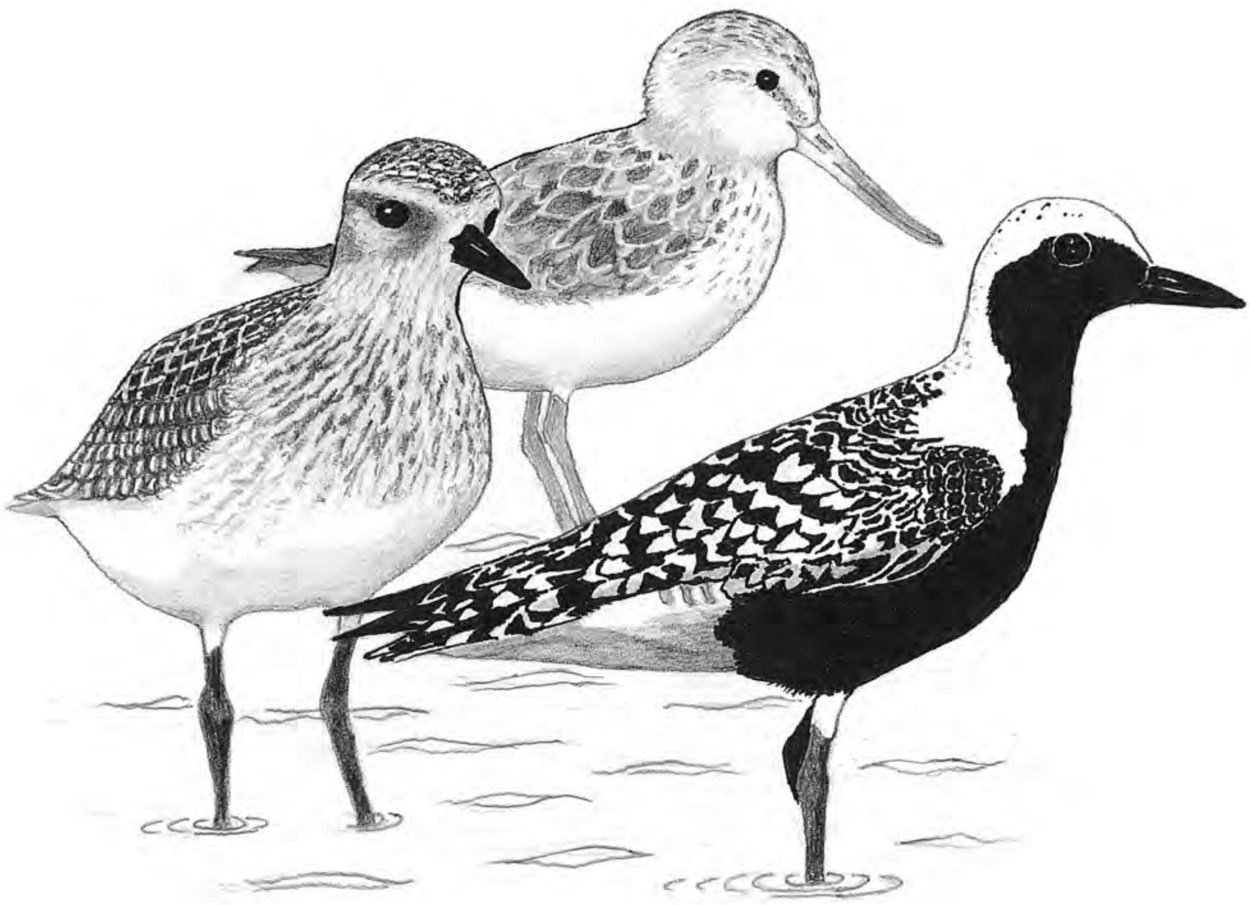
Stilt

The Journal for the East Asian-Australasian Flyway



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Australasian Wader Studies Group

Stilt

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MISSION STATEMENT

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

OBJECTIVES

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

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

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EDITORIAL

Welcome to the combined the issue of *Stilt* 63 and 64. I would like to start by taking the opportunity to thank Andrew Dunn, who retired from the position of production editor of *Stilt* early in 2013. He commenced in this role in April 1996, along with the new editor Mike Weston. In the 17 plus years that have elapsed since then, he has presided over the production of increasingly better quality issues of *Stilt* and has helped raise the profile of the journal to that of a widely recognised repository for the publication of scientific material on waders. We all thank him heartily for his huge contribution over nearly two decades.

This issue contains updates on activities and data from New South Wales and Western Australia, as well as several contributions from Indonesia where our counterparts have been busy again with continued wader monitoring. We also have several contributions on our resident species, which makes a interesting change to the usual migratory wader reports. The first is from Stuart Collard and his colleagues at the South Australian Department for Environment and Natural Resources, who report on the Banded Stilt breeding event at Lake Torrens in 2010. The second is brought to us by Mike Newman, reporting on his intensive observations of brood capture by Australian Pied Oystercatchers in Tasmania. The third is thanks to Michael Murphy's survey work in the Pillaga Forest in northern NSW. This issue also includes a review of the Action Plan for Australian Birds by Graham Fulton. The latest percentage juvenile paper plus the last NWA expedition report by Clive Minton and colleagues are also included.

For those readers wondering why *Stilt* 63 never arrived in the post, unfortunately insufficient contributions were received in time to produce a full issue. I was very disappointed about this and wish to avoid this happening again in the future. I again encourage all readers to send in their contributions, whether they are working on a full research article or wish to provide a short report on their group's activities. Readers are welcome to contact me first if they are uncertain about the appropriateness of their material for publication.

I am pleased to announce a major change to the *Stilt* editorial team, which will greatly benefit the journal. This is the formation of an editorial board, which will be responsible for various functions from coordinating reviews, providing advice in relation to specific contributions, and presiding over dispute resolutions and other publication issues. I welcome Danny Rogers (Arthur Rylah Insitute for Environmental Research), Marcel Klaassen (Deakin University), Phil Battley (Massey University) and Zhijun Ma (Fudan University).

I would also like to welcome Nancy Van Nieuwenhove, who has taken over as the new production editor for *Stilt*. She joins myself, Yaara Rotman and the editorial board members to make a sound editorial team. We have also been greatly assisted by Margaret Cameron, Doris Graham and Linda Patrick with proof reading. Thanks also to the many reviewers that have helped with improving manuscripts for publishing.

I remind readers that *Stilt* now includes Instructions to Authors, which can be found at the end of this issue. Please familiarise yourselves with this document if you are planning to submit an article for publication

The AWSG committee held its Annual General Meeting on 9 October at Birdlife Australia's Head Office in Melbourne. Following the editorial is a report from the new chair, Alison Russell-French, which summarises the major activities of the AWSG since her commencement and highlights strategic directions for the AWSG. The annual Treasurer's report follows.

I hope you enjoy this issue of *Stilt* and I am looking forward to publishing the next one, which promises more interesting contributions from around the flyway.

Birgita Hansen
Editor

NEWS FROM THE CHAIR

This is my first report since becoming Chair of the AWSG in October 2012. I would like to first of all extend my appreciation on behalf of AWSG to the previous Chair Dave Milton for his support and leadership of AWSG over the period of his tenure as Chair.

The plight of waterbirds across the Flyway continues to be one of major concern with ongoing declines in populations. Much of this is the result of the loss of staging sites in the Flyway, particularly in the Yellow Sea, with ongoing major reclamation and development of tidal flats. This was highlighted (again) by David Melville at the recent Meeting of the Flyway Partners in June 2013 and at the International Wader Study Group meeting in October 2013. He presented a report on a survey he had undertaken with Chinese researchers of many important areas of the Chinese coastline from Shanghai to Yalu Jiang, and the outlook from the expanding rate of reclamation and development is very bleak indeed.

This highlights the importance of having the best available science to inform decisions about land use and appropriate conservation options. With this as a driving force, the work of the AWSG has focused over the last 12 months on a number of priority areas.

AWSG activities nationally

Leg Flagging and Banding Databases

The previous edition of *Stilt* included the very sad news of the sudden death of Heather Gibbs, Leg Flag and Banding Database Manager for the AWSG and the Victorian Wader Studies Group (VWSG). Heather's loss was a terrible blow to us all. She was such a committed member of AWSG and a very long-standing member of Birds Australia, and her loss has reverberated in many ways.

We have faced a critical situation with respect to the future of the databases that Heather managed. These were very much Heather's creation and the contribution she made to the data amassed by AWSG on banding and leg flags was quite unique. The databases are a vital source of information on shorebird movements in the Flyway that must be maintained.

We have been very fortunate to have one of our volunteers, Roger Standen, pick up the very challenging task of reviewing the databases with the view of providing recommended ways forward for AWSG to consider on the future of the databases. A small sub-committee of AWSG has been over sighting the task, led by Roger. This is still a work in progress and I hope to be able to report on where we will be going with this in my next report.

Monitoring

Monitoring under the MYSMA project in northern Australia has continued, with the project running for another year. A good team has been built for the project and some funding was also obtained from Western Australian Marine Science Institution to support analysis and publication of monitoring efforts. Owing to very efficient budget management, there will be carry-over funds to cover the costs of summer surveys in November and December 2013. We are particularly fortunate to have a very dedicated team (including Chris Hassell, Adrian Boyle and George Swann) that has offered to undertake the counts for free this year. However, this highlights the ongoing issues surrounding funds that are needed for this critical project and other AWSG activities. I shall return to that issue later in this report.

Shorebirds 2020

The Population Monitoring Program has been nurtured by AWSG for almost 35 years. It is through the database that we are able to study the trends in the decline of shorebird species in Australia. The current phase of the program was commenced in 2008 when Shorebirds 2020 was adopted as a key program of Birds Australia. Sadly funding for this important program has not been continued by the Australian Government in the latest round of Caring for our Country grants. However, BirdLife Australia will continue this very successful program in a reduced capacity and guided by different priorities. It is seeking input from Shorebirds 2020 volunteers to an online survey to assist in planning the future of the program. There has also been a change of staff responsibilities at BirdLife Australia as a result of the funding situation. Golo Maurer who has been the Shorebirds 2020 Project Manager is moving to the position of Business Development Manager. He will stay involved with Shorebirds 2020 but the role of Project Manager will be taken by Dan Weller. We wish them both well and a big thank-you to Golo for his enthusiastic support of the project and AWSG generally.

Global Flyway Network

AWSG also works closely with Chris Hassell in his work with the Global Flyway Network (GFN). The work that GFN is doing in Bohai Bay (China) is providing a vitally important insight into the situation affecting shorebirds across the Yellow Sea and Chris provides regular information on the work of GFN. He is also a very strong advocate for shorebirds and has a strong presence in the local media.

Banding

Banding activities have been actively pursued over the 12 months. Almost 500 geolocators have now been placed on waders at a cost of almost $100,000 (provided from a number of sources). The geolocator program on waders is a major one and Australia is probably leading the activity globally. This work is primarily being done by the volunteer efforts of the AWSG, VWSG and Friends of Shorebirds SE, the Queensland Wader Studies Group and the GFN with some support from Deakin University.

As well, satellite transmitters will be put on Little Curlew in the 2013 November Broome expedition. Very little is known about Little Curlew migration and the satellites will hopefully provide much needed data. The terrific contribution by Clive Minton and volunteers, both financially and with commitment of their time, needs to be recognised as a hugely important element in the success of the banding activities.

