatra	Mar 02	5	20	22 979	0	Crossland *et al.* 2009
North Sumatra	Sep-Oct 2005	3	20	21 298*	0	Crossland *et al.* 2012
North Sumatra	Sep 06	1	10	809	0	Crossland *et al.* 2012
North Sumatra	Jan 09	3	20	27 869	0	Iqbal *et al.* 2010b
North Sumatra	Sept-Oct 2010	40	32	65 238	0	Crossland & Sitorus unpubl. data
North Sumatra	Jan-June 2011	4	23	20 114*	0	Putra *et al.* 2015
North Sumatra	Mar 11	1	9	431	0	M. Brady & J. Sterling (ebird)
North Sumatra	May-Nov 2012	5	13	26 438*	0	Harapan *et al.* 2013
North Sumatra	Sep 12	3	22	9 681	0	Crossland & Sitorus unpubl. data
North Sumatra	Nov 12	6	27	16 927	0	Crossland & Sitorus unpubl. data
North Sumatra	Dec 12	1	14	4 656	0	B. Harris (ebird)
North Sumatra	Nov 13	1	11	502	0	B. Harris (ebird)
North Sumatra	Oct 14-April 15	4	30	12 673*	0	Putra *et al.* 2017
North Sumatra	Mar 17	14	27	13 692	3	Crossland unpubl. data
Riau	Oct-Nov 1984	many	16	20 993	0	Silvius 1988
Riau Islands	Dec 01, Sept 02	3	10	323	0	Crossland & Sinambela 2005
Riau Islands	Dec 12	4	13	330	0	Crossland unpubl. data
West Sumatra	Nov 12	3	7	62	0	Crossland & Sitorus unpubl. data
Jambi	Oct-Nov 1984	many	22	37 580	0	Silvius 1988
Jambi	July-Aug 1984	many	16	17 829	0	Silvius 1988
Jambi	Mar-April 1984	many	28	27 018	0	Silvius 1988
Jambi	Jul 85	many	16	17 828	0	Danielson & Skov 1989
Jambi	Oct 07	1	21	6 889	0	Noni & Londo 2008
Jambi	Dec 07	1	22	3 819	0	Noni & Londo 2008
Jambi	Mar 11	2	15	4 144	0	Iqbal *et al.* 2012
South Sumatra	Oct-Nov 1984	many	17	42 319	0	Silvius 1988
South Sumatra	July-Aug 1984	many	16	17 829	0	Silvius 1988
South Sumatra	Mar-April 1984	many	18	14 363	0	Silvius 1988
South Sumatra	Aug 85	many	16	35 534*	0	Danielson & Skov 1989
South Sumatra	Oct 88-Oct89	many	25	280 519	0	Verheught *et al.* 1990
South Sumatra	Mar 12	1	17	725	0	R. Fuller (ebird)
Lampung	Nov 09	7	7	1 147	0	Iqbal *et al.* 2011
Total				827 212		

* = cumulative count totals

Certainly, the three previous records in Sumatra were found on these habitats.

We recommend that ornithologists visiting suitable tattler habitat around the mainland or visiting offshore islands keep a look out for tattlers and report their findings to suitable repositories such as eBird, the Indonesian ornithological journal "Kukila", or the Indonesian bird mapping scheme, Atlas Burung Indonesia (Taufiqurrahman 2016).

Grey-tailed Tattler distribution has been erroneously shown in field guides

Multiple references, including both field guides and books on shorebirds present distribution maps showing Grey-tailed Tattlers as occurring throughout coastal Sumatra and its satellite islands (e.g.; Hayman *et al.* 1986, Lane 1987, Higgins & Davies 1996, van Gils & Wiersma 1996, Strange 2001, Wetlands International 2002, Message & Taylor 2005, Wetlands International 2006, Bamford *et al.* 2008, Chandler 2009, Eaton *et al.*

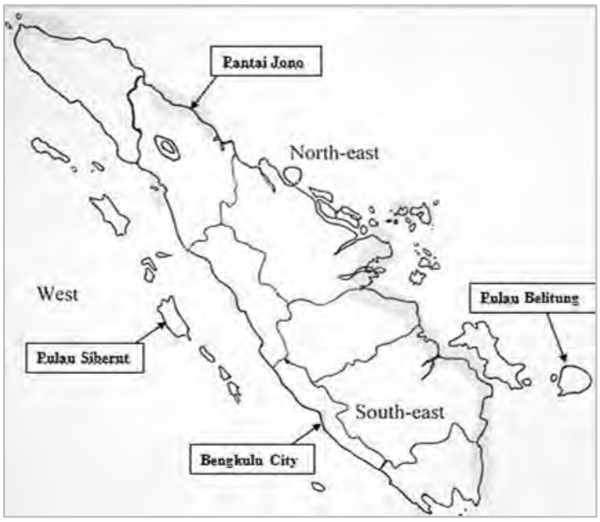

Figure 1. Map showing records of Grey-tailed Tattler in Sumatra and areas (shaded) covered by wader surveys listed in Table 1.

2016). This is erroneous and greatly overstates both the occurrence and distribution of the species in the Sumatran realm. It also gives a false impression of the global distribution of this species. We recommend that future field guides take note of this fact and list Grey-tailed Tattler as a vagrant or very rare migrant in Sumatra. Distribution maps should be redrawn to reflect that the regular zone of migration passage for this species is well to the east of Sumatra. Maps of non-breeding distribution should also be redrawn to show that outside of Australia, where 90% of the non-breeding population resides (Bamford *et al.* 2008), the remaining non-breeding areas are in fact located in eastern Indonesia and extend through New Guinea (Bishop 2006) into the western Pacific (Pratt *et al.* 1987, Dutson 2011, van Perlo 2011).

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A SURVEY OF WADERS IN THE JAYAPURA AREA, PAPUA PROVINCE, INDONESIA, APRIL 2017

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From 12-17 April 2017 we surveyed nine wetland sites around the city of Jayapura, on the north-eastern coast of Indonesia's Papua Province, New Guinea. We counted 811 waders of 22 species, with the most abundant being White-headed Stilt *Himantopus leucocephalus* (256), Black-tailed Godwit *Limosa limosa melanuroides* (112), Sharp-tailed Sandpiper *Calidris acuminata* (106), Wood Sandpiper *Tringa glareola* (84), Lesser Sand Plover *Charadrius mongolus* (65) and Common Sandpiper *Actitis hypoleucos* (47). A notable record was the discovery of the first Long-billed Dowitcher *Limnodromus scolopaceus* for Papua Province. This bird also represents the 2nd record for the island of New Guinea (following a 1984 record in Papua New Guinea). We suggest that the wider district (combining Jayapura city and the surrounding Jayapura Regency) is likely to be a key area for waders on the north coast of New Guinea.

INTRODUCTION

Knowledge of wader distribution and abundance is poor for most of eastern Indonesia including Papua Province on the island of New Guinea (Noor 1994, Bishop 2006, Marshall & Beehler 2007a). Aside from incidental species records there is a lack of even basic information on the status, distribution and seasonal abundance of all wader species. This is highly unfortunate given both the local conservation pressures facing birds and their habitats in eastern Indonesia, and the Flyway-wide significance of this transit area for birds migrating between North Asia and Australasia (Bamford *et al.* 2008). Recent contributions for the Lesser Sundas and the Moluccas (Johnstone 1994), Timor-Leste (Trainor 2005, 2011) and Flores (Schellekens & Trainor 2016) offer a foundation upon which further exploratory work in eastern Indonesia can be built upon. Bishop (2006) provided a summary of wader occurrence on New Guinea. He reported 49 species recorded up to 2006 and listed a small number of sites known to be important. Yet much of New Guinea's coastline remains ornithologically unexplored and Bishop (2006) recommended that survey work, particularly systematic surveys be undertaken with some urgency. In this paper we report on a wader survey undertaken in mid-April 2017 (during the northward migration period) near Jayapura City, Indonesia Papua, which is positioned centrally on New Guinea's northern coastline about 25 km from the Indonesian / Papua New Guinea border.

STUDY AREA AND METHODS

The provincial capital, Jayapura (pop. 316 000), is the largest city in Papua and located on Yos Sudarso Bay near the north-eastern corner of the province. The area has an increasing human population and has been identified as an economic growth area (Subagiyo *et al.* 2017). Wader habitats around Jayapura include small areas of inter-tidal mudflats, sea grass beds, mangroves, coral reefs, sandy and rocky shorelines, aquaculture ponds, short sward grasslands and lake edges.

Between 12 April and 17 April 2017, we surveyed nine wetland sites in and around Jayapura City. These were:

1. Base G Beach

Base G Beach (Site 1), (2°31' N, 140°44'E) is a sandy beach and reef complex 150-200 m wide and *c.* 2.6 km long, with rocky shoreline at both ends. Sand and coral

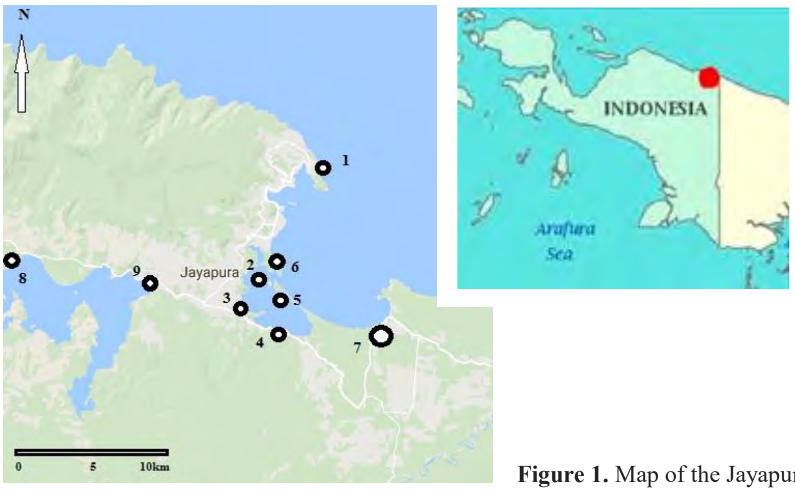

Figure 1. Map of the Jayapura study area showing sites surveyed.

are interspersed with muddy substrate and seagrass beds. The area has high year-round human use for recreational and shellfish gathering (S. Sinambela *Pers. Obs*.). We surveyed the beach which is on the ocean side of a narrow partly settled / partly wooded peninsula.

2. Teluk Youtefa (Youtefa Bay)

Teluk Youtefa is a *c.*1600 ha partially enclosed embayment on the southern side of Yos Sudarso Bay, separated from the sea by a 4.8 km-long vegetated sand spit. The bay is partly bordered by mangroves and coastal forest with human settlement mainly on the southern and western sides, as well as on islands at Enggros village at the mouth. We surveyed four areas of inter-tidal mudflats, the largest, Youtefa entrance (Site 2, 2°35' N 140°42'E), which comprises mudflat islands, seagrass beds, shoreline margins and open muddy areas within the mangroves. From study of Google maps we calculate the total area of these inter-tidal habitats at approximately 105 ha. Site 3 is the south-west corner of Teluk Youtefa (2°36' N, 140°41'E) where a small river enters the bay close to Jalan Pasar Youtefa. This site comprises mangroves around the river mouth with marginal mudflats covering approximately 1.5 ha. Site 4 is a small bay (2°37' N, 140°42'E) west of Nafri village on the southern shore with residual mangrove and a narrow mudflat edge of <1 ha in extent. Site 5 is the shoreline on the north side of Teluk Youtefa (2°36' N, 140°43'E), which has a narrow mudflat margin at low tide.

3. Pantai Hamadi Lagoon

Pantai Hamadi (Site 6, 2°35' N 140°42'E) is east of the Teluk Youtefa entrance and faces Yos Sudarso Bay. It is a 1.5 km long sandy beach with a narrow lagoon, separated from the open sea by a concrete and rock breakwater. At low tide, the lower foreshore and some localised sections of the lagoon bed with sandy or muddy substrates are exposed. The site has human recreational use (S. Sinambela *Pers. Obs*.).

4. Pantai Hotekamp (Hotekamp Beach) Aquaculture Ponds

The large complex of aquaculture ponds at Pantai Hotekamp (Site 7, 2°37'N 140°47'E), covers an area of approximately 600 ha. It has a 1.2 km interface with the coast and extends approximately 5 km inland. The area suffered extensive damage in the March 2011 Japanese tsunami (Sidik 2011) and now comprises a mix of both operational and derelict ponds, some of the latter with partial marsh and mangrove regeneration. We spent three hours surveying a core area of 100 ha of ponds nearest the sea.

5. Sentani Airport

Sentani airport (Site 8, 2°34' N 140°31'E), has an extensive area of short sward grass and bare ground measuring 3300 m x 350 m surrounding the runway and taxiways.

6. Danau Sentani (Lake Sentani)

Danau Sentani (104 km^2) is a large natural lake with an irregular shoreline situated immediately south-west of Jayapura city. We surveyed part of the north-eastern shoreline of this lake (Site 9, 2°36' N 140°37'E).

Wader counts were made at low to mid tide by a survey team of two personnel with the assistance of local guides. Optics used were a 30x spotting scope and 10x42 binoculars. Counting methods closely followed those outlined in Howes & Bakewell (1989). Namely they were ground-based counts of roosting or feeding waders obtained by scanning inter-tidal areas and aquaculture ponds from as close as possible without causing birds to take flight. Birds were identified and counted individually at all sites.

RESULTS

The survey recorded a total 811 waders of 22 species from nine sites in the Jayapura area. The most abundant species were White-headed Stilt (256 birds), Black-tailed Godwit (112), Sharp-tailed Sandpiper (106), Wood Sandpiper (84), Lesser Sand Plover (65) and Common Sandpiper (47). Survey totals are in Table 1.

DISCUSSION

Of 22 species recorded, White-headed Stilt was the most numerous with several flocks, totalling 256 birds scattered over the more marshy-edged aquaculture ponds at Pantai Hotekamp (Figure 2). None were found on any of the inter-tidal sites surveyed, nor around the shoreline

Figure 2. Part of a mixed species roost showing White-headed Stilts *Himantopus leucocephalus* and Little Black Cormorants *Phalacrocorax sulcirotris*, Pantai Hotekamp aquaculture ponds, 13 April 2017.

Figure 3. Immature White-headed Stilt *Himantopus leucocephalus*, Pantai Hotekamp aquaculture ponds, 13 April 2017.

of Lake Sentani. Although there are no records of White-headed Stilt breeding in Papua Province (Bishop 2006), we found *c.*10 immature birds (Figure 3) and observed agitated, breeding-type vigilance behaviours. We asked local residents about the stilts (which are conspicuous in the area), and they accurately described nest structure and materials, egg size and colouration, clutch size and both broken-wing and dive-bombing anti-intruder behaviours. This evidence is intriguing as it strongly suggests that White-headed Stilt have bred at this site. Other notable survey findings include 84 Wood Sandpipers, which was the fourth most abundant species and the most numerous scolopacid. They were scattered in small groups, freely associating with other wader species and favoured ponds that had muddy margins, reedy/grassy edges or residual cut-over mangrove clumps. We likely missed other birds that were in the expansive 500 ha of unsurveyed ponds. Bishop (2006) classifies Wood Sandpiper as a regular and moderately common Palearctic winter visitor and passage migrant to New Guinea, but most previous records involved <20 birds. Our count of 84 birds and a count of 50 on inland ricefields at Nimbokrang, 75 km west of Pantai Hotekamp, six months earlier on 9 October 2016 (D. Beadle per eBird 2017a), suggests this species may stage on the north coast prior to movements further north or south.

A single Long-billed Dowitcher *Limnodromus scolopaceus* was found roosting amongst a flock of Sharp-tailed Sandpipers on the muddy and mangrove stump-covered edge of a pond at Pantai Hotekamp. Several record photographs (Figure 4) were taken before the roosting waders flushed and the bird flew away. The identification of Long-billed Dowitcher was confirmed by a number of international experts (Crossland & Sinambela in press). This occurrence of Long-billed Dowitcher near Jayapura constitutes the first record for Papua Province and the second record for the island of New Guinea, after a 1984 record at Aroa Lagoon in PNG (Anon 1984, Bishop 2006).

Two Red Knot *Calidris canutus* feeding on mudflats at Teluk Youtefa entrance were the only Red Knot seen. Neither was in breeding plumage, so we assume they were immatures. Red Knot is an abundant migrant in the Trans Fly area of southern New Guinea but is much less

Table 1. Waders counted at nine sites in the Jayapura area, 12-17 April 2017.