AWSG Scientific Committee

The Scientific Committee of AWSG is considering future research directions and has, as a major exercise at present, the development of a position paper that will focus on the priorities that researchers need to undertake to support shorebird conservation in the Flyway. This is being considered in the context of "How do Shorebirds react to Habitat Loss?" The Scientific Committee has actively collaborated with Richard Fuller and his team from Queensland University who are conducting the three year ARC-funded project that is examining Flyway-wide trends in the abundance of waders and the extent of their habitat.

AWSG engagement internationally

East Asian – Australasian Flyway Partnership (EAAFP)

The EAAFP Meeting was held in Alaska in June 2013. AWSG was represented by Ken Gosbell in his role as Chair of the Shorebird Working Group, with a very challenging number of issues presented including David Melville's assessment of tidal flat habitat loss along the Chinese coastline. Phil Straw, Vice President of AWSG, participated in the Communication, Education and Public Awareness (CEPA) Working Group that is looking to bring together case studies from different sites to enhance education and learning about management of important sites. As Chair of AWSG, which is one of the Partners of the Flyway Partnership, I represented AWSG on behalf of BirdLife Australia across the broader range of issues and discussion.

The meeting was hosted by the US Government Department of Fisheries and Wildlife Services and the program offered a number of opportunities to consider what is being done (and not done) in the Flyway to address the state of migratory shorebirds and their habitat across the Flyway.

Prior to the Partnership meeting, meetings were held with the Commonwealth Department to discuss the agenda of the meeting and possible areas of cooperation for positions.

There were a number of significant elements in the program that reflected the need to address shorebird and shorebird habitat conservation. These were (a) the report which listed and prioritised important sites in the Flyway providing guidance and tools to assist in the nomination of high priority sites not yet listed, (b) a Science Workshop led by Dr Richard Fuller of Queensland University and assisted by Dr Judit Szabo, the new Science officer of the Partnership. This workshop focused on issues ranging from population collapse in migratory shorebirds in Australia, new methods of assessment of tidal flat losses in the Yellow Sea, understanding migration routes through use of geolocators to cost / benefit of habitat loss, and (c) a number of sessions on the importance of and threats posed to Yellow Sea shorebird habitat.

The Partnership meetings offer an opportunity to exchange information and practical experience in what is being done to address shorebird conservation. However, the dynamics of meetings are also very challenging with the multi-lingual representation of Partners and a very full agenda only on a 1-2 year basis. The Partnership now has 30 Partners including national governments (15), inter-government organisations (4), NGOs (10) and the international business community (1). Three new partners were welcomed at the meeting – Malaysia, the Conservation of Arctic Fauna and Flora (Arctic Council) and the Wildlife Conservation Society.

AWSG has been elected to the EAAFP Management Committee that advises the Partnership Secretariat and we will work to provide guidance and assistance to the Secretariat based on our experience, knowledge and research on migratory shorebirds. We certainly should not under-estimate the challenges that face the Partnership in meeting its objectives when faced with the range of social and economic pressures arising from land-use and development action in the Flyway. These are the root cause of many of the problems facing migratory shorebirds and make it imperative that good science is as the base of decisions about land use and conservation of shorebirds' habitat.

AWSG administrative issues

Structural issues following the formation of BirdLife Australia

AWSG is now a Special Interest Group of BirdLife Australia following the merger of Birds Australia and Bird Observation & Conservation Australia. As this required new Rules of Operation for AWSG, the opportunity was taken to include in the new Rules the flexibility to co-opt up to four additional members to be able to formally take advantage of a broader range of skills and expertise. We have done so with the addition of Dave Milton, Maureen Christie, Jon Coleman and Penny Johns as the current four co-opted members. Arthur Keates took on the role of Treasurer after the resignation of Brian Speechley and has made sterling efforts in the management of AWSG funds as well as taking responsibility for drafting the new Rules of Operation. The Board of BirdLife Australia approved the new Rules early in 2013.

AWSG is building a stronger working relationship with BirdLife Australia and this was enhanced by Ken Gosbell giving a presentation on AWSG to BirdLife Australia staff, many of whom are new to the organisation. We are keen to work with the new BirdLife CEO, Paul Sullivan, who has shown interest in achieving a strong working relationship between AWSG and BirdLife Australia. This is particularly important in the context of funding which is a fundamentally important issue for both. BirdLife Australia is working to build a more secure financial base for the organisation as a whole and AWSG will be part of this effort. Funding for wader research, the databases and ongoing monitoring and banding are our critical areas of funding needs, and we have discussed options for these with BirdLife Australia including the new role that Golo Mauer as Business Development Manager. We have already had the Board approve funding support for the initial work on the databases.

Conservation

Following the resignation of Dr Joan Dawes after two solid years of hard work in the national conservation position, we are currently looking at measures to both fill the national conservation position and work more cohesively within the BirdLife Australia conservation framework to maximise efforts to manage the wader conservation agenda. On behalf of AWSG I extend particular thanks to Joan for all her hard work and dedication in the conservation work she undertook during her time in the position. Joan will continue with her conservation work in NSW.

A number of meetings were also held with the Department over the 12 months to discuss a range of issues associated with migratory shorebirds and their conservation. The meetings were attended by Ken Gosbell, Joan Dawes, Doug Watkins and I. Samantha Vine, BirdLife Australia's Manager of Conservation, also attended meetings when able to.

AWSG Membership

As readers of *Stilt* will have seen editor Birgita Hansen has been doing a fantastic job and she is always keen for submissions to come her way. She has also taken on responsibility for AWSG membership as we are very keen to increase our membership base. It is through our members that we can much more effectively raise the profile of migratory and resident shorebirds, their ecological importance, and the threats that are facing them. The local voice can be very powerful and I urge members to take up the cause locally and nationally to conserve our waders with the community, industry and governments.

We are also seeking members' support in encouraging those who are interested in shorebirds to join AWSG. It is likely to be increasingly important to get local people involved with the conservation of their local sites and the shorebirds that use them.

Where to from here?

2014 Shorebirds Conference

The next Shorebirds Conference will be held in September, 2014 in Darwin. Professor Stephen Garnett of Charles Darwin University is leading the organizing committee which is well into the planning of the Conference. More information on the Conference will be forthcoming in the near future.

Mark Barter Award

AWSG has taken steps to put in place an Award that will celebrate the outstanding contribution by Mark Barter to migratory waterbird conservation in the East Asian – Australasian Flyway. Mark did much to raise the awareness globally about the importance of protecting and maintaining migratory waterbird populations. His on-ground banding and counting efforts in China, Japan and the Republic of Korea and mentoring of young researchers and community members was truly inspirational.

The Committee has agreed that the long term nature of the Award will need to be developed but as a first step and in recognition of Mark's emphasis on training and education, it agreed that it would be most fitting to approve funds to cover the costs of attendance and some specific training in Australia post the Conference for a young person from either China or Korea with the emphasis on the Yellow Sea.

Conclusion

I would like to thank all of the Committee members for their enthusiasm and support for AWSG and its activities. Being on the Committee is a very rewarding experience and I encourage any people interested to contact me if you would like to discuss how you might join us. There are many actions that can be done including data analysis by those skilled in this area. Being part of ASWSG and the Committee is both fun and rewarding so I encourage you to become involved with AWSG.

Alison Russell-French
Chair

TREASURER'S REPORT FOR 2012

Total payments exceeded receipts by $18,919.84 during 2012 and includes a non-contract deficit of $6,277. The balance of $49,939.51 carried forward at 31 December 2012 includes commitments for future expenditure on contracts of $4,697.
General accumulated funds were $45,242.51 at year-end.

Australasian Wader Studies Group
Receipts and Payments
1 January 2012 - 31 December 2012

RECEIPTS			PAYMENTS		
Item	**2012 $**	**2011 $**	**Item**	**2012 $**	**2011 $**
Balance brought forward	68,858.35	46,403.13	Printing	4,300.73	4,614.34
Subscriptions	6,837.50	8,471.11	Postage/Courier		626.55
Contracts - Federal Govt.	0.00	20,000.00	Consultants		22,863.66
Contracts - State Govts.	8,000.00	8,000.00	Surveys Reports Monitoring	32,963.30	48,013.21
Contracts - Other	19,500.00	95,190.40	Conferences/Meetings	11,884.91	174.95
Grants and Donations	4,763.00	26,563.03	Donations	200.00	16,100.00
Conference/Meetings	8,213.69		Travel & accommodation	15,836.93	8,988.49
			Equipment	0.00	33,389.12
			Other expenses	297.16	
			Admin fee (BirdLife Australia)	750.00	999.00
Total income	47,314.19	158,224.54	Total expenses	66,233.03	135,769.32
			Balance carried forward	**49,939.51**	**68,858.35**
	116,172.54	**204,627.67**		**116,172.54**	**204,627.67**

Membership Statistics for 2012:

The membership at the end of the year was:		2012	2011
	Australia/New Zealand	195	220
	Overseas (excl. NZ)	20	27
	Institutions	8	14
	Complimentary	55	16
	Total	**278**	**277**

This summary of receipts and payments 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 Birds Australia should refer to the Concise Financial Report included in the Birds Australia Annual Report 2012.

COORONG TO OUTBACK: OBSERVATIONS OF A BANDED STILT BREEDING COLONY AT LAKE TORRENS, SOUTH AUSTRALIA, MAY 2010

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In early 2010, heavy rain fell across the outback region of South Australia. Later that year the Coorong population of Banded Stilts (*Cladorhynchus leucocephalus*) left their usual coastal habitat, prompting an aerial search for the breeding birds across the vast salt lakes of northern SA. The search resulted in the discovery of one of the largest breeding colonies of Banded Stilts ever recorded at an isolated island in Lake Torrens National Park. A field surveillance team travelled to the island to observe the colony and, if required, to minimise the impact of Silver Gulls on the breeding birds. In this paper we provide an overview of past Banded Stilt breeding events in Australia. We describe the climatic conditions leading up the 2010 mass breeding event, the techniques used to discover the colony and the results of aerial and field-based observations, including observations on any impacts of Silver Gulls. We also provide information from follow-up observations, including the discovery of a second smaller colony at Lake Torrens in the same year. Using a conservative method that attempted to account for mortality, we estimate that more than 190,000 chicks departed the island after the initial breeding attempt. Subsequent breeding on the same island and in the secondary colony would have added substantially to this number. The mass breeding event is likely to contribute significantly to the long term viability of the Banded Stilt population in southern Australia.

INTRODUCTION

The Banded Stilt (*Cladorhynchus leucocephalus*) is a unique endemic Australian wader. The species is well known for its remarkable behavioural and physiological adaptations to the erratic rainfall patterns of the Australian outback. In early 2010, the world Banded Stilt population was estimated at between 206,000 and 260,000 individuals (Delany & Scott 2006, Geering *et al*. 2007). The species is listed as 'Vulnerable' under the South Australian *National Parks and Wildlife Act 1972*. The International Union for Conservation of Nature (IUCN) recognises the Banded Stilt as a species of 'Least Concern' given its broad range and the lack of a significant population reduction in the past decade (Birdlife International 2011). However, their dependence on spasmodic inland rainfall events and the significant impacts of Silver Gulls (*Chroicocephalus novaehollandiae*) on recent breeding attempts (Minton *et al*. 2000, Baxter 2003), suggest the species may be susceptible to sudden declines that could potentially threaten long-term population viability (Baxter 2003).

Large non-breeding flocks of Banded Stilts are commonly observed at estuarine and salt marsh habitats along the coastline of southern Australia (Marchant & Higgins 1993, Baxter 2003). However, knowledge of their breeding behaviour and movement patterns is incomplete because of the infrequent occurrence of suitable climatic conditions, the remoteness of preferred nesting areas and the speed with which breeding events occur. Large flocks of Banded Stilts are known to depart their non-breeding coastal habitats, setting down to nest close to the water on the exposed sand-spits and islands of ephemerally flooded inland salt lakes of inland southern Australia, including southern Western Australia, within days of their departure (Burbidge & Fuller 1982, Bellchambers & Carpenter 1992, Marchant & Higgins 1993, Gosbell & Christie 2006). Breeding pairs are thought to mate en-route as the first eggs are laid almost immediately following their arrival at chosen colonial nesting sites (Robinson & Minton 1989). Breeding coincides with the emergence of small crustaceans (mostly Brine shrimp (*Parartemia sp.*)) that provide the breeding stilts with an abundant and reliable food source (Jones 1945a,b, Williams *et al*. 1998, Gosbell & Christie 2006). The remoteness of the breeding islands, combined with the protection afforded by the surrounding salty water, provide an ideal refuge for the birds and protection from native and introduced terrestrial predators (Robinson & Minton 1989, Bellchambers & Carpenter 1992).

Banded Stilt nests are shallow earth scrapes, often adorned with a small amount of vegetation (Marchant & Higgins 1993). Clutches typically consist of 3-5 large eggs, which are continuously incubated by both parents and hatch within 19-21 days. The chicks are large (~30g) and immediately active and alert (Robinson & Minton 1989, Williams *et al*. 1998). Soon after hatching the chicks are led to the lake, dispersing vast distances (up to 100km from the colony) and independently feeding on brine shrimp (Williams *et al*. 1998). Chicks are fully feathered at 6-weeks (Gosbell & Christie 2006) and once the previous brood has departed, and if conditions are suitable, the nesting adults will remain and mate for a second time. Complete or partial breeding colonies will sometimes move to different islands for subsequent breeding attempts (Robinson & Minton 1989, Williams *et al*. 1998).

Prior to the 2010 breeding event reported in this paper, approximately thirty-two Banded Stilt breeding events had been documented across southern Australia (see Table 1). The first confirmed breeding events were at Lake Grace in southern Western Australia (WA) in 1930 and Lake Callabonna in South Australia (SA) (Figure 1) in 1930. The most recent breeding events occurred at Lake Ballard, WA, in 1995, and more recently at Lake Eyre North National Park, SA (Figure 1) in 2000. Since the first South Australian record, only seven further breeding events have been recorded in the state (Table 1).

Silver Gulls have been identified as a key predatory threat to the success of Banded Stilt breeding events and the long-term population viability of the species (Minton *et al*. 2000, May 2000, Baxter 2003). Although native to Australia, the gull population has been artificially increased by access to human food resources (Smith & Carlile 1992, Kingsford & Norman 2002). Silver Gulls also flock to inland salt lakes when they fill with water, often breeding in close proximity to Banded Stilt colonies and aggressively attacking and eating stilt eggs and chicks (Robinson & Minton 1989, Bellchambers & Carpenter 1992). Towards the end of the breeding event at Lake Torrens in 1989, Robinson & Minton (1989) estimated that 99.5% of chicks and eggs were taken by Silver Gulls. In 2000, at Lake Eyre North, Banded Stilts attempted to breed at Hughes Island. The first two breeding attempts failed due to unremitting Silver Gull predation. Fearing serious impacts on the stilt population, the Department of Environment and Natural Resources (DENR) intervened, culling a significant number of the culprit Silver Gulls. Following DENR's intervention, the Stilts attempted to breed for a third time, successfully producing approximately 50,000 chicks (Baxter 2003).

Widespread rainfall and cool conditions across Australia during 2010 led to the coolest year for a decade, and South Australia's third wettest year on record (BOM 2011a). In February and April of 2010 several low pressure troughs triggered heavy rainfall across much of outback South Australia, including over the catchments of Lakes Eyre, Torrens, and Callabonna and Lake Frome (BOM 2011b), previous breeding locations for Banded Stilts. In particular, rainfall of between 31-156 mm fell across the northern half of the Lake Torrens catchment in February and April. The heaviest of the April rain fell on the 9th (85-124mm), with less significant falls on the 6th (18-32mm) and 21st (19-38mm). The north-west quarter of the Lake Torrens catchment area received the heaviest falls; Andamooka and Roxby Downs Pastoral Stations received between 155-165 mm each (BOM 2011b). The April 9th rainfall flowed into the north-western section of the lakebed, and was detectable from satellite imagery within days (Modis 2010). Realising the potential for a significant breeding event and the serious threat posed by Silver Gulls, local amateur birdwatchers and DENR staff worked together to document the event and discover more about this enigmatic bird species.

This paper: 1) describes the methods used to locate and survey the Banded Stilt breeding colony at Lake Torrens; 2) presents results of observations made during a field expedition to the island in May 2010, including the impact of Silver Gulls; and 3) provides information from follow-up visits to the colony, including the discovery of a smaller secondary breeding colony at Lake Torrens. These findings are discussed in the context of previous studies and broader implications for the conservation of the species.

METHODS

Locating the breeding stilts – aerial surveys

Banded Stilts were observed at the Coorong, just south of Hacks Lagoon up until the 5th April, 2010 after which time they were not seen. To confirm that the stilts were not present at the Coorong, an opportunistic aerial survey of the Coorong was conducted by DENR on the 29th April. The survey began at the Murray Mouth, tracking south along the western shoreline to Stonywell Island, returning northwards along the eastern shoreline (Figure 1). Aerial surveillance focused on the backs of islands and embayments and on sites known for stilts, such as "The Needles" and "Parnka Point" (P. Wainwright *pers. comm.*). No Banded Stilts were recorded during the survey, providing justification for a broad-scale aerial survey of the outback salt lakes in South Australia (Figure 1).

A comprehensive survey of these lakes was proposed, with Lake Torrens National Park identified as the most likely breeding location on the basis of previous breeding records (Table 1). An aerial survey of the lakes was conducted by DENR on the 4th May. The survey began at Lake Frome, tracked north-east to Lake Callabonna, and then north-west to Lake Gregory, before returning along the western shoreline of Lake Torrens (Figure 1). Each salt lake was surveyed at a minimum of 60 metres (200 feet) altitude. Attention was given to islands within each lake, with persistent scanning for the presence of a "white and black moving surface". Lake Eyre was not surveyed because DENR Ranger staff had surveyed it on the 3rd May, reporting no sign of breeding Banded Stilts.

The survey team found no evidence of breeding colonies at Lakes Frome, Callabonna, or Gregory despite a thorough search. However, along the western shoreline of Lake Torrens several hundred stilts were seen feeding in the shallow water. As the plane tracked south along the eastern shoreline of Andamooka Island a small island with a nesting colony of densely packed Banded Stilts was spotted 3 km from the western shoreline of Lake Torrens. The island was later named 'Arduous Island' for future reference.

Table 1. Recorded Banded Stilt breeding events, 1904-2010.

Date	Location	No. Pairs/Nests	Comments	Reference
1904	Lake Cowan, WA	*	Unconfirmed - large colony	Whitlock 1932, Jones 1945a,b
1923	Quinn's Find, WA	At least 100 birds	Unconfirmed - but very likely	Jones 1945a,b
1929	near Menzies, WA	*	Unconfirmed - thousands of dead chicks	Glauert & Jenkins 1931, Jones 1945a,b
1930	Lake King, WA	*	"tens of thousands of adults and countless chickens"	Glauert & Jenkins 1931
1930	Lake Grace, WA	40,000 nests	No comment	Glauert & Jenkins 1931, Carnaby 1946
1930-31	Lake Callabonna, SA	27,000 nests	Colony covered an area of 3,640m^2. An estimated 81,000 eggs were produced.	McGilp & Morgan 1931, Minton *et al*. 2000
1936	Lake Callabonna, SA	*	Thousands of adults observed on an island - one egg observed - no further information available	SAOA 1937
1937	Seepage Swamp, Lake Torrens, SA	*	Unconfirmed - but likely	Cain 1938
1945	Lake Grace, WA	*	No comment	Carnaby 1946
1946	Lake Grace, WA	500 nests	No comment	Carnaby 1946, Burbidge & Fuller 1982
1960	Wagga Wagga Lake, WA	40-50 nests	Colony abandoned before egg laying commenced	Burbidge & Fuller 1982
1963	Lake Ballard - Menzies District, WA	*	1,400 chicks walked through town	Minton *et al*. 1995
1971	Lake Disappointment, WA	*	Probably bred, an adult & juvenile were spotted nearby, but the breeding colony was not observed.	Clarke *et al*. 2004
1973	Lake Ballard, WA	*	No comment	ODX EIS 2009
1974	Lake Ballard, WA			
1975	Lake Ballard, WA			
1975	Lake Marmion, WA	2,500-25,000 nesting pairs	25,000 breeding pairs in March, reducing to 2,500 nesting pairs in May.	Burbirdge & Fuller 1982, Kolichis 1976
1980	Lake Barlee, WA	178,835 (± 34,843) nests	High nest density likely due to successive waves of birds laying within the colony. Colony later abandoned due to falling water levels (est. 255,000 addled eggs & dead chicks). A large number of chicks (possibly around 350,000) are thought to have fledged prior to abandonment.	Burbidge & Fuller 1982
1980	Lake Goongarrie, WA	*	No comment	ODX EIS 2009
1980	Esperance, WA			
1981	Lake Ballard, WA			
1984	Lake Eyre NP, SA	*	Probably at Lake Eyre	Minton 1989, Minton *et al*. 2000, Baxter 2003
1986	Lake Ballard, WA	*	No comment	ODX EIS 2009
1988	Lake King, WA	*	No comment	ODX EIS 2009
1989	Lake Torrens NP, SA.	50,000 breeding pairs	Est. 50,000 pairs nested across 3 islands in the southern Lake Torrens NP.	Minton 1989, Robinson & Minton 1989, Bellchambers & Carpenter 1992
1992	Lake Barlee, WA	*	No comment	ODX EIS 2009
1992	Lake Giles, WA			

Table 1 continued. Recorded Banded Stilt breeding events, 1904-2010.

1995	Lake Ballard, WA	35,000+ nests	Multiple colonies. 20,000 nests at main colony & 15,000 at second major colony. 70,000-175,000 eggs may have been produced.	Minton *et al*. 1995
1997	Lake Eyre (North) NP, SA	*	No comment	Baxter 2003
2000 (Feb-April)	Lake Eyre (North) NP, SA	18,000 nests (9,000 occupied)	Stilts tried to breed at Hughes Island, but aggressive Silver Gull predation of eggs & chicks caused the failure of almost 9,000 nests (potential 27,000 eggs & chicks). Only 322 chicks were observed successfully departing the colonies.	Minton *et al*. 2000, Baxter 2003
2000 (May)	Lake Eyre (North) NP, SA	4,000 nests (abondoned)	Stilts nested again in late May at Hughes Island. Approx. 4,000 nests produced, but were abandoned by 31st May due to incessant gull predation	Baxter 2003
2000 (July)	Lake Eyre (North) NP, SA	18,000 breeding pairs	18,000 breeding pairs successfully bred to produce est. 50,000 chicks at Ibis Island in July. Following extensive Silver Gull control by NPWSA.	Baxter 2003
2000 (July - August)	Lake Eyre (North) NP, SA	2,000 breeding pairs	Nests abandoned in early August due to receding water levels, nearest water to Ibis Island was 8km.	Baxter 2003
2004	Lake Disappointment, WA	*	Breeding colony not visited. Approx. 750 chicks found dead scattered around the Lake. Some evidence to suggest some chicks successfully fledged.	Clarke *et al.* 2004
2006	Coorong, South Lagoon, SA	*	2 major nesting sites located with a combined potential to produce 2300 - 3100 chicks, but only 1006 juveniles were observed	Gosbell & Christie 2006
2010 (April - July)	Lake Torrens NP, SA	150,000 birds	The number of birds was calculated from aerial photos and ground measurements. Refer to Methodology section	(current study)
2010 (May)	Lake Eyre (North) NP, SA	4,500-5,000 nests	Small colony discovered mid-May by Trevor Wright. Subsequent aerial survey by DENR SA confirmed est. 4500-5000 nests present on Ibis Island (counted from aerial photo). Est. 6-7,500 eggs may have been produced.	T Wright *pers. comm.,* A. Clarke *pers. obs*.