		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
	Site	Base G Beach	Teluk Youtefa entrance	SW Teluk Youtefa	Bay W of Nafri	N side Teluk Youtefa	Pantai Hamadi Lagoon	Pantai Hotekamp	Sentani Airport	E end Lake Sentani	
	Date	12-Apr 2017	12-Apr 2017	12-Apr 2017	13-Apr 2017	13-Apr 2017	13-Apr 2017	13-Apr 2017	17-Apr 2017	13-Apr 2017	
	Habitat type	1	3	2	2	2	1	6	4	5	**Total**
	Species						**Count**				
White-headed Stilt	*Himantopus leucocephalus*							256			**256**
Grey Plover	*Pluvialis squatarola*		1								**1**
Pacific Golden Plover	*Pluvialis fulva*		3						20		**23**
Lesser Sand Plover	*Charadrius mongolus*							65			**65**
Whimbrel	*Numenius phaeopus*		15	1	2	9		5			**32**
Far-eastern Curlew	*Numenius madagascariensis*		2					2			**4**
Bar-tailed Godwit	*Limosa lapponica*		7					12			**19**
Black-tailed Godwit	*Limosa limosa*							112			**112**
Marsh Sandpiper	*Tringa stagnatilis*							6			**6**
Common Greenshank	*Tringa nebularia*							21			**21**
Wood Sandpiper	*Tringa glareola*							84			**84**
Terek Sandpiper	*Xenus cinereus*		2	1	3			1			**7**
Common Sandpiper	*Actitis hypoleucos*	1	3	21	2		1	17		2	**47**
Grey-tailed Tattler	*Tringa brevipes*		2	3				1			**6**
Long-billed Dowitcher	*Limnodromus scolopaceus*							1			**1**
Swinhoe's Snipe	*Gallinago megala*							1			**1**
Red Knot	*Calidris canutus*		2								**2**
Sanderling	*Calidris alba*							1			**1**
Red-necked Stint	*Calidris ruficollis*							12			**12**
Sharp-tailed Sandpiper	*Calidris acuminata*							106			**106**
Curlew Sandpiper	*Calidris ferruginea*							2			**2**
Red-necked Phalarope	*Phalaropus lobatus*							3			**3**
	Total	**1**	**37**	**26**	**7**	**9**	**1**	**708**	**20**	**2**	**811**

Habitat types:
1. Open coastline with exposed coral reef, sandy beach or rocky shoreline.
2. Mangroves with narrow mudflat margins.
3. Intertidal mudflats and seagrass beds.
4. Open grassland alongside airport runway.
5. Freshwater lakeshore.
6. Aquaculture ponds.
7. Sandy Beach with narrow lagoon enclosed by a breakwater.

Figure 4. Long-billed Dowitcher *Limnodromus scolopaceus* with Sharp-tailed Sandpipers, Pantai Hotekamp, 13 April 2017.

common elsewhere in New Guinea (Bishop 2006, Pratt & Beehler 2015). We observed one Sanderling *Calidris alba* – a bird feeding amongst a loose group of Sharp-tailed Sandpipers and Red-necked Stints on a partially dry acquaculture pond at Pantai Hotekamp. Bishop (2006) and Beehler & Pratt (2016) report that Sanderling records are few in New Guinea, particularl y on the Indonesian half of the island where the only previous records have come from Merauke area on the south coast (Bishop 2006). Our sighting is therefore notable for being possibly the first record for the north coast of Papua Province.

Three Red-necked Phalaropes *Phalaropus lobatus* were found roosting and feeding on the Pantai Hotekamp ponds. Two birds were solitary, and one was roosting in shallow water among Marsh Sandpipers *Tringa stagnatilis*, Common Greenshanks *Tringa nebularia* and White-headed Stilts. The seas north of New Guinea are a major wintering area for this species (Hayman *et al.* 1986). They have been recorded previously in various parts of New Guinea, with most records being from northern coastal waters and the Birds Head Peninsula (Coates 1985, Bishop 2006, Taufiqurrahman 2015, Beehler & Pratt 2016). This observation adds a new record for part of the mainland where the species has not previously been reported.

Our survey total of 811 waders probably under-represents total wader numbers in the Jayapura area as we did not survey several likely wader sites in Teluk Youtefa and along the Jayapura city waterfront. We also only covered one-sixth of the total area of the Pantai Hotekamp aquaculture ponds, although the part of the complex surveyed seemed to contain the main concentrations of roosting and feeding waders. The survey took place in mid-April, during the northward migration period. Some species such as Pacific Golden Plover *Pluvialis fulva*, Lesser Sand Plover, Grey-tailed Tattler *Heteroscelus brevipes* and Red-necked Stint *Calidris ruficollis* were low in number suggesting part of their local populations may already have departed on migration. Analysis of band recoveries have found that many wader species overfly the islands between the north coast of Australia and mainland East Asia, particularly on northward migration (Minton *et al.* 2006). They seem to stopover more frequently on southward migration, a pattern that has been detected for migratory waders in New Guinea (Bishop 2006, Beehler & Pratt 2016).

Prior to this survey, only one important wader site had been documented on the northern coastline of New Guinea – Wandammen Peninsula in West Papua Province, *c.*700 km west of Jayapura (Bishop 2006). It is interesting that the Jayapura area has not previously been identified as an important area for waders given that it is the largest population centre in Indonesian Papua, was a major allied base in WW2, and was the capital of Dutch New Guinea until 1967. Bishop (2006) did not mention the Jayapura area, and through our own literature search we've been unable to find reference to any historical wader observations for Jayapura or its previous colonial identities of Hollandia and Humbolt Bay. Perhaps early ornithologists passed through the area, but their attentions were always focused on New Guinea's endemics, the birds of paradise and other ornithological treasures? Perhaps also, habitat conditions for waders have improved in more recent times with development of artificial wetlands such as ricefields and aquaculture ponds – land uses that remain scarce in Papua. With 708 birds (87.3% of the total) and 19 species, the Pantai Hotekamp aquaculture ponds held the highest abundance and highest species richness of the habitats we surveyed. An isolated inland area of ricefields and irrigated agricultural land at Nimbokrang (2°53' N 140°12'E), 65 km west of Jayapura and 18 km inland from the coast, has had several wader species recorded and may prove to be another important local site for some species. Those reported include Pacific Golden Plover, unidentified *Charadrius* plovers, Sharp-tailed Sandpiper, Common Sandpiper and notable counts of 20 Swinhoe's Snipe, 60 Wood Sandpiper and six Long-toed Stint *Calidris subminuta* (D. Beadle, J.C. Mittermeier per eBird 2017a).

Although we only observed Common Sandpiper at Danau Sentani, other observers have reported a mix of species including Comb-crested Jacana (Jepson & Ounstead 1997), White-headed Stilt, Masked Lapwing *Vanellus miles,* Whimbrel *Numenius phaeopus*, Far-eastern Curlew *Numenius madagascariensis*, Black-tailed Godwit, Red-necked Stint, Terek Sandpiper *Xenus cinereus*, Common Sandpiper and Grey-tailed Tattler (T. Boucher, A. Knystautas, J. Pap, J. Sipiora per eBird 2017b). The long shoreline of this 104 km^2 lake may support good numbers of waders scattered in groups around the sections of shore with suitable habitat and low human disturbance. We recommend that a complete census be undertaken of sites within the Jayapura City and Jayapura Regency jurisdictions during peak migration periods to more accurately gauge the value of the wider area as a core wader habitat on New Guinea's north coast.

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TELANGANA STATE'S FIRST RECORDS OF BREEDING BLACK-WINGED STILT, AND THE OCCURRENCE OF NEST PREDATION BY FERAL DOGS

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The Black-winged Stilt *Himantopus himantopus* is a large wader widely distributed around the world (Cramp and Simmons 1983). It is believed to be both migrant or resident to the Indian sub-continent (Ali and Ripley 2001; Praveen *et al.* 2016). In India the species breeds in a wide range of habitats including operational and recently abandoned salt pans, brackish lagoons, marshes occasionally connected to the sea and temporarily flooded ponds, fish farming ponds, drainage canals, flooded clay-pits, freshwater marshlands, man-made ponds and rice fields (Tinarelli 1992).Some research has been carried out on the breeding biology of the Black-winged Stilt in Italy (Tinarelli 1992), in Spain (Castro 1993; Arryo 2000; Cuervo 2003, 2004), in Iran (Ashoori 2011) and the Cape Verdi Islands (Rodrigues and Tavares 2014). In India, a few breeding records of Black-winged Stilt has been reported from Kerala (Narayanan *et al.* 2005).

The present breeding record at the college farm (17° 19' 29.02" N; 78° 24' 26.55" E) (109 ha) of Professor Jayashankar Telangana State Agricultural University (PJTSAU) campus is the first for the Telangana state (Figure 1) in India. Two nests of Black-winged Stilt were observed in a restoration tank – an artificial water body mainly made for storing runoff water in the rainy season. The tank is a permanent water body covering an area of 0.1 ha, and surrounded by paddy fields. The bunds were fully covered with Swamp Rice Grass *Leersia hexandra*.

On 2nd July 2016, we observed a Black-winged Stilt threatening a Pariah Kite *Milvus migrans* in the air. Upon investigation, four adult Black-winged Stilts and two nests, one with four eggs and another with three eggs (Figure 2) were observed. The distance between the nests was 4.5 m. Nest shape was similar, but differences in size and construction were evident: Nest I was constructed on a small elevated rock. Mud was used to increase the nest height above water level and then leaves and stalks of the grass were used to build the nest. Nest I: Outer diameter 630 mm, inner diameter 320 mm, height 150 mm, and depth 30 mm. Nest II was constructed on a large, flat substrate. Leaves and stalks of the grass were used for construction. Outer diameter 730 mm, inner diameter 380 mm, height 460 mm and depth 18 mm (Figures 3 and 4).

Markings on the eggs differed between the nests. Nest I was encompassed by water. This resulted in more moisture to the nest material and a darker appearance of the nest. Eggs in this nest had dark/thick pigmentation on the shell, camouflaging them to the human eye. Nest II was located on an elevated dry flat with dry nest material. These eggs had dull/thin pigmentation on the shell (see Figure 2), again camouflaging them to the human eye. This phenomenon of egg shell colouration matching with the nest background was reported by Lee *et al.* (2010) in Black-tailed Gulls *Larus crassirostris*.

Figure 1. Map showing the nest site locations of Black-winged Stilt at PJTSAU College farm.

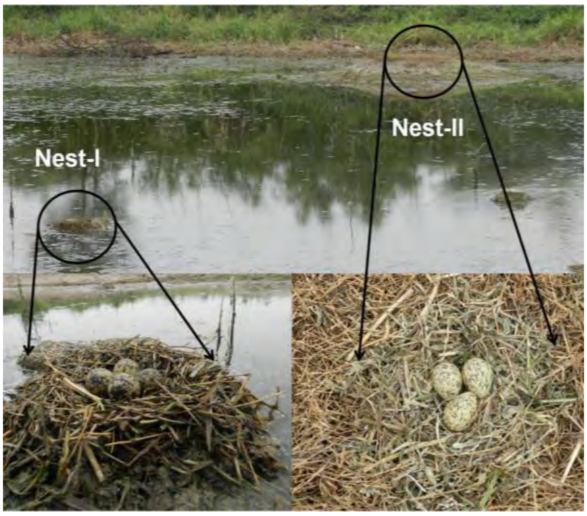

Figure 2. Nest placement and number of eggs in each nest.

Figure 3. Top left and right showing the outer and inner diameters of nests. Bottom showing the depth and height of nest.

Figure 4. Variations in egg pattern in each nest and incubation by Black-winged Stilt (Top -Nest I; Bottom -Nest II).

The egg size in nest I (length: 45 - 50 mm, width: 34 - 37.8 mm) was similar to nest II (length: 40 - 45 mm, width: 32.7 - 35 mm).

We monitored the nests every day between 06.00 and 07.30 hr and between 17.30 and 18.30 hr. Both sexes were observed incubating the eggs (Figure 4), as previously reported by Yeates (1937) and Cuervo (2003).

On 21st July 2016, when we arrived at the field site the birds were hovering and giving alarm calls. Six domestic dogs *Canis familiaris* were roaming in the water body. After eight to ten minutes the dogs located and consumed the eggs from both nests. They continued searching surrounding areas until labourers entered the area.

Nest site selection may have resulted in a low probability of fledging: i) the small water tank has a large catchment area (109 ha), and under normal monsoon rain patterns it would be flooded at this time; and ii) the site is within 300 m of the Rajendranagar village with garbage regularly deposited behind the wall. Due to this, local dogs regularly visit the area for food and sometimes enter the farm area (Figure 5).

Figure 5. Domestic dogs roaming in the PJTSAU College farm area.

At the college farm, domestic dogs are increasingly free ranging. They are commonly found in cities and appear to be increasing in semi urban, rural, natural areas and even within conservation units in search of food. Studies on predation of ground nesting bird eggs by dogs are limited (Sethi *et al.* 2011; Muralidhar and Barve 2013). Increasing numbers of dogs foraging in natural areas in India could have varied and complex ecological effects (Kay 1998), with implications for the conservation of threatened species.

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RECORDS OF COMMON SANDPIPER *ACTITIS HYPOLEUCOS* AT HIGH ELEVATION WETLANDS ON JAVA, INDONESIA

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The Common Sandpiper *Actitis hypoleucos* is known to breed at high altitudes, but its non-breeding distribution is usually associated with coastal and lowland wetlands (van Gils *et al.* 2017). In Greater Sundas – a non-breeding area – the species has been recorded up to 1400 m in Kersik Tuo and Rawa Bento, Kerinci Seblat National Park in Sumatera (Holmes 1996, Wibowo *et al.* 2013) and up to 1300 m in Sarawak, Borneo (Mann 2008). In Java, it is a widespread and common migrant, recorded from sea level to up to 1500 m (Hoogerwerf 1948, MacKinnon & Phillipps 1993). Here we report our observations from several high-altitude wetlands on Java above 1500 m.

During a visit to Ranu Pani lake, located at 2100 m, in Bromo Tengger Semeru National Park, East Java (8° 0' 48.19" S, 112° 56' 50.76" E) in November 2011, TA observed two Common Sandpipers present at the lake edge. Two birds were again observed at the same location in December 2011, and again in November to December 2012. In November and December 2013, TA recorded up to four birds in this location (Figure 1).

Ranu Pani is a 4 ha lake formed by ancient volcanic activity. The daily temperature averages around 10-28 °C and at night falls to between 5-6 °C (colder in the dry season). Water quality in the lake is poor, due to domestic waste and eutrophication. About 75% of the lake surface is covered by *Salvinia molesta* and other alien invasive species, such as *Alternathera sessilis* and *Zantedeschia aethiopica* (Hakim & Miyakawa 2015, T. Artaka *Pers. Obs.*). Many introduced species of fish can be found, such as Mozambique Tilapia *Oreochromis mossambicus*, Guppy *Poecilia* sp and Catfish. In recent years no other waterbird species have been present during surveys, however there are historical records of Pacific Black Duck *Anas superciliosa* and of Little Grebe *Tachybaptus ruficollis* breeding at the lake (van Balen 1992).

In the nearby Dieng Plateau, Central Java, Common Sandpiper were recorded in two high elevation locations. The first at the Sikidang Crater (2060 m; 7° 13' 10.49" S, 109° 54' 22.86" E) in Dieng Kulon village, Batur sub-district, Banjarnegara district, where a single bird was observed by SB on 16 February 2012. The second at Telaga Warna lake (2086 m; 7° 12' 56.78" S, 109° 54' 52.15" E), about 1 km from the Sidikang Crater. Here, on 18 January 2017 (Figure 2) and again on 23 January 2017, AH and RF observed a single bird. Previous visits by AH in June and August 2016 had not recorded the species. The occurrence of Common Sandpiper at the Sikidang Crater is notable, as the area is an active volcanic crater with hot mud ponds and dense sulfurous smoke (Figure 3). The temperature of the hotsprings reaches 61-88 °C (Ramadhan *et al.* 2013).

As far as we aware, no published information describes the presence of Common Sandpiper above 2000 m in Java as reported here, and so these records confirm the presence of the species at some of Java's

Figure 1. Common Sandpiper perched on a dead branch at Ranu Pani (2100 m), Bromo Tengger Semeru National Park, East Java on 10 December 2013. Photo: Toni Artaka.

Figure 2. A single Common Sandpiper on a dry area within the Telaga Warna lake (2086 m), Dieng Mountains, Central Java, on 18 January 2017. Photo: Ari Hidayat.

highest wetlands. Outside of the Greater Sundas region, Common Sandpiper has been recorded as high as 3500 m in the mountains of Papua (Bishop 2006) and as high as 4000 m in Turkey (van Gils *et al.* 2017).

Figure 3. The situation of Sikidang Crater (2060 m), Dieng Mountains, Central Java. Photo: Shaim Basyari.

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RED-NECKED PHALAROPE AT WERRIBEE WESTERN TREATMENT PLANT HAS UNUSUAL FEEDING MODE

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The Red-necked Phalarope *Phalaropus lobatus* has an almost circumpolar breeding distribution and has the unusual habit (shared with the Grey Phalarope *Phalaropus fulicarius*) of spending the non-breeding season in a tropical oceanic environment in three main areas. The nearest to Australia is in the Asian waters between The Philippines and Papua New Guinea. However, a small number (up to 20-30) regularly spend the non-breeding season in Port Hedland Saltworks, close to the northern coast of Western Australia. Elsewhere in Australia the Red-necked Phalarope only occurs as a rare annual visitor or vagrant (Higgins *et al.* 1996).

There have been occasional sightings of a Red-necked Phalarope at the Western Treatment Plant (WTP) of Melbourne Water (colloquially known as Werribee Sewage Farm) over the years. The most recent records were of a bird which visited there for three months (10^{th} January to early April 2016) in the 2015/16 non-breeding season and a bird which was present from 22^{nd} October-late February in the 2016/17 non-breeding season (Figure 1). This bird was observed by many birdwatchers over this period. Before that, the last record at the WTP was a bird present from at least 22 December 2005 to 25 June 2006 (WTP Count Data per D. Rogers).

The 2016/17 bird was caught and banded by the Victorian Wader Study Group, on 28 December 2016, when it was roosting with a large group of Red-necked Stints *Calidris ruficollis* and some Curlew Sandpipers *C. ferruginea* and Red Knot *C. canutus* on a rocky point of Port Phillip Bay adjacent to the WTP and close to the Beach Rd boat ramp. It was given a metal band (but no leg flag). The main parameters measured were bill (20.5 mm), head + bill (43.8 mm), wing length (111 mm) and weight (34 g). The bird was in primary moult ($5^6 4^1 2^1 0^2$) which, together with the lack of any residual juvenile plumage feathers, indicates that it was an adult (Figures 2 & 3). This was unusual in that most vagrants, where the age has been identified (waders and other species), have usually turned out to be immature birds, usually juvenile / first year birds. The biometric measurements were typical for Red-necked Phalarope and fell within the range of measurements obtained previously in Australia from 22 Red-necked Phalaropes caught at Port Hedland Saltworks on 18 October 2001 (Table 1).

Figure 1: Red-necked Phalarope at Kirk Point, near the Western Treatment Plant, 22 October 2016 (Dez Hughes).

Figure 2: Adult Red-necked Phalarope caught near the Western Treatment Plant on 28 December 2016 (Prue Wright)

Figure 3: The same adult Red-necked Phalarope caught on 28 December 2016, showing primary moult, with the outer two primaries not yet moulted (Prue Wright).

Table 1: Biometric Measurements of 22 adult Red-necked Phalaropes caught at Port Hedland Saltworks on 18 October 2001 (AWSG data) compared with 2016/17 bird.

	Mean	**Sample size**	**Range**	**Werribee 2016/17 bird**
Bill (mm)	21.1 ± 0.9	17	19.2 -22.4	20.5
Head and Bill (mm)	42.8 ± 1.2	22	40.3 – 45.0	43.8
Wing (mm)	110.1 ± 1.7	21	106 - 113	111
Weight (g)	30.4 ± 1.9	22	27 - 34	34

The 2016/17 bird may have been the same individual that had been present at the WTP in the 2015/16 non-breeding season because it occupied the same feeding and roosting areas and used the same distinctive feeding mode. In the latter part of the 2015/16 period the bird had changed from feeding on the sewage lagoons to using mainly the foreshore at the Little River estuary. During the 2016/17 season the Phalarope almost exclusively fed in the same area as the main wader flock on the foreshore from Kirk Point to the Little River estuary. For the majority of the time it fed while swimming in shallow water along the tide edge and less commonly in shallow pools on the mudflats usually pecking at food on either side. It was observed "spinning" on only a handful of occasions in the entire 2016/17 period. On rare occasions it walked clumsily on the mudflats while pecking food items from the surface of the mud (Figures 4 & 5). This unusual feeding mode has been recorded previously, but is apparently not widespread (Higgins *et al.* 1996). Presumably this option is only open to Phalaropes when they are not in their more normal oceanic habitats.

Figure 4: Red-necked Phalarope on the shore on 28 December 2016 (Andrew Hogg).

Figure 5: The lobed feet of the Red-necked Phalarope caught near the Western Treatment Plant on 28 December 2016 (Prue Wright).

At high tide, the 2016/17 bird always roosted on land with the main wader flock. The roost location was usually the rocky shore and beaches near Kirk Point and the Beach Road boat ramp rocks or less commonly on the dry edges of the sewage lagoons. During roosting it often perched on rocks with the other waders, though this has rarely been recorded previously.

Voluminous data worldwide has shown that most waders tend to return in the non-breeding season each year to the same non-breeding habitat / location (e.g. Burton and Evans 1997, Coleman and Milton 2012, Conklin *et al.* 2016, Leyrer *et al.* 2006, Piersma *et al.* 2016, Warnock and Takekawa 1996) This is particularly true for Red-necked Stints in Australia (VWSG and AWSG data). It seems possible, therefore, that this Red-necked Phalarope had inadvertently arrived at the WTP in the 2015/16 non-breeding season but had deliberately returned there in 2016/17. An extreme example of even a rarity returning to the same location each year is provided by a Semipalmated Plover *Charadrius semipalmatus* (originally the first for Australia) which has now been present at Broome Sewage Farm in north-west Australia in the last eight non-breeding seasons (per Chris Hassell).

Danny Rogers is thanked for providing reference and for assisting with the text

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ORIGIN OF THE AWSG FIVE STILT LOGO

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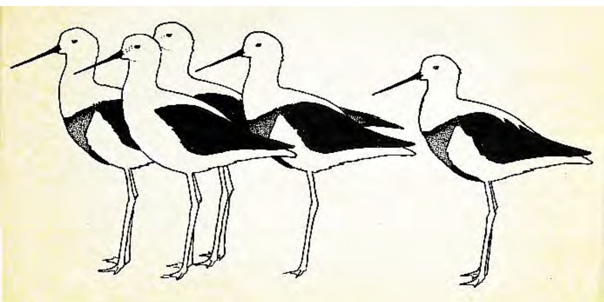
In a letter dated 2nd April 1981, John Martindale, then Organiser of the Royal Australasian Ornithologists Union, Australasian Wader Study Group, invited recipients to submit designs for 'an appropriate logo for the Group'. This invitation was repeated in a letter dated 27-5-81 [sic], with the words, 'You might also like to consider a logo for the group so that our first cover looks attractive'. John acknowledged receipt of a design by letter to me, dated Thurs. 3/6/81 [sic], with the text, 'Thanks for the logo. What I thought we might do is publish them in the first newsletter and invite comments on them. I have one small criticism of yours – I feel the birds should face into the page not out! Still I much prefer it over <u>all</u> the others – we have two submissions now!!!'

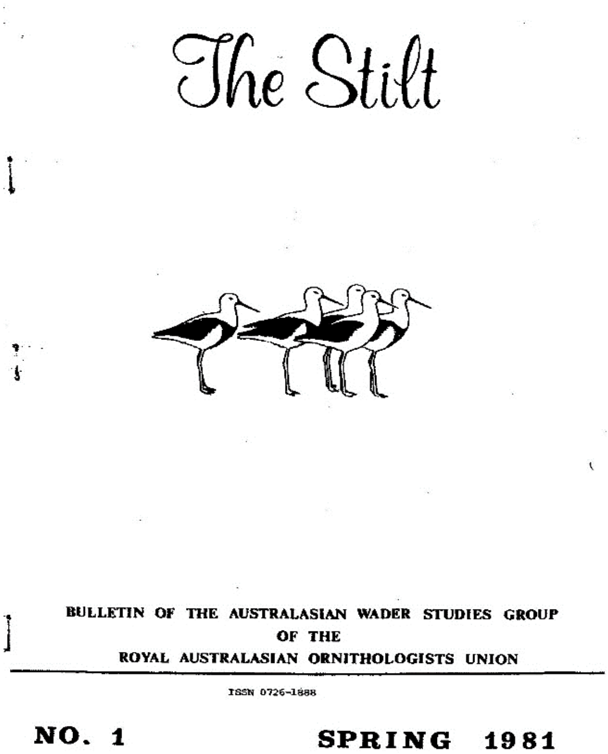
At the time I was active within the informal wader study group of the South Australian Ornithological Association and was keen to create and submit a design featuring the Banded Stilt. My thinking was that it was an attractive enigmatic species endemic to the region that would suit the new organisation well. It had been the subject of my honours thesis (McNamara 1976), so I was familiar with its appearance and typical everyday (non-breeding) habits.

Presumably, before the end of May 1981 I submitted a logo featuring five Banded Stilts facing left together with the group initialism in upper case classical Roman letters. In the original design the five birds, in left profile were grouped with four close packed and one spaced a little behind the others: the first bird shows a full banded plumage while the second bird, standing behind and to the front, shows a juvenile white-breasted condition, the third bird also a juvenile is mostly obscured but shows some greying of the face (lores) so was also intended to show the juvenile condition, the fourth bird is depicted standing on one leg and with its right (far-side) wing cocked up a little, while the fifth bird in full adult plumage is standing back a little and has the elongate white mantle feathers draped over the dark wing.



As a model I used the cover image of Roy P. Cooper's (1966) book. By tracing the depicted lone Banded Stilt in right profile, its off-side wing is displaced, not conformably settled, and its mantle feathers are not raised or visible over the wing, a template was made by reversing the tracing to produce a single bird in left profile, this template was used to compose some rough arrangements of grouped birds in felt pen on tracing paper. Seven bird and five bird rough layouts were produced before the original detailed five birds, in India Ink and white-out on tracing paper, was produced to be photocopied directly and in various reductions, so that it could be combined with the Group's initials to form a suitable letterhead. I did not record which or how many photocopies were submitted but retained the original and several working copies and paste-ups.

Later in 1981 the first, Spring, issue of 'The Stilt' was printed with five Banded Stilts in right profile, centrally placed on the front cover under the name. This was essentially the logo described here, though now reversed and slightly retouched with lines thickened and eye shapes altered, but bird 2 was still white breasted and bird 4 was on one leg with wing cocked as in the original.



The only relevant subsequent Group correspondence is a copy of a letter from me to John Martindale, Coordinator, AWSG, dated 10/11/81 [sic], in which the last paragraph begins, 'Pleased to see the Banded Stilt on the cover of the newsletter …'. I do not recall contemporary or subsequent mention in letter or in print of the origin of the Group logo design, including the format for the Group initials, nor of any influences involved in determining the journal (then Bulletin) name, itself.

My search of this journal for references to the logo has been limited to the early editions and has not been exhaustive, in tracing subsequent variations or iterations of the logo, as used in various ways over the intervening 36 years. I am not an historian, just an old 'orno' given to reminiscing. It is gratifying to see the five stilt logo still in use.

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WHITE-HEADED STILT (*HIMANTOPUS LEUCOCEPHALUS*) NOW AN INTERNATIONAL MIGRATORY WADER?

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The Black-winged Stilt genus (*Himantopus* sp.) has a worldwide distribution with populations occurring on all continents expect Antarctica (del Hoyo *et al.*, 1996). Some populations are sedentary; others are migratory (or at least partially so). In Australia the local species, recently reclassified as White-headed Stilt *Himantopus leucocephalus* (e.g. Gill and Donsker 2017), is regarded as resident (Higgins & Davies, 1993).

Banding and flagging have now shown that this species regularly makes long distance movements (up to 1750 km) within Australia (Table 1). Long movements have also recently been found to occur in two other species which share similar habitats in Australia – the Red-necked Avocet *Recurvirostra novaehollandiae* (movements up to 3000 km – VWSG & AWSG unpublished data) and the Banded Stilt *Cladorhynchus leucocephalus* (movements up to 2300 km – Minton *et al.* 2015, Pedler *et al.*, 2017).

The recent sighting of a Broome-flagged White-headed Stilt in Indonesia has potentially changed its Australian status from 'resident' to 'international migrant'. This note details this flag sighting and summarises current knowledge of movements of White-headed Stilt in Australia and over waters between Australia and Indonesia. It attempts to assess whether a part of the population makes regular migratory movements or whether this new record is just an extreme example of the more random dispersals previously reported for this species.

White-headed Stilt 083-24871 had an engraved yellow flag LKA on its right tibia and was marked as an adult – **not** a juvenile as first reported (CM *Pers. Comm.*) – in a cannon-net catch of 125 White-headed Stilts at a high-tide roost on the northern shores of Roebuck Bay, Broome, Western Australia (17^0 58' S 122^0 20' E), on 24 June 2017. It was subsequently observed by Iwan Londo, an experienced Indonesian ornithologist who specialises in waders, on 9 September 2017 at Sidoarjo Fish Ponds in East Java (7^0 27' S 112^0 44' E). This is 1573 km NNW of the banding location. This is the first recorded overseas movement of a White-headed Stilt marked in Australia (David Drynan, Australian Bird and Bat Banding Scheme *Pers. Comm.*).

There have previously been nine recorded long-distance movements within Australia of flagged White-headed Stilts, all also involving birds originally marked in the Broome region of north-western Australia (Table 1). Eight of these birds moved to the south-western part of Western Australia, to the area just south of Perth, with movement distances between 1705 and 1765 km (south south-west). They had all been banded in the June-July period and were subsequently reported in the August / January period. These movements all conform with the well-established pattern of large numbers of White-headed Stilt occurring in suitable habitats in northern Australia because of flooding during the January-March wet season. Most of these birds disperse as the dry season (April-November) advances. An additional long-distance movement from Broome was a White-headed Stilt that moved east to Tennant Creek Sewage Ponds (1256 km), where it was seen in late October.

The scale of these seasonal movements in Australia is large. At Roebuck Plains, for example, tens of thousands of White-headed Stilts sometimes occur towards the end of the wet season in March / April. In some years, the majority of these will disperse widely

Table 1. Flag sightings of White-headed Stilts marked at Broome in N.W. Australia

Date	Marking Location (Age, Moult)	Flag (ELF)	Resighting date	Location of sighting	Distanced moved
*	-	Yellow	08.10.94	Peel Inlet	1748 km SSW
	-	Yellow	13.10.07	Lake McLarty	1765 km SSW
	-	Yellow	30.10.10	Tennant Creek, N.T.	1256 km E
10.12.09	Taylor's Lagoon (2+, 5^{10})	Yellow (20)	01.11.10	Thomson's Lake	1705 km SSW
	-	Yellow	29.11.10	Lake McLarty	1765 km SSW
	-	Yellow	17.01.14	Lake McLarty	1765 km SSW
17.07.10	Broome (Juv., J^{10})	Yellow (50)	30.12.15	Goegrup Lake (Near Mandurah)	1745 km SSW
17.07.10	Broome (2+, 5^{10})	Yellow (83)	30.12.15	Goegrup Lake	1745 km SSW
04.07.12	Broome (1+, $6^2 5^8$)	Yellow (AR)	29.12.16	Lake McLarty	1765 km SSW
24.06.17	Broome (2+, $5^7 0^3$)	Yellow (LKA)	09.09.17	Sidoarjo, East Java, Indonesia	1573NNW

*Date of marking not known.
All sighting locations in south-west Western Australia unless stated otherwise.
Date of marking not known for birds with plain yellow flags

over the plains and nest. On Anna Plains, adjacent to 80 Mile Beach (180 km to the south-west of Broome), flooding is much less frequent. But in 1999 and 2000 the 'flood of the century' created a lake some 120 km long (Mandora Marsh) and an estimated 200 000 White-headed Stilts nested there in each year (Halse *et al.* 2005). Outside the wet season White-headed Stilts are only thinly and widely dispersed in these northern regions of Australia, with the greatest concentration usually being 400-800 birds which feed in Roebuck Bay and roost on the northern shores of the bay at high tide close to the Broome Bird Observatory at Crab Creek.

Further evidence of long movements by White-headed Stilts is demonstrated by the quite frequent records obtained from islands situated in the Timor Sea between northern Australia and Indonesia (Table 2). For example, during ten shorebird surveys at Ashmore Reef (12° 20' S 123° 0' E; 630 km north of Broome and 325 km off the Kimberley coast) White-headed Stilts were detected in five occasions, with one flock containing 21 individuals (Clarke and Herrod 2016). On the basis that such locations are typically only visited two to three times per year by ornithologists, and that records demonstrate White-headed Stilts are usually only present on an island for one or two days at a time, these observations support the notion that small numbers of White-headed Stilts regularly traverse marine waters between north-western Australia and Indonesia.

On 11 November 2017, a flock of 23 White-headed Stilts were observed heading southward (bearing 160°) over open ocean (13° 5'42"S, 123°13'16"E; 550 km north of Broome) between Ashmore Reef and Browse Island. The flock was observed flying in a line formation at heights between 10 m and 50 m. This flock was not recorded during shorebird surveys at Ashmore Reef in the four days prior to the sighting, so were not expected to have departed from that location. However, based on their direction of flight, it is likely they departed from an island to the north of Ashmore Reef, in the Lesser Sunda group of Indonesia.

There is further evidence of possible, more regular migrations by White-headed Stilts obtained from the "Visible Migratory Departures" studies by Broome Bird Observatory, carried out in March-April each year since 1981. At the commencement of the program sightings of White-headed Stilts on the shores from which the northern hemisphere migrants were seen departing were not regarded as migration-related. However more recently it has been increasingly realised that the behaviour of some of these birds is very similar to that of the Palaearctic migrants. Even stronger evidence of potential migration occurred on the 30 March 2016, when 55 White-headed Stilts were seen to depart northwards on migration at 1710 hrs, with the flock establishing the usual migratory formation as they departed. Ultimately, on this occasion, the birds did not to migrate and rather, returned to the bay within a few minutes. Nevertheless, this behaviour is strongly indicative of a desire to migrate as some Palearctic migrant waders engage in aborted departures, possibly because they find the wind conditions, as they gain height, not to their liking.

Primary moult details and some biometric data were collected from the White-headed Stilts caught on 24 June 2017. The adult birds had a wide range of moult scores ranging from 0^{10} (not started moult) to 5^{10} (completed a full moult), with many birds in active moult. 083-24871/LKA was, unusually, in arrested moult $5^{7}0^{3}$. This may be an indication that the bird was physiologically preparing for a long-distance flight.