* information not available or not recorded

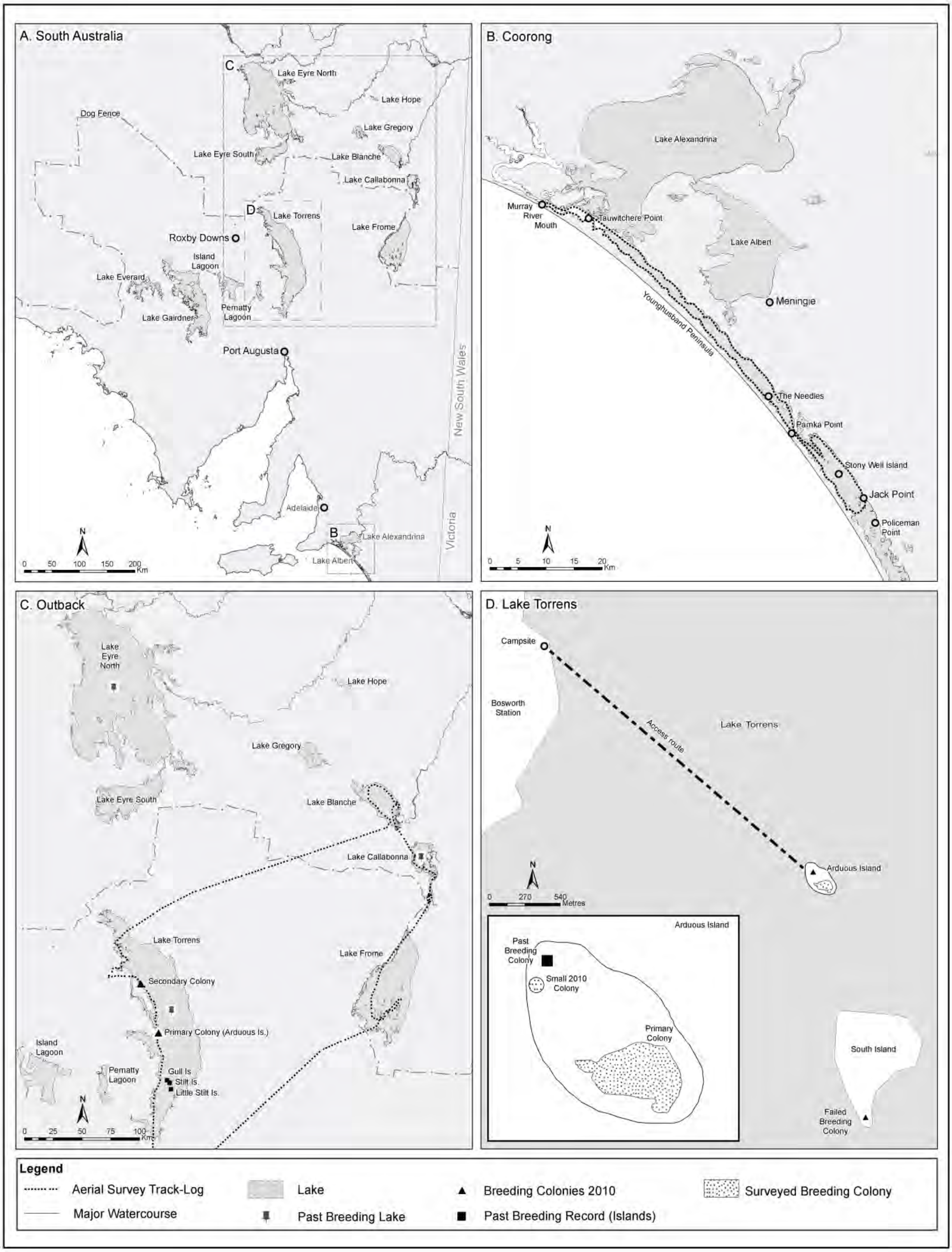


Figure 1. Map of the study area showing: A) locations in South Australia, B) flight path at the Coorong, C) flight path over the outback salt lakes, previous breeding locations and the location of the primary and secondary colonies in 2010, and D) the access route to Arduous Island, the failed breeding colony at "South Island" and (inset) the location and extent of the documented and past breeding colonies on Arduous island.

Site description and access

Arduous island is oval in shape, approximately 250 metres north-south and 100 metres east-west. It is a protrusion of the gibber pavement, which dominates the landscape adjacent to the nearby western edge of the lake, and rises to a maximum of 2.5-3.0 meters above the lake surface. A layer of loamy sand, vegetated with low chenopod shrubland, covers the gibber over much of the island. Where the gibber is exposed, in a relatively small portion of the northern half of the island, only sparse (<10% cover) Samphire (*Tecticornia* sp.) occurs. On the 20 metre wide shelf around the island perimeter there is even more sparse Sea-heath (*Frankenia* sp.), in some parts fringed with Pop Saltbush (*Atriplex holocarpa*). Plant species diversity and density is poorer in the area of the Banded Stilt breeding colony at the southern end of the island, where Bladder Saltbush (*Atriplex vesicaria* ssp.) is dominant.

Access to the site was gained through Bosworth Station. Once at the western shore of Lake Torrens, kayaks or wading were used to cross the knee-deep water between the island and the mainland camp. The island lay approximately three kilometres from the western shoreline of Lake Torrens (Figure 1D). The majority of the nesting birds were located on the southern end of the island while a much smaller colony of an estimated 250 nests was located near the northern tip.

Aerial estimates of colony population size

Aerial photographs of the primary colony at Arduous Island were used to rapidly assess the size of the breeding population prior to the field visit. High resolution images were captured using a Canon 1D digital camera while flying between 60 m and 90 m altitude. The plane was tilted onto its side while passing over the colony, providing the greatest field of view possible to capture both close-up and broad-scale images.

A rough initial estimate of the colony size was 70,000 birds. We considered it important to be able to rapidly assess colony size from the aerial surveys as detailed field visits to colonial bird breeding sites are often not be possible due to resource constraints, limited access or remoteness. To estimate colony size, a combination of close-up and broad-scale images was used. Initially, a broad-scale image of the entire colony was printed and a regular 5mm x 5mm grid superimposed over the image. The total number of grid cells overlapping the colony was counted and summed. Cells at the edge of the colony had on average half the number of birds compared with interior cells and these were counted as half cells.

Five of the best quality close-up images were then used to determine the number of birds present on the ground. These were scaled relative to the broad-scale image by comparing the dimensions of vegetation features common to images at both scales. Using this method, an approximate scale of 1:5 was calculated, indicating that cells with dimensions of 25 mm x 25 mm in the close-up images contained the same number of birds as the 5 mm x 5 mm cells in the broad-scale image. Counting the entire colony was not possible due to the resolution of the photos and the time required to do this. Instead, the number of birds present in 13 sample cells across the five close-up images was counted, and the mean number of birds per sample cell calculated. This number was then multiplied by the total number of occupied cells from the broad-scale (colony) image to derive an estimate of total population size. The estimate conservatively assumes that both adult birds were present at the nest at the time of the photograph.

Field observation methods

The breeding colony was observed for six consecutive days from 10th May – 15th May 2010, coinciding with the peak departure of chicks from the island. Surveyors were present at the colony between 1-2 hours after dawn to 1 hour before dusk. Care was taken to disturb the colony as little as possible. However, in the absence of large numbers of Silver Gulls, a low level of disturbance was deemed acceptable. Variables recorded included clutch size, scrape / nest densities, group size and colony departure rates, offshore group counts and chick mortality. Demographic and behavioural observations at the breeding colony as well as assumptions for estimation techniques are summarised in Table 2. A large amount of high definition video footage of breeding behaviour was also recorded at the colony for future use.

RESULTS

Estimate of colony population size

The total number of adult stilts in the primary colony was estimated from aerial photographs to be 135,100 birds. It was assumed that all birds observed from the air were breeding pairs, hence the number of nests was calculated to be half this number (i.e. 67,550 nests). Colony size was also estimated by multiplying the mean number of scrapes per quadrat (i.e. 9.50 / m^2 - see below) by the area of the colony from the GPS track log (i.e. 7,726m^2). This gave a total of 73,397 nests, a similar number to the aerial estimate.

Scrape density and clutch size

Scrape density ranged from six to 13 scrapes per square metre, with a mean density of 9.50 scrapes (Table 3). The mean number of eggs and/or chicks per scrape ranged from 0 - 5, with a mean of 2.85 (Table 3). A high proportion (75%) of all clutches had three eggs or chicks (Figure 2).

Figure 2. Distribution of clutch size.

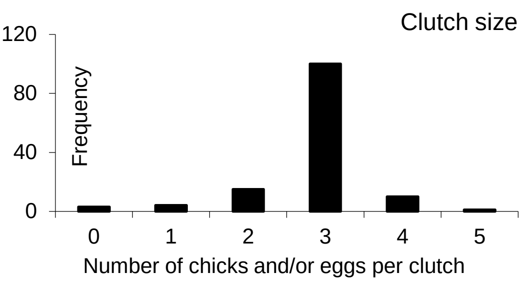


Table 2. Demographic and behavioural observations made at the breeding colony, methods used and assumptions made.

Observation	**Method**	**Comments/ assumptions**
Colony area	GPS track-log function used to create a polygon that was later used to determine area with ArcGIS software	Slight buffer from edge of colony to avoid undue disturbance to nesting birds
Clutch size	Combination of opportunistic visual counts (including photographs) at different parts of the colony and formal quadrat counts (see below)	The number of quadrats (n = 14) was minimised to reduce disturbance to the breeding birds
Scrape/Nest density	Photographs of 1m x 1m quadrats randomly placed at different locations within the colony (n = 14)	Photographs inspected later to determine number of scrapes / m^2
Group size counts & departure rates	Timed counts of the number of chicks and adults departing the island at different times of the day and standardised according to time spent counting	Counts included loose groupings of chicks and adult birds
Offshore group counts	The number of adults/chicks in groups swimming on the water surface >100m offshore from the island	Assumes that family groups have separated at >100m from the shoreline
Chick mortality rate	Approximate mortality rate calculated by comparing mean clutch size counts with mean offshore group size	Assumes that all chicks from each nest are led away from the island by one or both parents once offshore (i.e. >100m).
Vegetation information	Vegetation communities and plant species identified	None
Silver Gull numbers and behaviour	Daily gull count and record of predatory behaviour	None
Other predators	Daily count of other predators and opportunistic observation of predator behaviour	None
Other vertebrate species	Opportunistic records of other vertebrate species	Results not reported here
Aquatic	Water depth, sampling of aquatic invertebrate communities	Results not reported here

Table 3. Scrape density and clutch size counts.