There was a wide range of weights in the 23 birds weighed – from 116 g to 195 g, with most birds being in the range 150-160 g. The high weights could again have been an indication of birds capable of a further onward, long-distance movement – such as across the Timor Sea to Indonesia. Unfortunately, LKA was not one of the birds weighed. It is also worth noting that the weights of the five known (because they carried engraved leg flags) White-headed Stilts which remained in Australia were all in the range 153-161 g.

The above information demonstrates the possibility of small-scale regular overseas migratory movements of White-headed Stilts from north-western Australia. However, it seems that most White-headed Stilts visiting north-western Australia remain on the continent and do so as part of more regular seasonal movements – albeit of a similar magnitude (1750 km) to the overseas movement to Indonesia in 2017 (1570 km) reported here. The relatively high proportion of banded birds (ten retraps, all banded locally, in 135 birds caught) in the 24 June catch also suggests some consistency in the movements of

Table 2: Sightings of White-headed Stilt on islands between North-western Australia and Indonesia. Data sources: Clarke *et al.* (2017), Clarke & Herrod (2016), and G. Swann, M.J. Carter and R.H. Clarke unpubl. data.

Location	Dates and effort	Sightings
Ashmore Reef	Total 10 visits. April & November 2010 -2014 (twice annually) - Shorebird counts.	Middle Island: 2 in April 2010, 21 in April 2012 West Island: 8 in November 2012, 4 in April 2014 1 Sandbar, April 2014
Ashmore Reef	16 visits, all October/November visits, 1 in March/April - Birdwatching visits	West Island: 2 in October 2005, 1 in March 2014, 5 in November 2016
Cartier Reef	10 Visits. April and November 2010 – 2014 (twice annually) + previously published record.	1, March 1990 1, November 2010
Browse Reef	12 visits	9, November 2012

White-headed Stilts visiting north-western Australia. The ages of the ten retraps ranged from two to 15 years, with four individuals being at least 11 years old. The oldest recorded White-headed Stilt in Australia was a bird retrapped at Broome 21 years and eight months after it had originally been banded (David Drynan *Pers. Comm*.).

Higgins & Davies (1993) describe the movements of White-headed Stilt in Australia as being 'apparently dispersive'. It specifically states that there is no known regular movement to Papua New Guinea. In New Zealand, however, the White-headed Stilt breeding on South Island is migratory, with most individuals moving to the North Island for the winter. Elsewhere, in Asia, long-distance movements / migrations have been recorded, with several movements into / out of Taiwan (the most recent being 642 km to Okinawa, southern Japan) (Chung Yu Chiang *Pers. Comm*.). However, in Japan itself, only local movements have been recorded (Tomohiro *Pers. Comm*.).

Before the White-headed Stilt was classified as a separate species, the Black-winged Stilt was considered to have a cosmopolitan distribution, with at least five separate subspecies. Some were considered sedentary, whilst others were long-distance migrants, particularly with the breeding populations from North and Central American migrating to Central and South America and some of the southern European breeding birds migrating to Africa (del Hoyo *et al.* 1996). The populations inhabiting areas in and nearest to the tropics were the least migratory. It appears that seasonal conditions (particularly the wet season) are the principal governing factor on White-headed Stilt movements within Australia, but that a small proportion of the population may possibly move as far as Indonesia on a regular basis. It will be especially interesting to learn if 'LKA' is seen again elsewhere in the future.

Thanks are due to all those who have taken part in the banding and flagging of White-headed Stilt over the years. Roz Jessop is thanked for assistance with references. Adrian Boyle made helpful suggestions during the preparation of this paper.

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UNUSUAL NATAL AREA DEPARTURE OF HOODED PLOVER CHICKS

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On 9 January 2017, two or three Hooded Plover *Thinornis rubricollis* chicks were seen leaving the natal area by an unusual route. Although the chicks were not seen leaving the nest itself, they were observed leaving the area by jumping from a cliff to the beach below (Figures 1 and 2). This involved the parent birds repeatedly flying down to the beach, a drop of 4.9 m, while calling to the chicks, and then flying back up to the top of the cliff. After this process continued for approximately two or three minutes, each chick walked to the cliff edge and dropped to the beach. It was difficult to be sure if two or three chicks dropped down to the beach from our vantage point, some 100 m away. As there was very little time between each chick launching itself from the cliff top, and it was necessary to use binoculars to observe proceedings, given the distance from the jump off area, we could not be sure. The landing site for the chicks consisted of sandy beach interspersed with ragged isolated rocks and scattered dry beachwrack. One chick was seen to land in a small clear patch of sandy beach. On landing the chick was seen to bounce upwards on impact, then regain an upright position before running, rather slowly, away. The actual landing of a second chick was not seen, but it too was seen to run off towards the adult birds.

It was believed that a third chick may have leapt from the cliff, however if so it may have ended its fall amongst, or on, the rocks and become trapped or did not survive the rough landing. A search was made for this chick; however, it could not be located. Only two chicks were seen on the beach with the adults. Some time after the chicks had made their fall to the beach one of the adults was observed running around near the nest on top of the rocky outcrop, calling in an agitated manner. It was surmised that the adult was looking for the missing chick as there seemed to be no other reason for this behaviour.

The cliff involved in the incident is a part of the calcarenite headland of Nora Creina, South Australia (37^{0} $19'$ S, 139^{0} $50'$ E). The cliff itself is part of a now isolated rocky outcrop, a remnant of the Robe Range (Short 2006), surrounded by the sea on two sides and sandy beach on the other two. The top of the rocky outcrop is generally flat although on a slight incline towards the mainland, with an area of approximately 4,000 m^2. The Hooded Plover nest was previously sighted by MC and was located near the top of the outcrop. This site has been used as a Hooded Plover nesting site for at least several years. It was presumed that the plovers would walk the chicks down the incline towards the upper beach from the nest location. Rather than jumping from the cliff, walking the chicks another 11.3 metres down the incline would have resulted in a lesser drop of 3.05 metres. To reach the lowest point of the outcrop a relatively short drop of just 0.5 metres would have been required after walking another 18.2 m.

Hooded Plover nesting on rocky outcrops is said to be an occasional occurrence in various literature sources (e.g. Marchant & Higgins 1993, Maguire 2008) however no references can be found for chicks jumping from cliffs. This behaviour is however well known and documented for those duck species which nest in high tree hollows, e.g. Australian Wood Duck *Chenonetta jubata* (Marchant and Higgins 1990), where the chicks are said to float to the ground. In the case of shorebirds, the Green Sandpiper *Tringa ochropus* uses old and disused passerine nests and the chicks drop to the ground (Nethersole-Thompson & Nethersole-Thompson 1986).

Figure 1. Rocky outcrop at Nora Creina. Arrow shows jump-off point. Spot shows lateral area of nest (Photo: Maureen Christie)

Figure 2. Close view of rocky outcrop at Nora Creina. Arrow points to jump-off site. (Maureen Christie)

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NORTH-WEST AUSTRALIA WADER & TERN EXPEDITION 2017 REPORT WEDNESDAY 8TH FEBRUARY TO THURSDAY 2ND MARCH 2017

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INTRODUCTION

The NWA 2017 Expedition was a marked contrast to the NWA 2016 Expedition. Instead of an ultra-dry February, we experienced a true 'wet season' – in fact one of the wettest wet seasons in recent years, with a total of over 1000 mm of rain in the Broome area in the December to March period. Although it rained on all but four of the 22 days of the Expedition, it did not interfere with any of the cannon netting catches or cause the alteration of any of our fieldwork plans. However, it did mean that our vehicles had to suffer repeated immersions in red pindan pools which sometimes stretched for 100+ metres on the road out to the Broome Bird Observatory.

The 2016 Expedition produced a record catch total of 4303 birds, but the 2017 catch totalled 2657 – below the long-term average of just over 3000 birds caught for each Expedition. Most of the short-fall occurred at Roebuck Bay, Broome, rather than at 80 Mile Beach. This year, few of the 'less commonly caught' species were trapped. This was partly because some, such as Little Curlew, Oriental Plover and Oriental Pratincole, were almost totally absent from NWA habitats this year (presumably having moved to more inland sites), and partly because we experienced some technical problems (misfires, compounded on one occasion by a jump rope around the furled net!), reducing catching efficiency.

Despite this introduction giving the impression of difficulties and underachievement in 2017, some excellent catches were made, particularly at 80 Mile Beach and everyone thoroughly enjoyed all aspects of the Expedition. Key objectives were achieved. This included sampling the main species to determine 2016 breeding success from the percentage of juveniles in catches. We also managed to make a sufficient number of retraps (238) to enable the calculation of annual survival rates for the more common species.

The field team was the same size (30) as in 2016. Again, almost half of the team members came from overseas. There was a particularly strong representation of Chinese participants, with five people from Taiwan, two from mainland China and two from Hong Kong. Sixteen of the participants had previously taken part in NWA Expeditions, including two from the first Expedition in 1981 and another from the 1982 Expedition. Much training took place, as usual, during the Expedition, notably with Katherine Leung (one of the Expedition leaders) qualifying for her cannon netting endorsement.

Mid-week start and finish dates did not seem to deter participants. We will therefore continue to select dates in the future with the optimum tide conditions. Dates selected for the next Expedition are Monday 12 February to Tuesday 6 March 2018.

MAIN ACHIEVEMENTS

Catching

A total of 1731 waders were caught at 80 Mile Beach in ten catching days and a total of 926 waders at Broome in six catching days (on one of which we failed to catch) (Tables 1& 2). In addition, 160 terns were also caught, at 80 Mile Beach. This gives an Expedition catch total of 2657.

The largest catch was 622 on 28 Feb. at Nick's Beach, Broome. The average catch size was 157 birds at 80 Mile Beach and a little larger (185) at Roebuck Bay, Broome. The most frequently caught species were Greater Sand Plover (715) and Great Knot (553). Other species where greater than 100 were caught were Red-necked Stint (390), Grey-tailed Tattler (228), Bar-tailed Godwit (182) and Curlew Sandpiper (149) (Table 3).

Note the almost complete absence of species such as Grey Plover, Eastern Curlew, Little Curlew, Black-tailed Godwit, Common Greenshank, Ruddy Turnstone, Broad-billed Sandpiper, Oriental Plover and Oriental Pratincole. Because of our lower overall catching rate, time did not allow us to target many of these species during the Expedition. However, in some cases there just weren't sufficient individuals in the NWA area to make the targeting of species practical.

A success, however, was the targeting of Red Knot on the first day of catching at 80 Mile Beach. Chris Hassell had noticed from earlier population census visits that this species was mainly concentrated about 50 km south of the Anna Plains entrance – some 10 km further south than we normally make catches. The sand is very soft in this area but is navigable on the lower high tides. There were thousands of Red Knot present when we visited on 10 February and we succeeded in catching 86. We only caught 11 more during the remainder of the Expedition.

One species which we caught more of than in most recent years was the White-winged Black Tern. The flocks seen on the shore and feeding on the adjacent rangeland were bigger than any seen in 2016. This facilitated the first significant cannon net catch of this species since 2009, White-winged Black Tern adjourn to roost on the sandy shores of 80 Mile Beach in the heat of the day. One hundred and forty-eight were caught, this being the largest catch of this species since 2009. A retrap from this catch was the oldest yet for this species in Australia (eight years). It is also interesting to note that many of the birds had considerable patches of yellow on their body plumage derived from their habit of picking insects from the tops of large grass stems, which at that time were in full flower on the adjacent Plains.

Table 1: NWA 2017 Expedition Catch Totals (Waders)

Catches	Location	Sub-site	New	Retrap.	Total
10/02/2017	80 MILE BEACH	51 km south of AP	86	2	88
11/02/2017	80 MILE BEACH	42 km south of AP	299	6	305
12/02/2017	80 MILE BEACH	41 km south of AP	216	11	227
13/02/2017	80 MILE BEACH	40 km south of AP	145	7	152
14/02/2017	80 MILE BEACH	41 km south of AP	156	8	164
15/02/2017	80 MILE BEACH	29 km south of AP	179	8	187
16/02/2017	80 MILE BEACH	26 km south of AP	372	12	384
17/02/2017	80 MILE BEACH	24 km south of AP	1	0	1
18/02/2017	80 MILE BEACH	6 km south of AP	34	1	35
19/02/2017	80 MILE BEACH	8 km south of AP	28	0	28
Sub-total			**1516**	**55**	**1571**
Terns			159	1	160
Total Anna Plains			**1675**	**56**	**1731**
24/02/2017	BROOME	West Quarry	9	2	11
25/02/2017	BROOME	Stilt Viewing	1	1	2
26/02/2017	BROOME	Eagles Roost	161	65	226
27/02/2017	BROOME	West Quarry	53	12	65
28/02/2017	BROOME	Nicks Beach	464	158	622
1/03/2017	BROOME	No catch			
Sub-total			**688**	**238**	**926**
Total Broome			**688**	**238**	**926**
Total Waders			**2204**	**293**	**2497**
Total Terns			**159**	**1**	**160**
Total Waders and Terns			**2363**	**294**	**2657**

Table 3: NWA2017 Expedition - Wader & Tern Catch Details

Species	New	Retrap	Total	Juv.	%Juv.
Bar-tailed Godwit	140	42	182	20	11
Black-tailed Godwit	6	0	6	3	50
Broad-billed Sandpiper	11	1	12	5	42
Common Greenshank	3	0	3	0	0
Curlew Sandpiper	126	23	149	60	40
Great Knot	477	76	553	50	9
Greater Sand Plover	647	68	715	85	12
Grey-tailed Tattler	205	23	228	33	14
Lesser Sand Plover	6	0	6	0	0
Little Tern	12	0	12	0	0
Red Knot	94	3	97	21	22
Red-necked Stint	340	50	390	66	17
Ruddy Turnstone	23	2	25	9	36
Sanderling	7	0	7	1	14
Terek Sandpiper	115	5	120	7	6
Whimbrel	4	0	4	0	0
White-winged Black Tern	147	1	148	0	0
Total	**2363**	**294**	**2657**	**360**	

Recaptures and Controls

As usual, the retrap rate at 80 Mile Beach (3.5%) was much lower than at Roebuck Bay (25.7%). This is because catches are only made at 80 Mile Beach during the Expedition whereas at Roebuck Bay in Broome catches occur throughout the June-October period as well as during the Expedition. Also, with the total population of waders at 80 Mile Beach being some six to eight times larger than at Roebuck Bay, with catching being spread over a 30 kilometres length of beach, the chances of making recaptures are reduced. Nevertheless, a total of 294 recaptures for the whole Expedition, 11.7% of birds caught, is significant.

This year there was only one control of a Chinese banded bird (Table 4). In addition, a Red Knot from Victoria, was caught, this bird having changed its non-breeding location by 3000 km.