	Mean (±SE)	**Range**	**Sample size (n)**
Scapes per m^2	9.50 (0.49)	6 - 13	14
Eggs and / or chicks per scrape	2.85 (0.06)	0 - 5	133

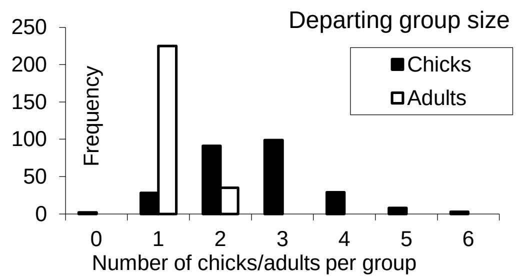
Table 4. Size of groups (adults and chicks) moving from the breeding colony to the water.

	Mean (±SE)	**Range**	**Sample size (n)**
Adults	1.57 (0.03)	0 - 9	707
Chicks	4.21 (0.09)	0 - 24	707

Group size and rate of departure

Groups of adults and chicks were observed moving from the colony to the water at points around the perimeter of the island, although the majority of departures occurred at the southern tip of the island. Departing groups contained up to nine adults and 24 chicks, however mean group size was 1.57 adults and 4.21 chicks (Table 4). The majority of these groups comprised one adult bird with two or three chicks (Figure 3).

Figure 3. Group size of departing birds.



Large groups of birds congregated loosely in the shallow water at the shoreline prior to departing the island. As the groups of birds moved offshore, they again separated into smaller groups with a mean of 1.13 adults and 2.62 chicks, typically one adult bird leading two or three chicks (Table 5).

Variation in departure rate appeared to be dependent on the time of day and prevailing weather conditions (Table 6). At the peak of activity, more than 2,800 chicks per hour were observed departing the island. At other times, departure rate was as low as 12 chicks per hour. Times of low departure rate appeared to coincide with inclement weather and maximum departure rates were commonly observed during the middle of the day (Table 6).

Predation

Silver Gulls were the main predators observed on the island. Gull numbers were variable during the survey period, with a maximum of 37 birds observed on the 13th May (Table 7). There were low levels of gull predation on Banded Stilt eggs and chicks and no gull breeding behaviour was observed on or around the island. The only evidence of gulls breeding in the outback in 2010 was a small nesting colony (only a few hundred birds) detected at Lake Eyre during aerial reconnaissance.

Opportunistic sightings of other predators included low numbers of Australian Raven (*Corvus coronoides*), flying to and from the colony on most days. A Wedge-

Table 5. Size of groups (adults and chicks) once > 100m offshore.

	Mean (±SE)	Range	Sample size (n)
Adults	**1.13 (0.02)**	**1 - 2**	**260**
Chicks	**2.62 (0.06)**	**0 - 6**	**260**

Table 6. Departure rates of chicks at different times during the field survey in 2010.

Sample ID	Date	Survey time/ duration	Departure rate (chicks/hr)	Weather conditions
1	12/5	12:16-12:46	1,362	Fine, sunny, warm, light wind
2	12/5	15.02-15.32	342	Fine, sunny, mild, light wind
3	13/5	10.31-11.01	2,842	Fine, clear, mild, still
4	13/5	13.06-13.36	744	Fine, clear, warm, still
5	14/5	11.01-11.11	1,266	Fine, clear, mild, light wind
6	14/5	12.15-12.25	282	Fine, clear, mild, light wind
7	14/5	13.30-13.40	174	Fine, overcast, mild, light wind
8	15/5	09.00-09.10	12	Fine, overcast, cool, moderate wind
9	15/5	10.00-10.10	18	Fine, overcast, cool, moderate wind
10	15/5	11.07-11.17	18	Fine, overcast, cool, moderate wind
11	15/5	12.00-12.10	204	Fine, overcast, mild, moderate wind

tailed Eagle (*Aquila audax*) was observed on the island once, after it was disturbed from the ground on the edge of the northern colony. A single Black Kite (*Milvus migrans*) was observed on one occasion circling over the colony.

Chick mortality

Mortality rate, determined by comparing mean clutch size on the island ($\bar{x}$ = 2.85) with mean offshore group size ($\bar{x}$ = 2.62) was estimated at 8.1%. This was used to calculate the number of chicks that successfully departed the island, based on an overall breeding colony size of 73,397 nests. Using this method, it was estimated that 192,000 chicks left from Arduous island. This figure does not take into account the number of surviving chicks from the subsequent breeding attempts or from the secondary breeding colony.

Other important field observations

One adult stilt with an orange overyellow banding flag was observed during the survey, confirming the presence of birds from the Coorong population (see Gosbell & Christie 2006).

Evidence of two earlier breeding events or attempts was found in the area. One was a recently abandoned attempt on the southern tip of a separate larger island less than a kilometre south of the active breeding colony (Figure 1D inset), and the other was a much older nesting site underlying the small active breeding colony on the north-western corner of Arduous Island (Figure 1D inset). At the former colony, many of the nest scrapes still contained eggs, whilst other eggs were scattered loosely around the area. Approximately 150 dead adult birds were scattered throughout and around the colony with little evidence of predation.

Follow-up after the initial visit

During an aerial survey on the 21st May, a secondary Banded Stilt breeding colony was discovered on an island approximately 50kms to the north of the original colony at Lake Torrens (Figure 1C). A conservative estimate of 15,000-20,000 nesting individuals was made from the aircraft. The birds appeared to be sitting on eggs and there were no chicks visible in the water surrounding the island. Silver Gull presence appeared to be higher at this colony. On the same day, an aerial survey of Lake Eyre (on advice from Trevor Wright) uncovered a Banded Stilt breeding colony of around 4,500-5,000 birds incubating their eggs on Ibis Island, the site of a previous breeding event in 2000. Silver Gull presence at this colony was deemed to be low. Subsequent observations of the Banded Stilt breeding colony at Arduous Island following the initial survey period are summarised in Table 8.

DISCUSSION

Our observations of the Banded Stilt clutch size and scrape density are similar to those of previous field-based studies (e.g. Burbidge & Fuller 1982, Robinson & Minton 1989, Bellchambers & Carpenter 1992). The maximum chick departure rate from Arduous Island exceeded that documented by Minton *et al*. (1995) for a smaller breeding colony in Western Australia. Our observation of groups of chicks departing from the island closely associated with a single parent or (pair of adults) concurs with the findings of Minton *et al*. (1995) who noted no true crèching behaviour.

Table 7. Silver Gull numbers observed daily at Arduous Island from 10th – 15th May 2010.

Date	Number of Silver Gulls
May 10	7
May 11	12
May 12	30
May 13	37
May 14	21
May 15	20
Mean (±SE)	21.2 (± 4.5)

Table 8. Observations of the Arduous Island breeding colony following the initial survey period.

Date	Survey type - participants	Estimated colony size (adult birds)	Silver Gull estimate	Comments
21st May	Aerial - Alex Clarke and Scott Dickery	40-60,000	30	• Thought to be incubating second clutch of eggs
4th June	Field - Alex Clarke	50-60,000 (75% still incubating eggs)	35-40	• Low numbers of chicks departing • Many nests and eggs abandoned • Evidence of recent dingo visitation • Water level reduced by 20-30% since May • Limited courting/mating behaviour
8th July	Aerial and Field – Alex Clarke	0	150-200	• Both colonies completely disbanded with no evidence of further breeding. • Water level low with lakebed exposed in some areas. • Signs of dingos • Thousands of juvenile stilts (most fully fledged) spread across the lake very few adult stilts present

*Observations of the same colony were also made by the VWSG and are reported elsewhere

Many questions regarding the stilt breeding behaviour remain unanswered. In particular, little is known about the different role played by adult male and female birds during breeding as they are difficult to distinguish in the field. Extensive high definition video footage and photographs captured as part of this study including of mating behaviour could be reviewed in more detail to potentially yield further insights into breeding behaviour and parental roles.

The success of breeding events following irregular inland flooding is linked closely to the conservation status and population viability of the Banded Stilt (Minton *et al*. 2000, Baxter 2003). Silver Gull predation was surprisingly low compared with previous events in South Australia (e.g. Robinson & Minton 1989, Bellchambers & Carpenter 1992). Although predation was apparent, the small number of gulls meant that the impact was low relative to the size of the stilt colony and gull control measures were not necessary. Increases in gull activity / predation were not observed when the stilts were disturbed from their nests and the birds appeared to resettle quickly. Disturbance to the breeding birds to collect data was deemed acceptable because of the low levels of predation. The reason for the lower than anticipated number of gulls is uncertain. However, it is possible that gull control measures (e.g. oiling and egg pricking) at nearby Roxby Downs in recent years have reduced gull numbers in the region.

A number of previous breeding events had occurred at Arduous Island and surrounding islands at different times in the recent past. The active smaller colony to the north of the island appeared to have started before the main colony, as most eggs had hatched and all adult birds had vacated the area by the morning of 13th May. The unsuccessful breeding colony on the southern island suggests that an even earlier group of birds arrived - the reason for the demise of this colony is uncertain but it is possible that the adult birds began nesting before sufficient aquatic invertebrate food sources were available. There was also evidence that a small number of stilts had nested on Arduous Island in previous years. This most likely coincided with widespread heavy rainfall in mid-January 2007 (R. Peddler *pers. comm.*). At this time Andamooka, approximately 100 kilometers to the north-west recorded rainfall of 48 mm over five days (17/1/2007 to 21/1/2007) and Pernatty Station, 45 kilometers to the south-west of the breeding site, recorded 73 mm over three days (18/1/2007 to 20/1/2007) (BOM 2011b).

The unexpected success of the breeding event documented in this study is likely to have resulted in a significant increase to the Banded Stilt population in Australia. Follow-up observations confirmed that breeding continued until late June, suggesting that some birds nested at Arduous Island for a second and possibly even third time, resulting in an even greater number of chicks successfully departing the colony. Although it is not possible to estimate the number of chicks that progressed to maturity, opportunistic aerial and field observations of large numbers of juvenile stilts have been documented in South Australia and it is likely that the sheer size of the breeding event, coupled with the relatively low chick mortality at the island has improved the long-term viability of the population.

Despite the success of this breeding event, we recommend that future events continue to be closely monitored for Silver Gull predation. Decisions by government about whether to protect and monitor future Banded Stilt colonies may depend on accurate and timely estimates of breeding colony size. The scale-based aerial estimation method used for this study proved to be consistent with field-based estimates and therefore suitable for future use. Where appropriate, gull control measures should be implemented in accordance with the Banded Stilt Action Plan (DENR 2009). This will aid in the ongoing management of predation and disturbance to nesting colonies. The monitoring and collation of data from this survey has provided a baseline to measure trends in occurrence and abundance over time from which future assessments and reviews of the species' conservation status can be based. Considering the dependence of the species on significant inland rainfall events and predictions for drier and warmer conditions under climate change scenarios for inland southern Australia (Steffen & Hughes 2013), ongoing monitoring is recommended to ensure the long term viability of the population and to increase our knowledge of the breeding biology of the species.

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BROOD-CAPTURE BY AUSTRALIAN PIED OYSTERCATCHERS

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The Australian Pied Oystercatcher *Haematopus longirostris* almost invariably breeds as highly territorial monogamous pairs. It was surprising when three instances of apparent brood-capture involving one pair taking over the parental duties of an adjacent pair and nurturing their hatched young were observed. This behaviour conflicts with the tendency of oystercatchers to attack, injure and even kill young of other pairs venturing into their territory as observed in both this and other studies. Possible reasons why there would be an advantage in nurturing as opposed to repelling or killing additional young are discussed. For Australian Pied Oystercatchers brood-capture as described here appears to be an occasional rather than aberrant phenomenon, occurring at a frequency of at least 1% of breeding attempts when pairs are nesting in close proximity in south-east Tasmania.

INTRODUCTION

Oystercatchers are large relatively long-lived shorebirds that are typically thought to form and maintain monogamous pairs for life, unless a partner is lost through mortality. In Australia, oystercatchers are strictly coastal and once paired, usually maintain territories along stretches of sandy and/or rocky beach. In areas of high density of oystercatcher pairs, breeding territories may abut and be as little as 50 m apart. Highly territorial behaviour is typically observed in these areas, with pairs aggressively defending nesting and adjacent foraging areas from neighbours and their offspring.

During a 20 year period starting 1977 the breeding of Australian Pied Oystercatchers *Haematopus longirostris* (hereinafter referred to as oystercatchers) was monitored annually in south-east Tasmania. Oystercatchers are widely dispersed in this area, particularly breeding pairs which are found on beaches throughout the area (Fletcher & Newman 2010). This long-term study has involved monitoring more than one thousand breeding attempts. On three occasions a pair of oystercatchers feeding unfledged young acquired one or more additional chicks from an adjacent pair in the period before the young were capable of flight. In each instance a different pair of oystercatchers was involved in brood-capture.

Superficially the behaviour described above resembles kidnapping, which is rare in nature. Kidnapping has been described for the White-winged Chough *Corcorax melanorhamphos*, with the behaviour being explained in terms of group benefit by the acquisition of an additional member (Heinsohn 1995). Unlike the White-winged Chough, for which cooperative breeding is essential to survival, the oystercatcher is usually strongly socially monogamous and highly territorial when breeding. It is therefore surprising that oystercatchers should indulge in behaviour superficially similar to kidnapping although their motives may be different. There are no previous reports of brood-capture in oystercatchers. However, cooperative polygamous long-term breeding of a trio of oystercatchers involving one male and two females has been described (Totterman & Harrison 2007). Here I document the first apparent instance of brood-capture in the Australian Pied Oystercatcher and discuss the possible reasons for such behaviour.

METHODS

The observations reported in this paper were made on beaches of the South Arm (42°S 146°E), which forms the northern shore of the Derwent Estuary and includes Ralphs Bay-Lauderdale, South Arm Neck, and Gorringes Beach, Mortimer Bay, which lies between these two locations. The study area is shown in Figure 1, which indicates the main areas where oystercatchers and other shorebird species congregate and local movements between these areas.

Beaches in the South Arm area of south-east Tasmania were visited regularly during the oystercatcher breeding season, which extends from late September to February in this region. Most of the oystercatcher breeding territories were well known and a large number of breeding adults were individually marked with colour bands. Unfledged young were also banded. In the first two instances of brood-capture discussed below most of the adults and the runners (unfledged hatchlings) involved were individually colour-marked.

The key aims of the original study were to determine breeding parameters such as clutch size and incubation period, as well as pair and site fidelity as part of the BirdLife Australia (formerly Birds Australia / RAOU) Nest Record Scheme. Visit timings were variable, with a weekly frequency being typical at the height of the breeding season. However, more frequent observations were made for events of significance, for example, egg laying intervals, hatching sequence, fledging and to band unfledged young when they reached an appropriate size.

Below I describe in detail the observations of instances of apparent brood-capture made during this study.

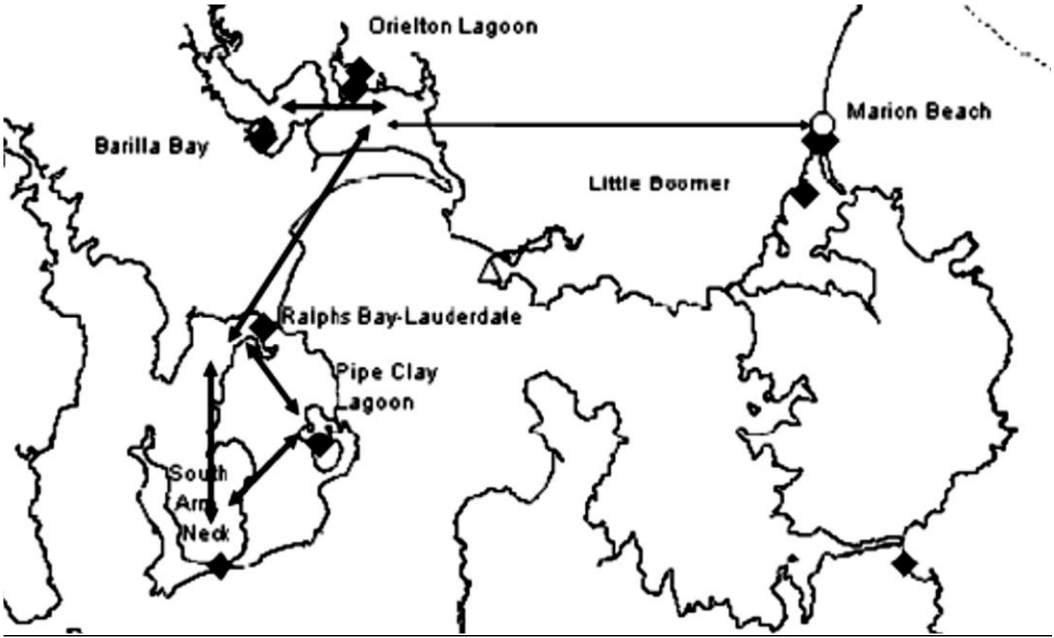

Figure 1. Study area and oystercatcher breeding locations in south-east Tasmania.

OBSERVATIONS

Instance one

Three pairs of oystercatchers, designated 5, 6 and 7 (Newman 1992), hatched one, two and one young from clutches of two eggs around 22, 13 and 14 of November 1987, respectively. Five of the adult oystercatchers had previously been individually colour-marked (M. Newman & P. Park, *unpubl. data*). Pairs 5 and 6 used nest sites separated by approximately 30 m and located at the base and tip, respectively, of the spit at the southern end of Gorringes Beach, Mortimer Bay. Pair 7 nested on a headland beyond the spit.

On 14 November three young boys were walking down the beach carrying a small downy oystercatcher chick. I asked the boys where they had found the bird and explained that it would die if it was not returned to its parents. They said they had taken it because it was being attacked by a "rat". The boys indicated that they had found it on the spit about 1km away at the southern end of the beach. From their description I thought it belonged to pair 6 (on the basis of my knowledge of their territory boundaries) and I returned it to their nest scrape near the tip of the spit (i.e. in pair 6 territory). I do not consider this event is central to or the cause of what subsequently happened, but consider it to be an intervention which needs to be recorded.

On 27 November the female of Pair 7 was missing, but a chick had survived. On subsequent visits in December the Pair 7 male was associating with a new unmarked female, and the young appeared to be gone.
From the adult oystercatcher behaviour, namely lack of alarm calls, it was concluded that Pair 5 had lost their young by 19 December.

On 22 December one young, almost able to fly, was found and banded near the Pair 6 nest scrape at the tip of the spit. At the same location on 25 December a further two chicks, one of which was noticeably smaller, were captured and banded. All three young were foraging with the Pair 6 adults, and neither Pair 5 nor Pair 7 adults behaved as if they had young at that time.

On this basis, I surmise that the Pair 6 oystercatchers acquired an additional chick from one of the adjacent territories, probably from Pair 5. I base this on the estimated eight day difference in hatching dates and the smaller size of one of the chicks banded on the 25 December. When the additional chick was acquired is uncertain, but it is improbable that it was caused by the return of the chick taken by the boys, as both the adjacent pairs subsequently behaved as if they still had young.

Pair 6 was the most experienced of the three pairs, having occupied their territory for the longest number of years (Newman 1992). Towards the end of September 1987 the corpse of the female which had held the adjacent Pair 5 territory since 1977, was being eaten on the end of the spit by a Swamp Harrier *Circus approximans.* The deceased female had made scrapes each year, but had failed to lay eggs in the previous seasons. The surviving male quickly acquired a new mate and eggs were laid only one week later than the other two pairs. Hence Pair 6 may have experienced increased competition with Pair 5 as the new female became established.

Instance two

Two pairs of oystercatchers bred on the spit at Lauderdale in October 1989. The spit is a small tongue of land, approximately 100 m long and 50 m wide at the base, protruding into Ralphs Bay. At the time, the area was residential with the spit and adjacent mudflats subject to regular human disturbance. The spit is a traditional oystercatcher nest site, which had been in continuous use for at least 25 years prior to 1989. From 1986 to 1989 a second pair of oystercatchers nested on the spit, which had become increasingly eroded, so that the only nest sites, free from inundation by very high tides, were at the tip. In 1989 the two nests were about 20m apart. All three Australian resident gull *Laridae* species, together with non-breeding oystercatchers and other species roosted at high tide near the nest sites.

The Pair 1 male was originally banded as a breeding adult at Lauderdale in November 1984 at a nest site approximately 500 m from the spit in a territory where the nest site was separated from the mud flat by a causeway with heavy vehicle traffic. This disruption by vehicles required the adults to fly food to the chicks in a similar manner to "leapfrog" territories described in studies of Eurasian Oystercatchers *Haematopus ostralegus* in Holland (Ens 1992). This terminology is used here to describe these breeding territories. In November 1989 this male was more than 10 years old. It relocated its breeding territory to the Lauderdale spit in 1985-86, when it bred successfully. The Pair 1 female was banded in November 1989, and its previous breeding history is unknown. Both the Pair 2 male and the female were banded as unfledged chicks, being eight and seven years of age respectively in 1989. The male first bred unsuccessfully at the spit in 1987-88. Following the loss of his original partner, 1989-90 was his second season with the replacement female. Unlike the Pair 1, neither of the Pair 2 adults had yet bred successfully.

Pair 1 nested on the north side of the spit and completed their clutch of three eggs about 8 October. Pair 2 completed their clutch of two eggs approximately 11 days after Pair 1, on about 19 October, using a site on the opposite side of the spit. Pair 1 hatched two young, which left the nest on 10 November, after an incubation period of 33 days. The remaining egg, although fertile and in the process of hatching, was abandoned. Pair 2 hatched two young after an incubation period of 31 days. They left the nest nine days later than the chicks of Pair 1.

Observations were then discontinued until 26 November to minimise disturbance. At this date Pair 1 were highly agitated and two young, of obviously different size, were located (this observation does not preclude the possibility of additional chicks being hidden on the spit). In contrast Pair 2 was not agitated, either on this or any subsequent visit during 1989, and it was presumed that they had lost their young.

On 16 December Pair 1 were feeding three young, two of which were caught, measured (340 and 350g weight) and banded. The third and much larger chick (495g) was caught two days later and banded. On 22 December the larger young was flying, the interval between hatching from a Pair 1 egg and flying being 42 days, which is near the minimum time recorded by me for this parameter in the Hobart area (Newman 1992). One of the smaller chicks was recorded on visits up to 5 January 1990, when it weighed 430g and was still not flying. At this date 56 and 47 days had elapsed from the hatching of the Pair 1 and Pair 2 eggs, respectively. On 29 December 1989 and 1 January 1990, when the non-flying young was recaptured for measurement, a scab was noted over one eye. The other smaller chick was not seen after 16 December.