Table 2: Comparison of catches during the 2006-2017 expeditions (including terns)

Catches	Year	New	Retrap	Total
Broome	2006	857	174	1031
(1st period)	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
	2015	623	288	911
Second part of expedition	2016	1529	365	1894
	2017	688	238	926
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
	2015	1152	46	1198
First part of expedition	2016	2312	97	2409
	2017	*1675*	*56*	*1731*
Broome	2006	1120	176	1296
(2nd period)	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	No 2nd period		
	2015	No 2nd period		
	2016	No 2nd period		
	2017	No 2nd period		
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	675	3830
	2015	1775	334	2109
	2016	3841	462	4303
	2017	2363	294	2657

Table 4: NWA 2017 Controls (recaptures of birds banded elsewhere)

Species	Band Number	Date Banded	Banding Location	Age at Banding	Retrap Date	Retrap Location
Red Knot	052-52107	20/10/2007	Queenscliff, Victoria	3+	10/02/2017	80 Mile Beach (51 km S)
Great Knot	F127500	25/03/2013	Chongming Dongtan, China	2+	15/02/2017	80 Mile Beach (29 km S)

Table 5: Oldest Recaptures during NWA 2017

Species	Band	Date banded	Banding location	Age at banding	Retrap date	Retrap location	Minimum age at retrap
Red Knot	052-00113	18/07/1999	80 Mile Beach	2	10/02/2017	80 Mile Beach (51km Sth)	20
Great Knot	062-58105	10/01/2001	80 Mile Beach	2	11/02/2017	80 Mile Beach (41km Sth)	18
Great Knot	062-79297	25/02/2005	80 Mile Beach	2+	13/02/2017	80 Mile Beach (42km Sth)	14+
Terek Sandpiper	052-01775	10/01/2001	80 Mile Beach	2+	14/02/2017	81 Mile Beach (42km Sth)	18+
Greater Sand Plover	062-44070	7/09/1998	80 Mile Beach	3+	16/02/2017	80 Mile Beach (40km Sth)	21+
Greater Sand Plover	052-40404	18/11/2005	80 Mile Beach	2+	16/02/2017	80 Mile Beach (29km Sth)	13+
Great Knot	062-79277	25/02/2005	80 Mile Beach	2+	16/02/2017	80 Mile Beach (26km Sth)	14+
White-winged Black Tern	042-63959	4/03/2011	80 Mile Beach	2+	17/02/2017	80 Mile Beach (22km Sth)	8+
Bar-tailed Godwit	072-81444	23/03/2002	Roebuck Bay	2+	25/02/2017	Roebuck Bay (Wader Beach)	17+
Bar-tailed Godwit	072-55005	18/04/1994	Roebuck Bay	1+	26/02/2017	Roebuck Bay (Eagle's Roost)	24+
Bar-tailed Godwit	072-55009	18/04/1994	Roebuck Bay	1+	26/02/2017	Roebuck Bay (Eagle's Roost)	24+
Bar-tailed Godwit	073-21168	5/03/2005	Roebuck Bay	2	26/02/2017	Roebuck Bay (Eagle's Roost)	14
Bar-tailed Godwit	073-01001	1/12/2002	Roebuck Bay	2+	26/02/2017	Roebuck Bay (Eagle's Roost)	16+
Bar-tailed Godwit	073-21192	12/06/2005	Roebuck Bay	2	26/02/2017	Roebuck Bay (Eagle's Roost)	14
Great Knot	062-57517	30/05/2000	Roebuck Bay	1	26/02/2017	Roebuck Bay (Eagle's Roost)	17
Great Knot	062-75963	18/11/2002	Roebuck Bay	2+	26/02/2017	Roebuck Bay (Eagle's Roost)	16+
Greater Sand Plover	052-26181	15/11/2001	Roebuck Bay	1	28/02/2017	Roebuck Bay (Nick's Beach)	16
Curlew Sandpiper	042-16909	16/08/2003	Roebuck Bay	2	28/02/2017	Roebuck Bay (Nick's Beach)	15
Great Knot	062-57405	4/03/2000	Roebuck Bay	2+	28/02/2017	Roebuck Bay (Nick's Beach)	19+
Great Knot	062-79645	2/03/2005	Roebuck Bay	2+	28/02/2017	Roebuck Bay (Nick's Beach)	14+
Great Knot	062-58758	1/01/2001	Roebuck Bay	2+	28/02/2017	Roebuck Bay (Nick's Beach)	18+
Great Knot	062-78447	13/02/2004	Roebuck Bay	1	28/02/2017	Roebuck Bay (Nick's Beach)	14

Old Birds

A selection of 24 of the oldest birds recaptured during the Expedition is given in Table 5. The most notable, by far, were two Bar-tailed Godwits banded together in Roebuck Bay on the 18th of April 1994, and retrapped together on the 26th of February 2017, when each bird was a minimum of 24 years old. The next oldest bird was a Greater Sand Plover which was a minimum of 21 years old, followed by a 20-year-old Red Knot. Interestingly, eight of the old birds were from 80 Mile Beach – rather surprising given that retrap rates there are so much lower than at Roebuck Bay, Broome.

A newcomer to the 'old birds' list is the White-winged Black Tern, which was a minimum of eight years old. However, since many terns seem to be at least as long-lived as waders, it is possible that in due course we may be able to obtain White-winged Black Tern retraps which are much older.

Proportion of Juveniles

Overall there was a considerable improvement in the level of breeding success of waders in the boreal summer of 2016 compared with 2015 (Table 6). Curlew Sandpipers did exceptionally well, producing an average of 40.3% juveniles. Ruddy Turnstone also had a high figure of 36% juveniles. However, most of the species had a below-average breeding success – the second consecutive year for several species. The Curlew Sandpiper figure was like that obtained in the 2016/17 non-breeding season in south-eastern Australia by the Victorian Wader Study Group. The exceptional 2016 breeding of Curlew Sandpiper was also very noticeable in India, where the percentage of juveniles was close to 50% (Balachandran, *Pers. Comm.*). We certainly hope the 2017 breeding season proves a better one for most of the wader populations which visit North West Australia.

The high percentage juvenile figure (40%) this year means that two out of every five birds in the non-breeding flocks of Curlew Sandpipers are less than one-year old. This means that on the Arctic Tundra during the 2016 breeding season every pair of Curlew Sandpiper produced an average of 1.3 young. Given that this figure was measured some six months after the breeding season, and after the completion of their first southward migration (considered to be a particularly hazardous event), then the rate of production of young to the free-flying stage in July 2016 must have been even higher.

Table 6: Percentage juveniles in cannon net catches during NWA 2017 Expedition. No. Juv = Number of Juveniles, % Juv. = Percentage juveniles in total catch, Mean % Juv. = Mean percentage juveniles 1998/99 to 2015/16.

Species	Total Catch	No. Juv.	% Juv.	Mean %Juv.	2016.breeding success
Great Knot	553	50	9.0	11.1	Below average
Greater Sand Plover	715	89	12.4	22.7	Very poor
Red-necked stint	390	67	17.2	19.6	Below average
Bar-tailed Godwit	182	20	11.0	10.4	Average
Grey-tailed Tattler	228	33	14.5	19.8	Poor
Curlew Sandpiper	149	60	40.3	16.7	Exceptionally good
Terek Sandpiper	120	7	5.8	13.3	Very poor
Red Knot	97	21	21.6	15.8	Good
Ruddy Turnstone	25	9	36.0	N/A	Very good

Many such good breeding seasons will be needed to restore the population to the level of the early 1980s, before the major decline of Curlew Sandpipers commenced in The Flyway (Studs, C. E. *et al*.).

The most noticeable differences in percentage juvenile figures between the 2015/16 and the 2016/17 season were in Red Knot (2.7% vs. 21.6%) and Ruddy Turnstone (11.2% vs. 36.0%) (Table 7). Both these species bred much more successfully in the 2016 arctic summer following their almost complete breeding failure in 2015. Although the sample of Ruddy Turnstone was small this year, the credibility of the exceptionally high 36% juveniles figure is supported by the >30% juveniles' figures obtained in south east Australia by the Victorian Wader Study Group in the 2016/17 breeding season.

Terek Sandpiper and Greater Sand Plover both had poor breeding success for the second consecutive year. The latter has regularly had percentage juvenile figures above 20% over the last 18 years (mean 22.7%, Table 7), but has recorded a figure around half this level (10.5% and 12.4%) in the most recent two years. It will be interesting to see if this is reflected in population levels (via the AWSG biannual counts).

Satellite Transmitters

The AWSG has, so far, not done well in its attempts to gain additional valuable migration data using satellite transmitters. As in the previous three years, most transmitters deployed did not survive a full annual cycle on birds, with many ceasing to operate well within their first year. In fact, most of the transmitters which failed did so during stop-overs on northwards migration. At present, there is no explanation for this higher than expected level of failure to collect data, but we suspect failures may be mostly due to problems in the harness attachment system, allowing transmitters to be shed by birds or at least moved into a position where they are not satisfactorily charged each day by the sun. It is also possible that the higher failure rate may be because birds are more subject to predation when they are carrying a transmitter – either because it draws attention to the bird by making it more obvious to a predator or because the massive (up to 100%) weight fluctuations which our waders regularly undergo may cause harnesses to be pulled out of place, broken or loosened sufficiently to enable them to be shed.

The five 5 g units deployed on Grey Plover in February 2016 all failed within five months of deployment, with only two birds reaching their breeding grounds and none completing the return journey to Australia. Nevertheless, much has been learnt about the migratory movements of Little Curlew and Grey Plover.

An even greater disappointment in 2017 was that all five satellite transmitters deployed on Grey-tailed Tattler failed since being deployed in February at 80 Mile Beach. No transmitters survived longer than seven weeks, and no bird had therefore departed on northwards migration. Some of the birds have been seen in the wild with broken aerials (still alive). Because the failures are thought to be associated with the harness and aerial, which was supplied with the 2 g units by Microwave Telemetry Inc., MTI have most generously agreed to provide replacement transmitters for use during the next non-breeding season (2017/18). So, hopefully, we will have the beginning of an exciting story on Grey-tailed Tattler by February next year.

Five 5g satellite transmitters were deployed on Whimbrel (Figure 1) – one at 80 Mile Beach and two at Roebuck Bay, Broome in February and two more there in late March (by mist netting on the plain behind BBO at night). At the time of writing, four of these transmitters were operating. The birds were expected to depart from Broome in mid-April (By 24 April – Three Whimbrel left Broome. Two made their first stop in Taiwan. The other was over the equator and still flying). So hopefully we shall have some tracks to follow their northward migration. Whimbrels have been extensively studied by

Table 7: Percentage juveniles in N.W. Australia cannon-net catches.

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	14/ 15	15/ 16	*Mean (18 yrs)*	16/ 17
Red-necked Stint *Calidris ruficollis*	26	46	17	17	41	10	13	20	21	20	10	17	18	24	14.8	16.5	10.3	11.1	*19.6*	17.2
Curlew Sandpiper *C. ferruginea*	9.3	24	11	19	15	7.4	21	37	11	29	10	35	24	1	1.9	25.1	18.5	0.7	*16.7*	40.3
Great Knot *C. tenuirostris*	2.4	4.4	18	5.2	17	16	3.2	12	9.2	12	6	41	24	7	6.6	4.0	6.5	5.7	*11.1*	9.0
Red Knot *C. canutus*	3.3	14	9.6	5.4	32	3.2	(12)	57	11	23	12	52	16	8	1.5	8.3	13.3	2.7	*16.8*	21.6
Bar-tailed Godwit *Limosa lapponica*	2.0	7.7	4.8	15	13	9.0	6.7	11	8.5	8.0	4.0	28	21	8.0	7.6	17.0	5.5	10.3	*10.4*	11.0
Non-arctic northern migrants																				
Greater Sand Plover *Charadrius leschenaultii*	25	33	22	13	32	24	21	9.5	21	27	27	35	17	19	28.2	23.6	*19.9*	10.5	*22.7*	12.4
Terek Sandpiper *Xenus cinereus*	12	N/A	8.5	12	11	19	14	13	11	13	15	19	25	5	12.3	15.2	*12.3*	9.2	*13.3*	5.8
Grey-tailed Tattler *Tringa brevipes*	26	N/A	17	17	9	14	11	15	28	25	38	24	31	20	17.8	15.8	*19.0*	8.9	*19.8*	14.5

All birds cannon-netted in the period 1 November to mid-March. Averages (for previous 18 years) exclude figures in brackets (small samples) and exclude 2016/2017 figures.

Figure 1: Deploying 5 g satellite transmitter on Whimbrel in Broome (Photo: David Chang) (Photo: Richard Loyn)

satellite tracking in North America, but these will be the first individuals for the East Asian- Australian Flyway.

Flag Sightings

Only a modest amount of time was available for scanning for leg flags during the Expedition. Efforts were primarily concentrated on foreign flagged birds (mainly Great Knot from China) and on scanning for leg flags on Red Knot marked with colour-combinations in NWA by Chris Hassell/Global Flyway Network. Whilst plenty of Chinese flagged birds were seen, there was a noticeable decrease in the number captured during the banding operations (only one from China this year, compared with 11 during NWA 2016, Table 4). This may be indicative of some reduction in banding intensity in China, particularly for Great Knot at Chong Ming Dongtan. A Great Knot carrying ELF from Kamchatka, Russia was seen in Broome.

'Passerine' Banding

Some successful mist-netting was carried out around the Anna Plains Homestead (Table 8). This included a couple of beautiful Red-winged Parrots as well as seven Pied Butcherbirds and 17 Yellow-throated Miners.

OTHER MATTERS

Participants

The 30 volunteer participants came from Australia (16) and five overseas countries (14). In addition, at 80 Mile Beach, Kimberley Ranger Network Rangers from the Karajarri and Nyangumarta, traditional custodians of 80 Mile Beach, also fully participated in the Expedition. The 47% overseas origin is like most other North-West Australia Expeditions.

The Kimberley Ranger network is facilitated by the Kimberley Land Council and is supported by the Australian Federal Government. Indigenous land and sea Rangers undertake cultural and natural resource projects to improve and enhance the unique biodiversity and cultural values of the 80 Mile Beach Marine National Park and at Roebuck Bay (Yawuru).

Details of origins are:

16 Australia (8 WA, 6 Vic, 1 NT, 1 Qld)
5 Taiwan
2 China (mainland)
2 China (Hong Kong)
2 Japan
2 Netherlands
1 UK

Figure 2: The team enjoying Cape Missiessy on a day-off

Table 8: Passerine Mist-netting

Site	Date	Species	New	Retrap	Total	Nets
Anna Plains Station (Homestead)	18/02/17 5:30 to 7:00 AM	Yellow-throated Miner	11	0	11	3x15m 1x6m
		Pied Butcherbird	6	0	6	
		Red-winged Parrot	1	0	1	
TOTAL			**18**	**0**	**18**	
Anna Plains Station (Homestead)	19/02/17 5:30 to 7:30 AM					
		Yellow-throated Miner	1	1	2	3x15m 1x12m
		Pied Butcherbird	1	0	1	
TOTAL			**2**	**1**	**3**	
Anna Plains Station (Homestead)	20/02/17 5:30 to 8:00 AM	Brown Honeyeater	1	0	1	4x15m 1x12m
		Yellow-throated Miner	2	2	4	
		Red-winged Parrot	1	0	1	
TOTAL			**4**	**2**	**6**	

Itinerary

This followed the same pattern as in 2016, with ten catching days being spent at 80 Mile Beach followed by seven at Broome. These were separated by four days when tides were too low for cannon netting. One day was spent birdwatching at Anna Plains/80 Mile Beach, one on transferring the team back to Broome from 80 Mile Beach and two in the Broome area (looking at birds on the flooded Roebuck Plains) (Figure 2).

Talks

Evening talks on a wide variety of subjects were again presented by Expedition members in the evenings at both

Anna Plains and Broome. Subjects covered (not in any particular order) were:
- Microlight Project, 'Wing Threads: Flight to the Tundra' – Milly Formby
- Bar-tailed Godwit Genetics – Jesse Conklin
- Bohai Bay/Red Knot – Chris Hassell
- Passerine Banding in Japan – Noboru Nakamura
- Wader Expedition to Kamchatka 2016 – Robert Bush
- Ruffs – Yvonne Verkuil
- Broome Birds - Nigel Jacket (BBO Warden)
- Orinoco Wetlands – Richard Lyon
- Foraging Ecology of Shorebirds on Roebuck Bay – Grace Maglio
- Alaska 2016 – Emilia Lai (BBO Assistant Warden)
- Yalu Jiang (northern Yellow Sea) – Wang Xiaofei
- Red Knot Migration (PhD project) – Ginny Chan
- Little Terns in Taiwan – Le-ning Chang (Ning)
- The Migrations of Roseate and Black-naped Terns – Kiyo Ozaki

Several other members of the Expedition had prepared presentations but we ran out of time!

Finances

The Expedition was again financed primarily through participants' contributions of $39 per day (for food and operating costs/overheads), $40 per day for transport costs and $10 per night for our stay at Anna Plains Station. Additional most generous funding was received from the department of Department of Parks and Wildlife WA, who loaned us three four-wheel drive vehicles for the duration of the Expedition and two large trailers to assist our travels down to and from Anna Plains/80 Mile Beach.

Costs are yet to be finalised as various items of equipment (e.g. powder, fuses, engraved flags etc.) are still to be purchased to replace those used during the Expedition. But it is again estimated that we will finish with a small surplus.

The final surplus for the NWA 2016 Expedition was $5469. This balance has been carried forward for use on equipment purchases (including satellite transmitters) and further Expeditions in NWA.

NEXT EXPEDITION

Having been tested by a proper wet season this year, we are now happy that it is practical to schedule successful Expeditions in the wet season period in NWA. This means that we can continue to use a February date, which has advantages over a November date (which was used for many years). The cloudiness and occasional rain resulted in significantly lower temperatures in February which is of benefit to both the birds and the team. Also, starting or finishing the Expedition on a non-weekend date seemed to work satisfactorily for the NWA 2017 Expedition and gives an advantage in being able to select optimum tides for catching.

The most suitable series of tides in early 2018 occurs from Monday 12 February to Tuesday 6 March and so these will be the dates for the NWA 2018 Expedition. We again intend to spend the first half of the Expedition at Anna Plains/80 Mile Beach with the remainder of the period then being at Broome. We do hope that many members of the NWA 2017 team will return in 2018. If you are not able to come yourself, could you possibly please find a suitable replacement? The success of our expeditions is maximised if at least half the team have had previous experience of catching and banding waders in North West Australia. It is also a marvellous opportunity to share time in the field with experts from other parts of The Flyway and from the worldwide community of wader enthusiasts.

ACKNOWLEDGEMENTS

Considerable thanks are due to the West Australian Department of Parks and Wildlife not only for providing three vehicles and trailers but also for financially assisting the participation of four of the participants from Taiwan.

We are again enormously grateful to Anna Plains Station for hosting the Expedition for 12 days. To be able to live in the homestead compound, with its attendant facilities, greatly alleviates any problems associated with it being the wet season. Also, to be allowed to roam anywhere on the Station looking at or catching birds is hugely appreciated.

Figure 4: The NWA Expedition Team 2017 (Photo: Robert Bush**)**

Figure 3: The new Shade-house at BBO (Photo by Katherine Leung)

Broome Bird Observatory was again our base for nearly half of the Expedition. We were the first beneficiaries of a completely refurbished shade-house (Figure 3). This has a much higher roof and insect-mesh walls and is therefore far cooler and lighter than the previous shade-house. The construction of this new facility was completed on the day on which participants arrived in Broome! It was a bold decision by BBO management to carry out this major refurbishment in the January period and they are congratulated on finishing it right on time just before the Expedition arrived.

The AWSG and Global Flyway Network thanks the Yawuru, Karajarri and Nyangumarta traditional owners for permission to conduct research on their lands.

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:
WA: Milly Formby, Kerry Hadley, Chris Hassell, Grace Maglio, Ken Mills, Maurice O'Connor, Frank O'Connor, Jill Rowbottom.
VIC: Mike Dawkins, Roz Jessop, Richard Loyn, Clive Minton, Hannah Smith, Prue Wright.
NT: Peter Newberry.
QLD: Robert Bush.
China:
Mainland: Ma Li, Wang Xiaofei.
Hong Kong: Katherine Leung, Ying Chi Chan (Ginny)
Japan: Noboru Nakamura, Kiyo Ozaki.
Netherlands: Jesse Conklin, Yvonne Verkuil.
UK: James Kennerley.
Taiwan: Han-Po Chang (David), Le-Ning Chang (Ning), Meng-Chie Feng (Blackie), Emilia Lai, Kun-Chang Li (Murray).

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CONSERVATION STATUS OF NEW ZEALAND'S BREEDING SHOREBIRDS: THE ISSUES AND THE OUTLOOK

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The New Zealand avifauna has one of the highest proportions of threatened species of any avifauna globally. The 18 extant shorebird taxa that breed in New Zealand typify this; 8 are classified as Threatened, 9 as At Risk, and only 1 is Not Threatened. Three other taxa are recently extinct. The main reason for the declines and extinctions has been predation by introduced mammals, and predator control or eradication has been the single most important management tool in preserving extant taxa. Recent rat incursions on two islands have provided graphic evidence of the susceptibility of the shore plover to predation. Other issues facing New Zealand shorebirds, particularly on the mainland, include loss and degradation of habitat, a resource management system that does not always offer adequate protection, and a massive shortfall in funding for management and research. These issues are compounded by public and political ignorance (or even denial) of the state of our biodiversity and the impacts of human activities on it. Climate change will pose further challenges for coastal species and for shorebirds that breed in riverbeds. A vision to free New Zealand of introduced predators within 35 years (PFNZ 2050) has recently been announced. If realised, it would clearly be of huge benefit to biodiversity in this country, but it will face major financial, social, and technical challenges. In the meantime, many bird taxa continue to decline, and extinctions are a real (and continuing) prospect. Even if the PFNZ vision is realised, it may come too late to save one New Zealand shorebird.

Oral presentation

MAKING SPACE; MANAGING HUMAN DISTURBANCE OF WILDLIFE IN COASTAL AREAS

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Human disturbance of wildlife is an under-recognised and under-regulated problem. This presentation examines intensifying human pressures impacting coastal habitat and species and discusses how law and policy are failing to keep pace with change. Traditional approaches to conservation management in protecting wildlife from disturbance are examined and limitations and challenges identified. The key problems are deficiencies in regulation of species disturbance, lack of definition of thresholds of harm that contemplate rarity and conservation status, insufficient comprehensive wildlife conservation planning and the need for innovative planning methods that address species mobility, permeable boundaries, aerial spaces and environmental dynamism. Regulatory controls including enforcing setbacks/approach distances through either enhanced species protection or 'mobile habitat' protection are recommended. Extending such implementation methods in resource management plans to identify and protect significant aerial habitat would also be of benefit.

Oral presentation

MANAGING ARTIFICIAL COASTAL HABITATS FOR MIGRATORY SHOREBIRDS

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Rapid and extensive reclamation of the intertidal zone and land use change in coastal wetlands of the Yellow Sea have driven serious migratory shorebird population declines in the East Asian–Australasian Flyway. Many of the remaining wetlands fringing the Yellow Sea are artificial, such as aquaculture ponds and salt pans, but relatively little is known about the importance of these habitats for migratory shorebirds or how to manage them effectively. Given the enormous pressure on natural coastal habitats, it is of critical importance to assess how artificial habitats can provide feeding and resting areas. In this talk I will review existing knowledge about the use of artificial habitats by migratory shorebirds in the EAAF and elsewhere, and explore the socio-economic factors crucial for management of these areas. I will then identify some of the urgent research gaps that could hamper optimal management of feeding and roosting sites in artificial habitats in the Yellow Sea, and present a research plan for addressing these.

Oral presentation

BEACH-CAST MARINE ALGAE FISHERY IN THE SOUTH EAST OF SOUTH AUSTRALIA

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In South Australia beach-cast marine algae is a ‘fishery’ administered by Primary Industry and Regions SA (PIRSA) operating within one of Australia’s most important sites for Ruddy Turnstone, Sanderling and Hooded Plover. The industry commenced in the early 1990’s with one licensed operator, Australian Kelp Products P/L (APK), holding a licence that covered 100 km of the coast in the South East of the state. With a change of ownership in 2014 the average 79.5 wet tonnes annual harvest was planned to increase up to 10,000 wet tonnes. For AKP to obtain an export licence PIRSA had to obtain approval from the Federal Department of Environment and show that the fishery would be managed in a sustainable manner posing no significant threat to species covered under the EPBC Act. We will discuss the processes involved in negotiating new management arrangements that allow the fishery to operate but with safeguards to protect shorebirds.

Comment was first called for in March 2014 on an Assessment that lumped Beach-cast Seagrass and Marine Algae together, permitted a take rate of 75% of the beachwrack along most of the licence area using heavy machinery and gave no credible protection to migratory or resident nesting shorebirds. There were several rounds of comment, a rewritten assessment and the Minister’s Declaration of an Approved Wildlife Trade Operation. An appeal was made through the Administrative Appeals Tribunal against this declaration as it offered no protection for shorebirds in the critical five weeks prior to northward migration. This Appeal was based on long term data gathered from VWSG banding, flagging and geolocators studies and AWSG count data collected by committed and dedicated volunteers.

Through a negotiation process between FoSSE, the Commonwealth Government, AKP and PIRSA a new model for the fishery was developed – no heavy machinery throughout the fishery, no harvesting on over 50% of the coast, including the Significantly Important site of Rivoli Bay, a limit on the time harvest is permitted in other important sites and exclusion of harvesting around breeding Hooded Plover pairs

Oral presentation and poster

NATURAL RESOURCE PLANNING FOR SHOREBIRD CONSERVATION

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Across Australia, there are 56 regional Natural Resource Management (NRM) organisations that act as delivery agents for Australian Government funds and Landcare programmes. Integrating coast and marine projects into these, often terrestrially focused, NRM frameworks has historically been challenging.

A national Wildlife Conservation Plan (WCP) for Migratory Shorebirds was developed under the Environment Protection and Biodiversity Act in 2006. This Plan outlined statutory commitments for migratory birds and their habitat, as well as actions to promote the conservation of migratory shorebirds, both within Australia and across the East Asian - Australasian Flyway at Local, State and National level. The WCP has recently been reviewed and a revised plan released. Arguably, long-term, targeted funding approaches are needed to maintain management of coastal wetlands and important shorebird sites.

The development of NRM planning in the Adelaide and Mt Lofty Ranges region coincided with the release of the initial Shorebird WCP. Local WCP actions were incorporated into NRM coastal programmes. Whilst still presenting challenges; regional and local organisations can work with local communities, councils and NGOS to implement local initiatives for shorebird conservation. These include research and citizen science approaches to identify of high value habitats and risk assessment, on-ground works to protect habitat and public awareness and community arts activities, input into local planning and protected area approaches.

Involvement of NGO and community expertise in shorebird research projects is essential to provide important information to help connect local people and places to their global context. Resident non-migratory shorebirds can also be an important citizens' science and awareness tool to highlight valuable habitat areas. The epic long-haul migrations these birds undertake can provide an important linchpin for better connecting people to the often undervalued saltmarsh and mudflat habitats necessary for shorebird survival. With shorebird conservation, acting locally is acting globally.

Oral presentation

TRACKING OF GREY PLOVER IN THE EAST ASIAN-AUSTRALASIAN FLYWAY

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Knowledge of Grey Plover migration in the East Asian Australasian Flyway is limited. Over six hundred Grey Plover have been banded in Australia since 1960, with few recoveries, and no Australian-marked birds recorded in the breeding range. A 2001 analysis of biometric data, suggested that north-western Australian Grey Plover probably utilized mainland Siberian breeding sites east of the Lena River, and that some south-eastern Australian birds may breed on Wrangel Island, off the coast of north-east Siberia. Prior to a single 2014 sighting of a bird, flagged on Wrangel Island, in Jiangsu Province, East China, there was no flyway information for Grey Plovers breeding on Wrangel Island. Satellite telemetry was undertaken using 5g solar powered Platform Terminal Transmitters, attached using 'leg-loop harnesses'. The units were programmed to a 10 hrs ON/48 hrs OFF duty cycle. Five satellite devices on Grey Plover have been deployed north of Adelaide, South Australia since 2014. Birds demonstrated high site fidelity to locations in their non- breeding areas. Five transmitters were also deployed on Grey Plover at Roebuck Bay, north-western Australia in February 2016, as part of publically funded Pozible appeal, through the Australasian Wader Studies Group, and BirdLife Australia. In 2016, two WA and two SA birds were tracked to Arctic Siberia. Birds from both marking locations utilized sites on the Chinese Yellow Sea Coast for over fifty days. From China, birds were tracked to the Yakutia coast of Eastern Siberia. From there, the SA flagged birds flew east, to Wrangel Island in the Arctic Ocean. These are the first records of any Australian-marked bird on Wrangel Island. One WA-deployed unit and two SA deployed units continued transmissions throughout the breeding season, and all three appear to have hatched eggs successfully. It is hoped further information on migration will be forthcoming.

Oral presentation

GEOLOCATOR TRACKING OF COMMON REDSHANK *TRINGA TOTANUS* IN SINGAPORE

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Geolocation by light is a cost-effective and established method for shorebirds migration study. However, it requires recapturing of the tagged birds to recover the geolocators for data processing. The Common Redshank (*Tringa totanus*), is one of the most common shorebird species found in Sungei Buloh Wetland Reserve (SBWR), with an annual winter peak count range of 305 to 1,250 between 1993 to 2013 (SBWR, unpublished data). This species generally has a high fidelity to their wintering site. Based on the bird ringing data of SBWR from 1990 to 2013, the recapture rate for the Common Redshank is 14.7%.This is the highest amongst all the shorebird species found in the reserve (SBWR, unpublished data). With a high fidelity and recapture rate, the Common Redshank was chosen for the first Geolocator study in Singapore.

A total of 99 geolocators were deployed on Common Redshanks from 24 October 2014 to 5 March 2015, with 97 birds of at least one year in age. The same birds were also tagged with serialized engraved flags. In the following migratory season from July 2015 to April 2016, sixty of the geolocator-tagged birds were observed at SBWR (60.6%). Between the 9th September 2015 and the 4th March 2016, one juvenile and six adult birds of these were recaptured. Data from the six adult birds suggest that the Common Redshanks in this study breed in Tibet-Qinghai Plateau in China. Along the migration pathway, there were two major stopovers: the area inclusive of the Inner Gulf of Thailand and southeastern coast of Myanmar, and Sichuan province, China. Meanwhile, juveniles remained mostly in

Singapore and/or the immediate region, including Thailand.

With the geolocator technology, we were better able to understand the migration route and breeding ground of the Common Redshank wintering in SBWR. Looking forward, we plan to apply satellite tracking technology for medium to large shorebird species such as the Whimbrel (*Numenius phaeopus*) and Common Greenshank (*Tringa nebularia*).

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Oral presentation

TRACKING MIGRATION OF GREY-TAILED TATTLERS USING LEG FLAGS AND GEOLOCATORS

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Queensland Wader Study Group have caught and leg-flagged Grey-tailed Tattlers *Tringa brevipes* in Moreton Bay for over ten years and more recently embarked on an attempt to use geolocators to gain more detailed information on their migratory habits. Leg-flags indicate that Queensland tattlers rely heavily on Japanese staging grounds on their northward migration but there are virtually no resightings of Queensland birds further north, or on southward migration. This easterly migration track, with minimal Yellow Sea interaction is almost certainly the reason that this species is not in decline in Queensland, unlike many of its migratory counterparts. To fill in the gaps in our knowledge of this species geolocators were used in the 2010/11 and 2011/12 Austral summers with 40 devices fitted over the two seasons. Return rates, although not significantly different to birds banded and not fitted with geolocators, were unusually low compared to previous seasons and the reasons for this are discussed. Despite this a small number of geolocators were recovered and all provided complete northward and southward tracks with one device, recovered two years later, providing an additional northward track for that individual. Each bird presented a different northward migration track staging in different locations in Japan but apparently all breeding in Kamchatka. In one case an individual took a far more westerly path, staging in the Philippines and then Japan. On southward migration birds travelled almost directly to Australia with brief stopovers in the mid Pacific. The bird that provided two northward tracks provided data suggesting that the species is not only site faithful on their non-breeding grounds but also to their staging areas and migration routes. Migration speeds, duration and synchronisation will also be presented and discussed in this presentation.

Oral presentation

CLARIFYING THE MIGRATIONS OF RED KNOTS FROM NEW ZEALAND

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For all the interest and banding work that there is on Red Knots, it is still unclear just how New Zealand-wintering knots migrate up and down the East Asian-Australasian Flyway. Early band records indicated that birds probably staged in northern Australia or Papua New Guinea on northward migration, but surveys in the Gulf of Carpentaria have failed to locate them. Geolocator tracking of two New Zealand birds tagged in Russia showed that they migrated direct from New Zealand to eastern Asia on northward migration; this finding is at odds with records in May of evidently newly-arrived New Zealand knots in China, as those birds must have staged elsewhere in April. According, we deployed geolocators on knots at the Manawatu Estuary in the North Island of New Zealand in 2013, retrieving 8 of 25 loggers after migration. These show indisputably that all the tracked birds did indeed have a prolonged staging period in the northern Australian/Papuan region before making their way to the Yellow Sea region in eastern Asia. Clarifying just where the staging took place is proving difficult, as there is little difference in predicted light conditions between West Papua and northern Australia. On the way south, knots made complex series of stopoffs in the Sea of Okhotsk/Sakhalin Island region, the Yellow Sea, Papua/northern Australia again, and for some birds also within-Australia movements to east or southeast

Australia before eventually reaching New Zealand. The long staging period on northward migration meant that most knots spent little time in Asia. In one extreme case, a bird that was evidently of the subspecies *piersmai* that breeds on the New Siberian Islands remained in Australia until 2 June before migrating north, spent just one week in the northern Yellow Sea, and only reached the breeding grounds around 23 June. Having confirmed that some knots do indeed stage between New Zealand and Asia on northward migration, we now have to answer why others fly more than twice that distance without a stopoff on the same migration.

Oral presentation

A REVIEW OF GEOLOCATOR STUDIES IN AUSTRALIA, 2009–2016. WHERE TO NOW?

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Australia was one of the first countries to utilise light level geolocators for tracking shorebirds. Commencing in 2009 the VWSG, AWSG, Deakin University, GFN and QWSG have deployed these instruments on a range of migratory shorebird species including Ruddy Turnstone, Eastern Curlew, Sanderling, Great Knot, Red Knot, Greater Sand Plover and Grey-tailed Tattler. Locations have included the coasts of Victoria, King Island (Tasmania), south-east of South Australia, Roebuck Bay, Broome (Northwest Australia) and Moreton Bay (Queensland). We will present a summary of retrieval and success rates as well as discuss the key findings from this extensive program. By analysing the many successful migration tracks over this period, including several multiyear tracks, a picture of the various routes and strategies will be presented. These provide information on the relative importance of a range of stopover sites, a fundamental requirement in developing conservation strategies. In addition, the data recorded by more recent geolocators has enabled an assessment of breeding locations as well as incubation strategies.

The results have contributed to a range of conservation outcomes from flyway wide (including the development of initiatives for the Yellow Sea) to local issues (South Australia beach wrack). In addition they have been used as a resource for more detailed connectivity studies.

Recognising the constraints of geolocators the question is 'what next'? We will discuss recent developments of geolocators and the current development of a satellite based instrument that may extend our knowledge for many other species for which geolocators cannot be used.

Oral presentation

HOW BIVALVE SIZE AND QUALITY INTERACT TO LIMIT INTAKE RATES OF BAR-TAILED GODWITS AND GREAT KNOTS IN THE NORTHERN YELLOW SEA

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The intake rate is commonly used as the surrogate for fitness and therefore is an important currency in the study of foraging ecology. We studied the foraging ecology of shorebirds in the northern Yellow Sea, China, and found clear behavioural evidence for the existence of a digestive bottleneck in these species when ingesting bivalves. At the population level, bivalve-reliant Great Knots showed lower foraging activity than the mixed-diet Bar-tailed Godwit. Within individual foraging bouts, the species with the greatest reliance on bivalves ingested whole (Great Knot and Red Knot) had more frequent and longer pauses in their foraging than the species with mixed diets (Bar-tailed Godwit) or that ingested only the flesh (Far Eastern Oystercatcher). Godwits feeding mostly on hard prey also had more frequent and longer pauses than those feeding on soft prey. These findings imply that the ability to process the hard shells of bivalves limits intake rates of these species, with 'penalties' of approximately 5% of foraging time in shellfish-feeding godwits and >20% in Great and Red Knots.