The following explanation is proposed for the above observations. The Pair 1 adults are clearly more experienced breeders than pair 2, through the known long term occupancy of the spit territory by the male and previous success in fledging young. It is suggested that this pair have the superior nest site and probably foraging territory, as evidenced by their ability to lay their eggs earlier than Pair 2. Indeed the Pair 1 male is probably particularly enterprising and aggressive as in 1985 he switched from a low quality territory, in which the nest site is remote from the foraging territory, to the superior spit territory, where the young can be fed on the mud flat immediately adjacent to the nest site. Between 19 and 26 November I conclude that Pair 1 acquired both of the Pair 2 chicks, based on the size differences between the three young in January when the birds were measured close to fledging. The acquisition of their neighbour's young may have corresponded with or followed the loss of one of their own young. While I have no knowledge of the cause of this event, both the oystercatchers and other roosting birds are frequently disturbed by people and dogs; the scab noted on one of the chicks is consistent with attempted predation by a gull species, or alternatively could have been inflicted by an adult oystercatcher during a territorial dispute.

Instance three

During October 1997 a pair of oystercatchers was incubating two eggs at a traditional nest site, located adjacent to the road at the southern end of the South Arm Neck. Two chicks were hatched about 7 November. After 15 December this pair was seen to have three chicks, one of which was noticeably larger than the other two, and was the first to fly on 20 December (observations made by P. Park).

Immediately beyond this nest site the shoreline bends sharply right away from the road. Approximately 300 m from the bend a spit has formed at the entrance of a small tidal creek. This spit has for many years been both an oystercatcher nest site and a high tide roost for oystercatchers and other species. In October 1997 three pairs of oystercatchers nested on this spit, which is about 100 m long, compared with at most two nesting pairs in previous years. All three pairs had chicks, and from our knowledge of the breeding sequence and clutch sizes it would have been possible for two of these pairs to have lost a chick to the pair nesting near the road. I consider this important because, as the shoreline bends sharply, all four pairs of oystercatchers and their young feed in close proximity when the mud flats are exposed at low tide.

DISCUSSION

When this behaviour was first observed in 1987 it was completely unexpected and I wondered whether my intervention in rescuing the chick from the boys had impacted on the situation. However, subsequent detailed analysis of my observations allowed this possibility to be discounted and in the other two instances there are no doubts concerning the conclusion that an oystercatcher pair acquired an additional chick during the period between hatching and fledging. That is, in every case the number of young tended by the oystercatcher pair exceeded the number of chicks hatched by the pair). Brood-capture can only be detected when the chronology of breeding from the hatching of eggs to the fledging of young by a pair of oystercatchers is monitored regularly. During a twenty year period I estimate the continuity of observation I achieved, with the assistance of co-workers, was sufficient to potentially detect brood-capture in any one of 300 breeding events recorded. Hence in the Hobart area oystercatcher population brood-capture may occur at a minimum frequency of around three instances in 300 breeding events (1%), i.e. there may have been instances that were missed. That would suggest brood-capture in Australian Pied Oystercatchers is occasional rather than aberrant phenomenon. However, not all the 300 breeding events involved circumstances prerequisite to the occurrence of brood-capture; namely that oystercatcher pairs breeding in adjacent territories simultaneously have young of a similar age. When these circumstances prevail the probability of brood-capture is likely to exceed 1%.

Possible mechanisms for brood-capture

Instances one and two above involve pairs of oystercatchers nesting in close proximity. In each case the long term residents acquired a chick of an adjacent less experienced pair. My studies have shown that birds usually remain faithful to a breeding territory and partner (Newman 1992, 2008). In both of the above instances the pair that lost their chick had at least one partner which was new. Also in both instances prime status of the acquisitive pair is underpinned by their ability to complete their clutch of eggs earlier than the pair which appeared to lose their young. It may also be significant that in Instance three an additional pair had newly established a territory adjacent to the pair which acquired an additional chick, although in this case territory overlap was in the low tide feeding zone as opposed to the vicinity of the nest site.

Thus, a pattern emerges in which the conditions for brood-capture are driven by a population which is increasing in size and for which nest sites are at a premium. Long-term trends in oystercatcher numbers for the Ralphs Bay-Lauderdale area show a period of rapid increase between about 1986 and 2000 suggesting that this condition was prevalent in the area where these observations were made. In addition at Gorringes Beach, Mortimer Bay, I noticed an increase in the number of breeding pairs from five to eight between 1977 and 1990.

It has been suggested that the two most basic aspects of the life history of the oystercatcher are its long life span, which may restrain the birds from heavily investing in the current breeding attempt, so as not to imperil future reproduction, and intense competition for breeding space of high quality (Ens 1992). I tentatively suggest that these apparent instances of brood-capture may be explained by the pair of oystercatchers acquiring the additional chick being able to provide improved parental care to the extended family by decreasing their involvement in territorial disputes.

My previous (unpublished) observations of oystercatcher territorial behaviour in the Hobart area population provide support to the above hypothesis. For instance oystercatchers with young are constantly vigilant for potential predators, providing early warning alarm calls to their young. The chicks, according to their age and circumstances, respond in various ways including remaining hidden in cover, crouching, or running to cover. However, when other oystercatchers are present defending the territory takes precedence over concern for the young.

Oystercatchers nesting in close proximity eventually arrive at a truce, based on mutual exemption from their respective low tide feeding territories. At high tide they often roost close together near their nest sites, moving in opposite directions when either disturbed or commencing to forage.

While parent oystercatchers usually adhere strictly to their mutual exclusivity protocol, this is not always the case with their young. When oystercatcher chicks are close to flying their response to disturbance while feeding with their parents at low tide often involves either running to cover above the high tide mark, or running into the water and swimming out to sea. I have regularly observed this behaviour in the study area, which is frequently disturbed by people and dogs. When this happens the young have little sense of direction and may enter and eventually take refuge in the territory of another breeding pair. This provides a situation in which brood-capture could occur opportunistically. The adult alarm calls, which cause the young's panic dash for cover, often attract flocks of non-breeding oystercatchers, which sometimes attack the runner. When this occurs the breeding oystercatchers immediately concentrate on repelling the intruders and may not know where the runner eventually takes cover. Territorial demarcations may deter the original parents from searching for their young in the area where it is hiding. I suggest that young lost from their natal territory in this manner, may respond to the calls of their future foster parents, when they are calling their own young out to feed. By fostering the chick, supervision and provisioning of the combined young becomes the responsibility of one as opposed to two pairs, which halves the number of birds making alarm calls to the young. This decreases the frequency with which other oystercatchers, particularly those in non-breeding flocks, are attracted to the area by the alarm calls resulting in territorial disputes between non-breeding birds and the breeding pair. Thus, territorial conflicts, which decrease the efficiency of parental care, may be prevented if only one pair is tending young.

In studies of the Eurasian Oystercatcher in the Netherlands (Ens 1992), the distinction was made between resident and leapfrog territories on the following basis. Resident territories have nest sites immediately adjacent to the area where the oystercatchers forage and the young are called out to feed with them as the tide falls. Leapfrog territories are located away from the high tide mark behind the resident territories. Resident pairs attack any “leapfrog” adults attempting to feed in their territories and they are forced to feed beyond the resident pairs at low tide. If “leapfrog” parents attempt to move their unfledged young through the resident territories the young are attacked by the resident adults and may be killed. Consequently, the leapfrog young are fed exclusively by flying food to the leapfrog territories, which are typically 200 to 500 m from where the parents forage, a provisioning strategy which is 3.5 times less efficient based on the number of young fledged / pair.

The behavior of the oystercatchers observed in this study in which they capture and foster additional young is in marked contrast to the attacking and even killing of “leapfrog” young described above. I have previously observed resident oystercatchers attack the young of other pairs which venture into their territories (M. Newman, *unpubl. data*). Hence, it appears that there is a delicate balance between whether an adult will nurture or injure the young from another pair. I speculatively suggest the following possibility as an explanation of this dilemma. If the captured young is allowed to remain hidden in the territory of the dominant pair (i.e. the pair acquiring the additional young) and is subsequently provisioned by them it will remain silent. The less experienced breeding pair will eventually accept that their young have perished. In my extensive experience oystercatchers do not lay replacement clutches when they have lost young which have been hatched for four or more days. Once they have ceased breeding activity they become less territorial and hence the number of territorial disputes with their neighbours decreases. This would be expected to increase the efficiency of provisioning by the dominant pair, which may at least partially offset the need to tend additional young. However, if the dominant pair attempted to injure or kill captured young their calls would alert their parents and result in violent conflict between the two pairs of adults with an uncertain outcome. Alternatively, the stimulus of chick begging as opposed to fleeing may promote an overriding nurturing instinct.

Polygamy and brood-capture

Since the observations reported in this paper were made, a long-term polygamous breeding association involving a male and two female oystercatchers has been described (Totterman and Harrison 2007). This association lasted for ten years and demonstrates that oystercatchers can breed cooperatively, but the literature review by Totterman and Harrison concludes that they rarely do and their record is the only instance of it occurring in the Australian species. While the present strategy of brood-capture is different from a polygamous breeding association, both behaviours may be a consequence of a shortage of breeding territories and mature birds queuing for an opportunity to breed.

In Eurasian Oystercatchers 7.0% of male and 5.1% of female copulations by members of pairs involved Extra-Pair Copulations (EPCs), but these predominantly occurred well before eggs were laid (Ens 1992). In all other respects the paired oystercatchers were strongly territorial and monogamous. DNA-fingerprinting of 20 chicks confirmed that only one was not fathered by the male partner, but by a neighbouring male, which was seen to copulate with the female before egg-laying. Male breeders whose mate was absent sometimes evicted soliciting female intruders instantly. This suggests that EPCs were not necessarily beneficial, even when there was no apparent risk to the mate. There was also no evidence of egg dumping by additional females engaging in EPCs with territorial males. Ens *et al.* (1992) concluded that the primary purpose of EPCs is to assess the possibility of changing mates in the future and this normally fails due to intra-sexual competition. Thus, the benefit of EPCs appears to lie in the future rather than current breeding events. Ens *et al.* (1992) further point out that benefits in the future are especially likely to be of importance in a long-lived species like oystercatchers. On the above basis I suggest that the motivation for brood-capture as described in this paper is unlikely to be associated with the investment made by oystercatchers indulging in EPCs.

Kidnapping, brood parasitism and creching

For the purposes of describing these behavioural observations, I have used the term brood-capture to represent the phenomenon, which is the subject of this paper. However, I acknowledge that although the outcome is similar to other forms of acquisition of another pair’s young, there may be significant differences in the mode of capture of young and the motives for acquisition between oystercatchers and White-winged Choughs (Heinsohn 1995). I also wish to distinguish the observed behaviour from the more commonly used concept of brood-parasitism involving the exploitation by one species (the brood-parasite or nest-parasite) of the parental behaviour of another species (the host). In this case brood-parasitism would, if relevant, involve two pairs of the same species, namely oystercatchers.