Intake rates (both numerical and biomass) of Bar-tailed Godwits and Great Knots were substantially lower in 2012 than 2011, despite similar numerical and biomass density of their most important bivalve prey *Potamocorbula laevis*. It seems that digestive constraints accompanied by a change in size-structure of the prey, a decrease in prey quality, and an increase in handling time and possibly searching time were the main reasons that contributed to the decline in total biomass intake rate in 2012. We conclude that prey quality, rather than quantity, principally determined the biomass intake rate of shorebirds in our study area. It is also important to take digestive constraints and the possible length of foraging period into account when studying the foraging ecology of shorebirds to allow meaningful comparison between studies and reliable estimates, especially for shorebirds that may face digestive bottlenecks at sites with very high food availability.

Oral presentation

SITE FAMILIARITY AND FOOD AVAILABILITY AFFECT THE STOPOVER SITE MOVEMENTS OF MIGRATING SHOREBIRDS

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Site familiarity and food availability are assumed to affect the movements of migrants at stopover sites, but few studies have examined such effects on free-ranging birds in the field. In 2012 and 2015, we studied the movements of staging Great Knots *Calidris tenuirostris* during northward migration at Yalujiang National Nature Reserve in the northern Yellow Sea, China. Using radio telemetry, we investigated the mean travel distance between roosting and foraging sites (MTD) and the core foraging area (CFA, 50% fixed kernel mudflat home range) of 19 (2012) and 15 (2015) individuals early and late in the staging period. We found that in 2012 when food was abundant, both the mean travel distance and core foraging area were lower in the late than early period. However, in 2015 when there was a dramatic decline in available food, there was no significant difference in both the mean travel distance and core foraging area between the early and late periods. These results suggest that lower site familiarity and food availability might be related to larger foraging ranges and longer commuting distances of shorebirds at stopover sites.

Oral presentation

WHAT HAVE WE FOUND ABOUT THE SPOON-BILLED SANDPIPER IN THE SOUTHERN JIANGSU COAST IN CHINA?

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The intertidal mudflats in the southern Jiangsu Province in the South Yellow Sea, China, are critical stopover site for the Spoon-billed Sandpipers and Nordmann's Greenshank as well as other 56 shorebird species. Our local conservation group, called the Spoon-billed Sandpiper in China, has been working with international conservation NGOs since 2008 to conduct regular surveys and community work in the region. In 2015, the team initiated a new project to investigate the stopover ecology of the Spoon-billed Sandpiper and Nordmann's Greenshank by collecting benthos samples and quantifying the moult pattern of these shorebirds in the southern Jiangsu coast. In the same year, the team participated in the first shorebird banding project in Jiangsu and released 10 individually marked Spoon-billed Sandpipers, as well as thousand shorebirds. Earlier this year, our team found at least six Spoon-billed Sandpipers over summering in the study region, indicating the potential importance of our study area for shorebirds during boreal summer. Unfortunately, the intertidal flats in our study area are under severe pressure from coastal development projects and exotic plant invasion. This talk will present the key results from our long-term monitoring work and discuss the problems encountered during our scientific and community work.

Oral presentation

SHOREBIRDS AND THEIR COASTAL WETLAND CHANGES IN CHINA'S YELLOW SEA

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Coastal wetlands in the Yellow Sea Region provide critical and irreplaceable stopovers for migrant shorebirds using the East Asian-Australasian Flyway. In our study, spring migrant shorebird census was carried out from March to May, in 2013 and 2014 and totally 42 species and 610804 individuals were recorded. Compared with the historical data, the species richness, total population, and 1% richness (species with their population exceeds 1% of biogeographic population) showed highly significant correlation with most external factors. According to demographic mechanism, shorebirds were classified into several sub-groups, such as freshwater, coastal and generalized species. Then combing coastal wetland, land claim and land-use distribution maps, I applied Generalized Linear Model to analyze the influential factors of shorebird population changes. Freshwater species showed significantly positive correlation with Farmland and Unused land. Coastal species showed significantly negative correlation with Farmland and Unused land. Generalists showed significantly positive correlation with land claim.

Oral presentation

SHOREBIRD SURVEYS OF THE WEST SEA COAST OF THE DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA 2009-2016

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The Yellow Sea and Bohai Bay are vital staging areas for shorebirds during migrations between southern non-breeding grounds and breeding grounds in north Asia and Alaska. Since the 1990s, main shorebird sites on the coasts of China and South Korea have become relatively well known, but much less well known is the West Sea (Yellow Sea) coast of the Democratic People's Republic of Korea (DPRK). In April 2009 the first coordinated counts of shorebirds using tidal areas of the West Sea were made by a joint team from the Korean Natural Environment Conservation Fund and Pukorokoro Miranda Naturalists' Trust (PMNT) at Mundok, about 80km northwest of Pyongyang. In 2015 and 2016 further surveys were carried out by a team from PMNT and Nature Conservation Union of Korea. Areas surveyed were to the north and south of Mundok, and the latter was revisited in 2016. In 2015 a total of 20,635 shorebirds of 31 species were counted. Three species, Great Knot *Calidris tenuirostris*, Dunlin *Calidris alpina* and Bar-tailed Godwit *Limosa lapponica*, occurred in numbers that met the 1% of population criterion used by the Ramsar Convention to identify internationally important wetlands. Together, these three species accounted for 86% of the total shorebirds counted. In 2016 16,590 shorebirds were counted and three sites were identified as being internationally important for Bar-tailed Godwit and Far Eastern Curlew. In addition 4,513 Dunlin were counted. Together, these three species accounted for 85% of the total shorebirds recorded. Numbers of the key species at Mundok were very similar in 2016 to those counted in 2009 and the count dates were similar. Over the next three years it is proposed to visit coastal areas further north towards the Chinese border, including Sin Do (Island), as well as further south towards the DMZ.

Oral presentation

SOUTHERN COLLABORATION WITHIN THE EAST ASIAN – AUSTRALASIAN FLYWAY PARTNERSHIP

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In November 2006 the East Asian - Australasian Flyway Partnership was established as a voluntary, non-binding initiative that brings together national governments, intergovernmental and non-government organisations to conserve migratory waterbirds and their habitats. The Partnership has grown from 16 Partners in 2006 to 35 Partners at present. At the southern end of the Flyway, four Partners (Australasian Wader Studies Group, the Pukorokoro Miranda Naturalists Trust and the New Zealand and Australia Governments) are engaging in activities that conserve migratory shorebirds that visit the southern hemisphere during the non-breeding season. Government and non-government collaboration has been important in progressing a number of Partnership objectives, including practical actions to conserve migratory shorebirds.

New Zealand Partners are contributing to the conservation of red knots and bar-tailed godwits (ssp. *baueri*) through engagement at key stopover sites in the Yellow Sea. Wwith the support from NZ Ministry of Foreign Affairs and Trade, data supplied by multi country shorebird counts, intensive banding and other research , is being used to engage with EAAFP Flyway site managers and government officials in the People's Republic of China and the Democratic People's Republic of Korea.

The Australian Government is contributing to the objectives of the Partnership through the recently released Wildlife Conservation Plan for Migratory Shorebirds under the *Environment Protection and Biodiversity Conservation Act 1999.* This national framework outlines a number of research and management actions aimed at conserving migratory shorebirds and their habitats. Australia is also leading the development of the EAAFP International Single Species Action Plan for the Conservation of Far Eastern Curlew (*Numenius madagascariensis*) which will be considered at the 9th Meeting of the Partners in Singapore, January 2017. AWSG members continue research on migratory shorebirds through leg flagging, banding, migration studies using geolocators and satellite transmitters, and count activities. Analysis of these data including Birdlife Australia's Shorebird 2020 program, the Monitoring Yellow Sea Migratory Shorebirds in Australia program and data from New Zealand and the Asian Waterbird Census (Wetlands International) have all underpinned a recent update to the shorebird population estimates of 37 species, funded by the Australian Government.

Government and non-government collaboration in the southern end of the Flyway has worked effectively to raise the profile of migratory shorebirds. However, migratory shorebird populations continue to decline as recognised by recent threatened species listings under Australian national environmental legislation and the IUCN Red List. Continuing international collaboration and cooperation between all Flyway Partners will be key to securing the future for migratory shorebirds in the East Asian–Australasian Flyway.

Keynote

REVISION OF THE EAST ASIAN-AUSTRALASIAN FLYWAY POPULATION ESTIMATES FOR 37 LISTED MIGRATORY SHOREBIRD SPECIES

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Migratory shorebirds in the East Asian-Australasian Flyway (EAAF) are declining rapidly. Protection of shorebird habitat across the region is critical for achieving effective shorebird conservation. The key legislative mechanism for protecting shorebird habitat in Australia is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The EPBC Act is triggered when proposed actions, such as developments or land use changes, are likely to have a significant impact on important habitat for migratory shorebirds. A site is considered important if it supports 1% (international importance) or 0.1% (national importance) of the total flyway population of a species. Therefore, frequent revisions of the flyway population estimates are needed to ensure important habitat is correctly identified, particularly given the widespread population declines in the EAAF. We present an update of the population estimates for the 37 species of migratory shorebird that regularly visit Australia listed under the EPBC Act. We collated shorebird counts from the last 10 years from Australia (BirdLife Australia), New Zealand (Ornithological Society of New Zealand) and 16 countries in Asia (Asian Waterbird Census). We tailored our analytical approach for each species, and according to data availability. Many of our population estimates were higher than previous figures, because of increased count coverage, estimation of shorebird numbers in unsurveyed areas, and the use of an estimate based on breeding range size for non-coastal species. Nevertheless, ongoing population declines swamped this effect in some species, with current flyway population estimates now even lower than previous assessments. We urge the protection of all remaining important habitat for shorebirds in the EAAF.

Oral presentation

WING THREADS – SHOREBIRD CONSERVATION PROJECT

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In April 2016, I started learning to pilot a microlight aircraft with the intention to fly the Australian migratory route of the Red-necked stint from Melbourne to Broome to promote urgent action for shorebird conservation. After witnessing the spectacle of hundreds of thousands of shorebirds carpeting 80-Mile Beach in Australia's northwest earlier this year, I have been moved to experience their journey first hand in the hope that future generations may one day too witness this breath-taking sight. By mimicking the Red-necked Stint's epic feat of endurance, I aim to shape a narrative that will inspire awe and motivate people to become involved in change. I believe a female pilot staging a cross-continental flight in a lightweight aircraft will create a spectacle large enough to capture the attention of a broad international audience outside the scientific and birdwatching communities already engaged with this issue.

Leading up to the flight, I will build this audience through a blog titled '*Wing Threads*' to share my experiences learning to fly, volunteering in shorebird conservation and creating artwork, as well as highlight current shorebird research, promote artists and exhibitions, and profile women in aviation. Applying my credibility, skills and experience as a qualified zoologist and artist, I aim to collaborate with people from science, aviation and the arts to create a documentary film and organise a group art exhibition to raise vital funds for shorebird conservation groups. In pursuit of this goal, I have begun to mobilise a wide network of professional contacts from across Australia and the UK for promotional and logistical support.

After I successfully perform this flight, I intend to pursue my ultimate goal of flying a microlight the length of the EAAF from Australia to Siberia to complete the Red-necked stint's journey.

Oral presentation

AUSPICATIONS AT WERRIBEE

BARBARA CAMPBELL

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Most professional scientists and citizen scientists who spend long periods of their life with shorebirds in the field will admit to a love of their subjects, the birds themselves. Which came first, the chicken or the egg (if you'll excuse the analogy)? Did the love generate the time commitment or did the time commitment increase the love? Like the difficulty of the chicken/egg riddle, the answer lies somewhere between the two end points. I suggest it lies in the interaction between species: shorebirds and humans. That interaction we can call performance.

My doctoral research over the last four–five years has been in the creative arts. My methodology stems from my practice as a Performance artist (the capital *P* referring to the standard way Performance has been understood as a cultural or aesthetic activity). And yet most of my fieldwork has been with birds and humans who have been performing together in certain places at certain times outside the capital P Performance arenas. Over time the waders and "waderologists" have challenged me to rethink my own definitions and practice of Performance.

In this conference paper I will present some of my findings on human-shorebird performance from the fieldwork conducted at Melbourne Water's Werribee Treatment Plant by the Victorian Wader Study Group (VWSG) each December. I will frame the VWSG activities in terms of the Roman practice of "augury" (an important divinatory practice based on the observation of birds) to show how precisely the catching and banding program is *performed*.

Oral presentation with slide presentation

A RIVER STORY, A BIRD STORY AND COLLECTIVE IMPACT FOR CHANGE

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The Adelaide International Bird Sanctuary is a unique safe haven for shorebirds, many of which are truly remarkable – migrating each year between Australia and the northern hemisphere. Over many years, volunteers, local communities and non-government organisations have strived to protect this internationally significant area, the shorebirds and their fragile habitat. In 2014, the South Australian Government got behind the community's conservation efforts by committing nearly $4 million to creating the Adelaide International Bird Sanctuary. The Sanctuary encompasses over 60 km of coastline north of Adelaide.

To be effective, conservation requires a coordinated effort across public and privately owned land. That's why the Adelaide International Bird Sanctuary is not defined by fences and boundaries. Rather it is a landscape where local communities, volunteers, government, non-government organisations, and land managers can work together towards shorebird conservation and enhancing community. A diverse range of land uses including salt production, horticulture, recreation and manufacturing have coexisted alongside conservation in the landscape for many years. Enhancing conservation in parallel with sustaining other land uses is a cornerstone of the Sanctuary concept.

The Adelaide International Bird Sanctuary is not a park, however the most critical areas of habitat are being provided with long-term protection through the creation of a national park within the Sanctuary. While conservation will be a priority, the national park will also become a focal point for people, who will be able to enjoy the area in much the same way as they always have. They will also be able to enjoy improved facilities, learn about Kaurna culture, and gain an appreciation of the role that the area plays in global shorebird conservation.

To establish the Adelaide International Bird Sanctuary, community and Government have created a mission statement: The Adelaide International Bird Sanctuary is an important area that safeguards native species, helps to develop a thriving economy, enhances the wellbeing of all visitors and expands global conservation efforts. People are driving the establishment of the Adelaide International Bird Sanctuary through a new way of working together and achieving shared outcomes – an approach called Collective Impact. Collective Impact in the Bird Sanctuary is the bringing together of local townships, international experts, Kaurna elders, farmers, local government, tour operators and so many more – all towards a common agenda for the birds and the people. This approach recognises that many people have a role to play in making an impact for things that matter, in this case protecting shorebirds and creating opportunities for people. Through the collective impact of partners and local communities, the Adelaide International Bird Sanctuary will assist in the protection of shorebirds and demonstrate the philosophy that people connecting with nature, strengthen communities and enhance nature.

Oral presentation

GOTTA LOVE A PLOVER: FOSTERING KNOWLEDGE-BUILDING AND SHOREBIRD CONSERVATION THROUGH COMMUNITY ACTION

JEAN TURNER[2] AND EMMA STEPHENS[1]

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Two of Australia's most charismatic resident shorebird species, the Hooded Plover (*Thinornis cucullatus*) and Red-capped Plover (*Charadrius ruficapillus*), live along the coast of South Australia's (SA's) Adelaide and Mount Lofty Ranges (AMLR) region. Both are subjects of volunteer-based citizen science programs supported by AMLR Natural Resources Management Board and BirdLife Australia's Beach-nesting Birds Program. Hooded Plovers have a restricted distribution, the eastern subspecies preferring high-energy beach habitats. In AMLR region they occur only on the Fleurieu Peninsula, where less than 50 adults remain. With a national population of 3,000, the Eastern Hooded Plover is listed as Vulnerable under the Federal Environment Protection Biodiversity Conservation Act 1999, and SA's National Parks and Wildlife Act 1972. The 2015 National Threatened Species Summit nominated Hooded Plovers as one of 12 Australian species to improve the trajectory of by 2020. Red-capped Plovers are more generalist, occurring in coastal and inland wetlands throughout Australia. In AMLR region they overlap with Hooded Plovers in the south, but their stronghold is the low-energy 'Samphire Coast' of northern Gulf St Vincent. Significant numbers (> 1% national population) have been recorded in the Samphire Coast and their status is considered 'Least Concern', although recent counts suggest they are declining. Both species are present year 'round on the AMLR coast and their breeding seasons coincide with the busiest time on our beaches. Nests and chicks of both species are well camouflaged, but vulnerable to increasing coastal pressures, particularly disturbance by people and dogs. Our monitoring programs have different goals but similar approaches, relying on skilled volunteers supported by coordination and mentoring. We will outline results of the two programs and how they build knowledge and foster conservation action. When agencies, NGOs, volunteers and the community connect, the result empowers people and inspires positive change to improve the plight of shorebirds.

Oral Presentation

AUCKLAND NZ DOTTEREL MINDERS: THE RISE OF A SHOREBIRD MANAGEMENT COMMUNITY

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For years, many Auckland community members have been monitoring NZ dotterels (*Charadrius obscurus*) on their local beaches. Many individuals in isolation have managed their populations, but there was no way for them to share this knowledge and experience, except for through existing relationships and reliance on a few key volunteers. An electronic mailing list was started to collate the breeding data the community were collecting, and then send it back to the various monitoring groups and individuals across the Auckland region. This has provided four years of very valuable data to allow views of trends across many different locations. There are now more than 90 recipients on the Auckland NZ dotterel minders newsletter mailing list. This mailing list soon developed to the groups and individuals requesting a forum to allow them to present findings, share news and get support for innovative management techniques from each other. In 2016 the Auckland NZ dotterel forum ran its third annual event in Omaha, which was organized in collaboration with Auckland Council, Birds NZ and the Omaha Shorebird Protection Trust. Over 60 people attended to hear the latest NZ dotterel news, as well as to share innovative and novel ideas for management and monitoring. This format has shown it is very important for the community members working on the ground to hear from experienced scientists and practitioners, to understand how individual efforts fit into a regional (and national) population context, and gain inspiration for ongoing volunteer work.

Oral presentation

FORAGING ECOLOGY OF MIGRATORY SHOREBIRDS ON ROEBUCK BAY

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Each year 100,000 waders of more than 20 species use Roebuck Bay as their wintering ground, feeding on the intertidal mudflats, rich with marine invertebrates. However, little is known about the diet and feeding behaviour of migratory shorebirds using Roebuck Bay, which is essential for their effective future conservation. Previous foraging studies of migratory shorebirds on Roebuck Bay have focused on knot and godwit species. Foraging ecology of the other species in the bay remains unstudied. Further, with the exception of a recent study into the effects of Lyngbya (blue-green algae) blooms on Bar-tailed Godwit feeding ecology, studies on foraging behaviour in this region have not been conducted for 10 years, presenting an opportunity to monitor any changes in diet and foraging behaviour that may have occurred.

Between April 2015 and March 2016 I carried out a broad study of foraging behaviour and diet of migratory shorebirds in Roebuck Bay, North Western Australia, using a combination of video footage analysis, benthos sampling and collection of faecal samples. From this study, I present preliminary findings of the foraging behaviour and diet and comparisons between 10 shorebird species. This study observed several shorebird species feeding opportunistically on an unexpected variety of marine invertebrates, highlighting crabs as being a prominent component of their diet. Other interesting records include Grey Plovers eating sea cucumbers and Bar-tailed Godwits eating brittle stars.

Oral presentation

FEMALES ABANDON CARE WHEN SURVIVAL OF YOUNG IS GUARANTEED

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The 'mixed-strategy' form of parental care involves desertion of the young by a parent of either sex. In such species there is the potential for competition between the parents over the continuation of care of the young. This male-female competition may evoke a 'trade-off' where a parent forgoes care of the current young in favour of an increase in investment of future young. We studied whether the amount of male and female care in the Red-capped Plover *Charadrius ruficapillus* varies, how the age of the young influences any variation in the amount of parental care and if any variation in parental care influences the survival of the young. We radio-tracked 42 Red-capped Plover broods and examined chick survival and the amount of both male and female parental care. Female and male parental care were both significantly correlated with chick age; females cared for chicks for the first half of rearing, then abandoned the brood for the male to take over for the second half of chick rearing. Additionally, chick survival increased significantly as total parental care (the combination of male care and female parental care) increased. The abandonment of the brood by females and increase in care by males seems correlated with the development of chicks to a stage where the likelihood of mortality has plateaued and survival to fledging is almost a certainty.

UNDERSTANDING "CRAMP" IN WADERS

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Capture myopathy is a metabolic syndrome seen as a complication of capture and handling in mammals and birds. The condition has been reported in a wide variety of species from birds to bears, dolphins to zebra. Often termed "cramp" in wading birds, the condition can lead to significant debilitation or death. The struggling and extreme exertion due to pursuit and capture can create a physiological cascade of effects, with resulting heart and skeletal muscle damage and systemic complications that are potentially fatal. Muscle damage results in stiffness, ataxia, weakness, and partial or complete paralysis: inability to walk or fly are common presenting signs in affected birds. Diagnosis is based on clinical signs and alterations in blood biochemistries, including elevation of the muscle-specific enzyme creatine kinase. Treatment of myopathy can be time-consuming and costly, but has been successful in some cases. Fluid therapy, supportive care, physiotherapy and adequate nutritional supplementation are essential treatments. Prevention of myopathy requires knowledge of the species susceptibility and risk factors for that species. Current knowledge of capture myopathy in birds indicates that overexertion, struggling, energy depletion and traumatic injuries are responsible for the initiating damage and attention should be brought to minimising these factors in capture operations.

THE BANDED DOTTERELS OF SOUTH BAY, KAIKOURA: THE EMPTY NEST SYNDROME

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The South Bay beach of Kaikoura Peninsula provides a nesting habitat that is highly favoured by the Banded Dotterel *Charadrius bicinctus* (Tuturiwhatu). The combination of the beach and adjacent racecourse appear to provide a particularly rich food source, and this is backed up by the influx of mostly juvenile flocks from other areas that arrive on the beach around mid-December and remain until autumn dispersal.

Casual observations over three breeding seasons between 2012 and 2014 suggested dotterels had minimal nesting success. Members of the local branch of Forest and Bird have committed to a 5-year formal study of dotterel nesting on this beach to quantify and improve nesting outcomes. In the first year of study (breeding season 2015–16), 20 nests were found within a 1.2 km stretch of beach. We caught and colour-banded 6 adults, and banded 14 chicks of which 9 were later recaptured and colour-banded. Our study showed that is likely that only one bird fledged from these 20 nests. It is possible that predation is a major cause of egg and chick loss, and traps are already being put in place for the 2016-17 breeding season.

As a beach where recreational use is high, we hope through education, and predator control, to vastly increase the chances of nesting success for the dotterels of South Bay. Weed and predator explosion in braided-river habitat may lead to a rapid decline of Banded Dotterel numbers nationally. The coastal enclaves therefore, may become particularly important for the long term survival of the species.

THE NORTHERN GAP: WHAT DO WE KNOW ABOUT THE STATUS OF SHOREBIRDS IN DARWIN, NORTHERN TERRITORY?

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Understanding how and why a population changes over time is fundamental to strategically managing threatened species. We know from monitoring programs that migratory shorebirds that visit Australia each year are rapidly declining. Shorebird status and population trends are known for most parts of Australia, but there is a knowledge gap along the northern Australian coastline. With coastal development increasingly becoming a major threat to shorebirds on non-breeding grounds, it is crucial that we understand the current status of migratory shorebirds in the developing Darwin harbour in northern Australia. Shorebird population size in the Darwin region of the Northern Territory has changed since monitoring began in the 1980s. Some species have declined notably and others have increased, often in contrast to species trends elsewhere in Australia – we examine the current and historical population trends of a community of migratory shorebirds in the Darwin Harbour region using long-term monitoring data. We evaluate these trends in the context of conserving shorebirds in a developing harbour.

Oral presentation

MIGRATORY SHOREBIRDS AND THE LNG BOOM: SIX YEARS OF SURVEYS IN GLADSTONE HARBOUR AND THE CURTIS COAST, QUEENSLAND

A.J. LEAVESLEY

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Gladstone Ports Corporation (GPC) obtained approval for a major port development, the Western Basin Dredging and Disposal Project in July 2010. The project involved dredging of new shipping channels and berths in Port Curtis (Gladstone harbour) and construction of a 265ha land reclamation on an adjacent mud flat. A condition of the approval was that GPC conduct a Port Curtis and Port Alma Ecological Research and Monitoring Program for 10 years. A major focus of the program is migratory shorebirds. Migratory shorebird monitoring commenced in January 2011 with an intensive phase involving two summer surveys in January and February, a northward migration survey in March, a winter survey in August and a southward migration survey in October. This was to take place for two years followed by six annual summer surveys and finishing with another two years of intensive surveying. Migratory shorebird abundance on the Curtis Coast in summer has been relatively stable during the study, with 12,058 ± 979 individuals. Abundance in October appears to be greater than summer suggesting that the Curtis Coast is an important site during the southward migration. The apparent stability in the total abundance of migratory shorebirds hides considerable variation in species abundance and distribution. A total of 24 migratory shorebird species have been recorded. Of these, the abundance of four (Eastern Curlew, Grey-tailed Tattler, Whimbrel and Terek Sandpiper) has been consistently >1 percent of the East Asian-Australasian Flyway population estimates, suggesting that the region is of international importance for them. Development at Gladstone appears to have disrupted birds in the immediate vicinity but the coincidence of disturbance of many different types has made it difficult to draw firm conclusions.

Oral presentation

BIG BIRDS UNDER TIME STRESS: SIZE-DEPENDENT STRATEGIES WHEN MIGRATING TO AND FROM THE BREEDING GROUNDS IN LONG-DISTANCE MIGRATORY SHOREBIRDS

MEIJUAN ZHAO[1], MAUREEN CHRISTIE[2], JON COLEMAN[3], CHRIS HASSELL[4], KEN GOSBELL[2], SIMEON LISOVSKI[1], CLIVE MINTON[2], MARCEL KLAASSEN[1]

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Migrants have been hypothesised to use different migration strategies between seasons: a time-minimization strategy during their inbound migration towards the breeding grounds and an energy-minimization strategy during their outbound migration towards the wintering grounds.

Given the equivocal support for this hypothesis, we propose body size as another key factor in shaping migratory behaviour in addition to season. Specifically, since body size is expected to correlate negatively with maximum migration speed, we hypothesise that large species are not only likely to adopt a time-minimization strategy during inbound migration, but also during outbound migration. We tested this idea using individual tracks across six long-distance migratory shorebird species (family Scolopacidae) along the East Asian-Australasian Flyway varying in size from 50–800g lean body mass. During inbound compared to outbound migration, the shorebirds generally covered similar distances, but they migrated faster, used fewer staging sites, and tended to use longer step length. These seasonal differences are consistent with the prediction that a time-minimization strategy is used during inbound migration, whereas an energy-minimization strategy is used during outbound migration. However, the seasonal difference in average migration speed tended to progressively disappear with an increase in body size, supporting our hypothesis that larger species tend to use time-minimization strategies during both inbound and outbound migration.

Oral presentation

PHENOLOGY OF SOUTHWARD MIGRATION OF SHOREBIRDS IN THE EAST ASIAN–AUSTRALASIAN FLYWAY AND INFERENCES ABOUT STOPOVER STRATEGIES

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The southward migration strategies of shorebirds remain poorly understood in the East Asian–Australasian Flyway, yet understanding such strategies is critical to shorebird conservation. We estimated passage dates of 28 species of shorebird from count data at 15 sites where counts had been carried out at weekly to monthly intervals through the arrival or departure periods. These data were analysed using "Thompson models". Our estimates of passage dates were consistent with available tracking data, giving us confidence that the modelled estimates were accurate. For large-bodied shorebirds, modelled departure dates from the northern Yellow Sea were similar to arrival dates throughout Australia, and their arrival dates in different regions in Australia were also similar, suggesting they flew directly from Asian staging areas to Australian non-breeding areas, or stopped only very briefly on the way. In contrast, small-bodied species apparently made multiple stops, especially in northern Australia, during their migration to their final non-breeding destinations. These differing patterns suggest that larger species in this Flyway depend on a small number of staging sites, whereas smaller species migrate in shorter steps and require additional staging sites between the northern Yellow Sea non-breeding grounds in Australasia. It is likely that some of these sites have not as yet been discovered, and that conservation of small shorebird species requires a more complete accounting of unknown and understudied staging sites.

Further information

A full version of this paper is published in:

Choi, C-Y., Rogers, K.G., Gan, X., Clemens, R.S., Bai, Q-q, Lilleyman, A., Lindsey, A., Milton, D.A., Straw, P., Yu, Y-t, Battley, P.F., Fuller, R.A. and Rogers, D.I. 2016. Phenology of southward migration of shorebirds in the East Asian – Australasian Flyway and inferences about stop-over strategies. *Emu* 116: 178-189

Oral presentation

HOODED PLOVER (EASTERN) *THINORNIS RUBRICOLLIS RUBRICOLLIS* RECOVERY ON PHILLIP ISLAND, VICTORIA, AUSTRALIA

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The Hooded Plover (eastern) *Thinornis rubricollis rubricollis* lives south eastern Australia and associated with ocean and bay beaches with sandy substrate. The density in Victoria is low with the total population estimated at 570 individuals (Garnett *et al.* 2011). The Australian Federal Government lists it conservation status as vulnerable as does the state of Victoria. On Phillip Island the population declined by 58% between 1981 and 1997 (Baird & Dann 2003).

Important contributing factors to the normally low breeding success were the high rate of egg and hatchling loss due to predation by the introduced Red Fox, dogs and native birds. Disturbance caused by dogs and people was also a factor. Disturbance can cause abandonment/loss of nests, as well as restrict the time that chicks can feed.

Since 1981 the Phillip Island Nature Parks has been running Hooded Plover Watch. This is a community-based initiative aimed at monitoring and improving Hooded Plover breeding success. Volunteers help monitor nest sites and educate island residents and visitors about the importance of keeping themselves and dogs away from nesting and chick rearing areas. The Hooded Plover Watch program is conducted from late spring to early autumn. Counts of all birds on beaches are held quarterly to monitor the species in the long term (commenced 1992).

The results from this program are outstanding. Hooded Plover are now once again nesting in most of their 16 historical nesting locations on the island. Numbers of birds in winter counts have increased from a low of 11 to 36. To maintain a sustainable population we are aiming for a long-term average of at least 0.47 chicks fledged per pair. From a low of 0 is the early 1990's Phillip Island has trended above 0.47 since 2007-08 and the trend in fledged per pair has increased over this period.

It is hoped that other volunteer warden programs developed along these lines across the southern coast of Australia will have similar success and together we are able to prevent further declines in this species.

References

Baird, B. & Dann, P. 2003. The breeding biology of Hooded Plovers, *Thinornis rubricollis*, on Phillip Island, Victoria. *Emu*. 103:323-328.:

Garnett, S., Szabo, J. & Dutson, G. 2010. The Action Plan for Australian Birds 2011. CSIRO Publishing.

Poster presentation

STILT - INSTRUCTIONS TO AUTHORS

Stilt is the journal of the Australasian Wader Studies Group. We welcome manuscripts presenting new information on the waders (shorebirds) of the East Asian-Australasian Flyway and nearby parts of the Pacific region from both amateurs and professionals. Authors should send their manuscript by email to the editor at gregkerr@adam.com.au. Authors are strongly encouraged to consult these instructions in conjunction with the most recent issue of *Stilt* when preparing their manuscripts. Authors are asked to carefully check the final typescript for errors and inconsistencies to minimise delays in publication. Authors are also encouraged to seek collegial advice on writing style and English before submitting manuscripts.

Material sent to *Stilt* is assumed to be original and must not have been submitted for publication elsewhere. All authors listed must agree to the publication of the material. Please refer to the *Stilt* Publication Ethics and Malpractice Statement for further information in relation to co-authorship and similar matters. The Publication Ethics statement is available at www.awsg.org.au/stilt. All submissions are subject to peer review. If a revision is requested corresponding authors must submit the revised manuscript by the requested date or seek an extension.

Stilt is produced in one issue per year. Suitable material submitted before **1st July** will normally be published in the next issue of *Stilt* in November. Late submissions may be accepted at the editor's discretion.

Submissions should be presented in a Microsoft Word version compatible with Office 2010 (version 14) or later. If authors are unable to access newer versions of Word, then files in .rtf format may be acceptable following liaison with the editor. All contributions, including table and figure captions and references, should be double spaced in 11 pt Times New Roman font. Tables should be in 10 pt Times New Roman. Please refer to the most recent version of *Stilt* for table styles. If photographs or grayscale images are to be included, please submit images in one of the following formats: jpg, jpeg, tiff, gif, bmp, pdf, pcx or eps. Figures, photos or other graphics exceeding 2 MB in size should be forwarded as separate files, clearly labelled to enable cross-referencing. Please ensure that photographs are of highest possible quality. Poor quality images will not be accepted.

Stilt publishes research papers, short communications, reports, book reviews, conference abstracts (usually only from the Australasian Shorebird Conference), notifications of AWSG committee matters and state-wide wader group reports. Research papers and short communications are peer-reviewed, and authors are welcome to suggest one or more suitable reviewers. Other material will usually be edited only, although reports may receive one or more reviews at the editor's discretion.

RESEARCH PAPERS

Research papers should document the outcome of original research from wader scientific studies and monitoring of waders. Please note at present, *Stilt* does not publish keywords. Research papers should contain the following sections:

TITLE - in bold, capitalised type.
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*
RUNNING TITLE - a short version of the title of approximately 50 characters.
ABSTRACT - This will summarise the main findings of the study, preferably in fewer than 200 words.
INTRODUCTION - This should be a short section of about half a journal page to "set the scene" and explain to the reader why the study was important. It should end with a clear definition of the aims of the study.
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 then 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., S. Garnett & C. Gole** 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. *Stilt* does not have the capacity to accommodate Supplementary 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 six 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° 42' N, 98° 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 must be in the metric system and SI units where appropriate (e.g. mm, km, °C etc). Rates should be recorded as, for example, d^{-1} rather than /day or per day. Whole numbers one to nine should be spelled out, unless associated with a unit (e.g. 5 g) and numbers 10 onwards given in numerals. Full binomial names should be given on the first occasion a common name for an organism is used. 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.

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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.

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Deadlines:
The closing dates for submission of material is **1st July** for the November edition.

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.

Stilt 71 – November 2017

Table of Contents