In the above discussion I have indicated that brood-capture may be an opportunistic event occurring when a fleeing young hides in an adjacent territory following disturbance. If my interpretation of the mechanism is correct, then the capture of young by oystercatchers is distinct from the strategy of kidnapping adopted by White-winged Choughs (Heinsohn 1995). There is published support for an opportunistic capture mechanism, which has been suggested as a possible precursor to the development of crèching behaviour (Campbell and Lack 1985), which may have originated during normal parental caring at high brood densities. Broods then become mixed, either because both pairs of adults are fighting in defending their broods, which then scatter, or because a chick of one brood wanders closer to a foreign brood than to its own parents and joins the foreign brood when it is called together by the adults. Such mixing is most frequent when broods are less than a week old (Campbell and Lack 1985). However, the present observations do not involve the formation of a crèche defined as an assemblage pooling the still dependent young of several pairs of a species because there was no long term shared accountability to parental care. Following, the brood capture event only the pair which had acquired an additional juvenile showed the typical alert, noisy behaviour characteristic of oystercatchers with dependent young. The other pair while continuing to occupy their territory did not display any behaviour suggesting they were involved in the parental care, that is, flights and calls warning young of danger.

If a brood-parasitism mechanism was involved it would imply that the pair, which had lost their young (the brood-parasite) had for strategic purpose orchestrated the transfer of their young into the territory of the adjacent pair (the host). This seems a most unlikely proposition. Given oystercatchers are aggressively protective of young, it seems unlikely a pair willingly foster out in perpetuity their young to another pair.

CONCLUSION

Even though as suggested earlier brood-capture may occur at a minimum frequency of 1% of breeding events when oystercatchers are breeding at high density, it is very unlikely that the act of acquisition of young would be observed spontaneously in the field. It will only be apparent in detailed studies involving the continual monitoring of nests throughout the breeding cycle until young are fledged. As stated by Whitelaw *et al.* (2005) such studies are rarely available and the work conducted by Priscilla Park and myself is an exception in Australia. However, other populations of oystercatchers breeding at high density have been intensively monitored (Ens 1996) and brood-capture would be expected to have been detected if it was occurring. Perhaps the "leapfrog" strategy in Eurasian Oystercatchers whereby poorer breeding territories are located behind good territories and thus, are separated from foraging areas requiring adults to fly food to young, eliminates the opportunities for brood-capture of young straying into adjacent territories. If not it remains to be explained why brood-capture occurs, possibly uniquely, in the Australian Pied Oystercatcher and not in closely related species.

ACKNOWLEDGEMENTS

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Many people contributed to banding the oystercatchers. Priscilla Park, Bob Paterson and Alan Fletcher helped with the trapping adult birds at the nest and banding runners. Others contributed to cannon netting of oystercatcher flocks, including Bill Wakefield and Mark Barter. I dedicate this paper to their friendship and memory. I express my appreciation to all who contributed to the team effort.

I have benefitted from discussions and comments on earlier drafts of this paper provided by many people, but I particularly wish to thank David Rounsevell, Lee Astheimer, Danny Rogers, the Editor and an anonymous reviewer for thought provoking comment and suggestions concerning alternative explanations of the perplexing events described in this paper. I hope that this paper inspires future workers to further the understanding and explanation of this unusual fascinating oystercatcher behaviour.

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COUNTS OF SHOREBIRDS AT THREE WETLANDS ON THE SOUTHERN COAST OF EAST JAVA PROVINCE, INDONESIA

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Nine shorebirds species were recorded wintering at three sites on the south-east coast of East Java Province, Indonesia in December 2012. A maximum of 175 shorebirds were counted in the study area. The shorebird community was dominated by Wood Sandpiper followed by Javan Plover. The most widespread species were Javan Plover and Common Sandpiper, which were both recorded at all survey sites. Compilation of historical records and recent shorebird surveys listed 39 shorebird species recorded in the south-east coast area of Java.

INTRODUCTION

Javan fauna lies in one of the world's most interesting zoogeographical areas, the Malay-Indonesian archipelago, an arc of some 13,000 islands straddling the equator and extending for five thousand kilometres between mainland Asia and the continent of Australia (Mackinnon 1988). Java is the most populated island in Indonesia, and is the centre of economic and political activities (Wibowo & Suyatno 1998). Although Java has a population exceeding 139 million, much of the south coast has a relatively low population density and many kilometres of shoreline remain in a natural state with minimal development (Crossland *et al.* 2010).

In Indonesia, the regions with the largest numbers of shorebirds occur on the north coast of Java and the south-east coast of Sumatra, and these sites account for over 90% of the shorebirds counted in surveys since the 1980s (Noor & Silvius 1997, Howes *et al.* 2003). Based on the presence of suitable habitats such as mangroves and intertidal mudflats, other coastal areas are likely to hold large numbers, but such areas have not yet been surveyed (Noor & Silvius 1997). Unlike the north coast of Java, information on shorebirds in the south coast Java is relatively lacking. The south-east coast of Java is of particular interest because this area was historically known as habitat for the endemic, Critically Endangered Javan Lapwing (Birdlife International 2001). However, recent information on other shorebirds in this area is sparse.

In this paper, we report our records of wintering shorebirds during December 2012 on the south-east coast of Java and we put our observations into context with reference to earlier records. It is hoped that this report will help to fill another gap in shorebird knowledge along the coast line of Java and provide baseline data for shorebird monitoring in the future.

STUDY AREA

Several locations in south-east coast Java, from Tempurejo (Lumajang district) to south to Mojosari (Meleman district), were the focus for shorebird surveys (Figure 1). Geologically the area comprises a coastal belt of sandy beach, and other associated wetlands, such as open grassy wetlands, a small river and rice fields (Figure 2). The main sites where shorebirds were present were Tempurejo, Watu Pecak and Paras Goang. Tempurejo is a sandy beach in Tempurejo village. The area (08^{0}19'S, 112^{0}58'E) is administratively located in Tempursari subdistrict, Lumajang district. The village has a total area of 470 ha, and there is an additional area of approximately 175 ha of sandy beach. Watu Pecak wetlands consist of various habitats of sandy beach, open grass wetland and rice field, with a total ±300 ha coastline. The area (08^{0}18'S, 113^{0}01'E) is administratively located in Pasirian subdistrict, Lumajang district. Paras Goang borders the Watu Pecak wetlands and has similar habitats, with a total of 200 ha. This area (08^{0}16'S, 113^{0}10'E) is administratively located in Pasirian subdistrict, Lumajang district.

METHODS

A bird survey was conducted during the wintering season for migratory shorebirds and the non-breeding season for resident Javan Plover along the south-east coast of Java from 11-17 December 2012. Out of nine locations visited, shorebirds were only present at Tempurejo, Watu Pecak and Paras Goang. The areas where shorebirds were absent were Bambang beach, Meleman, Gumuk Mas, Puger, Rawa Pulo and Rawa Jeni. The habitat of Meleman, Gumuk Mas and Bambang beach is sandy beach, similar to that at Tempurejo, Watu Pecak and Paras Goang.

Rawa Pulo and Rawa Jeni are two areas of freshwater grassland habitat. The Meleman, Gumuk Mas, Puger and Bambang beaches are all very small narrow sandy beaches bordering either the village or agriculture, so are probably not ideal habitat for many species of shorebirds (at least during our visit). Rawa Pulo and Rawa Jeni are freshwater grass and marsh habitat, and during our visit the habitat was flooded.

These habitats are potentially good for shorebirds when not flooded or drying, but may be suitable for only snipe when flooded.

The shorebirds recorded during this survey are listed and compared to the historical records of the shorebirds on the south-east coast of Java. In our review of these records, we consider the coastal area between 112^0-114^0E latitude. This region includes two important conservation areas Meru-Betiri National Park ($08^0$25'S, $112^0$50'E) and Alas Purwo National Park ($08^0$42'S, $114^0$28'E).

RESULTS

Nine species of shorebird were recorded across the three sites between 11-17 December 2012 (Table 1). Seven species were recorded at each of Watu Pecak and Paras Goang (Table 1) but only two species, Javan Plover and Common Sandpiper, were recorded at Tempurejo The following annotated list summarises our shorebird observations along with historical records (Table 2). Taxonomy and the English name of each species follow Sukmantoro *et al.* (2007).

Pacific Golden Plover *Pluvialis fulva*

This species was recorded only at Paras Goang, with maximum count of 25 birds in open grass wetlands on 14 December 2012. It was also recorded in a recent survey in south-east coast Java by Noni & Londo (2006) in the same area as our visit (Fransisca Noni and Sapari *pers.comm*), also in in small numbers (although the specific count is not provided).

Javan Plover *Charadrius javanicus*

This species was found at all locations, with a total of 35 birds observed. The highest count was 20 birds in Paras Goang on 14 December 2012 (Figure 3). Although recorded in small numbers, Javan Plover may be a widely distributed and common species on the south-east coast of Java. It has previously been recorded at Lumajang, Puger and Alas Purwo National Park (Kooiman 1940, Grantham 2000, Noni & Londo 2006). In Trisik beach, south coast Yogyakarta, 114 birds was recorded on 15 January 2009 from across a variety of habitats including sandy beaches, wet grassland, a small river estuary and rice fields (Iqbal *et al.* 2013, A. Maruly *pers. comm.*). The record from Trisik is the largest record for Javan Plover in the south coast (Iqbal *et al.* 2013). The two largest records from north coast of Java were 142 at Pacinan / Situbondo and 210 at Wonorejo, both in East Java.

Figure 1. Map of the survey areas and their location in south-east Java. The triangles indicates the survey locations covered by this survey and by Noni & Londo (2006), the stars indicate the locations covered by Kooiman (1940), the rectangle indicates the location covered by Seidensticker *et al.* (1980) and the oval indicates the location covered by Indrawan *et al.* (1997) and Grantham (2000).

Table 1. Wintering shorebirds counted during December 2012 on the coast of south-east Java.

Species	Location			Total	Percentage of total shorebirds
	Tempurejo	Watu Pecak	Paras Goang		
Pacific Golden Plover			25	25	14.3
Javan Plover	3	12	20	35	20.0
Little Ringed Plover			14	14	8.0
Marsh Sandpiper		2	1	3	1.7
Common Greenshank		1	2	3	1.7
Wood Sandpiper		8	60	68	38.9
Terek Sandpiper		1		1	0.6
Common Sandpiper	4	10	6	20	11.4
Grey-tailed Tattler		6		6	3.4
TOTAL	**7**	**40**	**128**	**175**	**100%**

Little Ringed Plover *Charadrius dubius*

A total of 14 birds were observed on 14 December 2012 using sandy beach and wet open grassy habitat in Paras Goang. This species is a regular winter visitor in Java (Mackinnon 1988), but seems not to have been recorded on the south-east coast before.

Marsh Sandpiper *Tringa stagnatilis*

Two birds were observed at Watu Pecak on 13 December 2012 and a single bird was recorded at Paras Goang on 14 December 2012. On the south-east coast of Java, this species has been recorded on the Lumajang coast and in Alas Purwo Purwo National Park (Noni & Londo 2006, Grantham 2000).

Common Greenshank *Tringa nebularia*

A single bird was observed at Watu Pecak on 13 December 2012 and two birds were recorded at Paras Goang on 14 December 2012. On the south-east coast of Java, this species has been recorded previously only on the Lumajang coast by Noni & Londo (2006).

Wood Sandpiper *Tringa glareola*

A total of 68 birds were recorded at Watu Pecak and Paras Goang on December 2012. Our record of 60 birds in Paras Goang was the highest count of any shorebird species during this survey. It seems the only previous record from the south-east coast of Java was by Noni & Londo (2006), although it is reported as common and widespread visitor in Java (Mackinnon 1988).

Terek Sandpiper *Xenus cinereus*

A single bird was observed on 13 December 2012 on a sandy beach at Watu Pecak. The bird is apparently a common coastal visitor in Java (Mackinnon 1988), but seems to be rare on the south-east coast with only one previous record (Indrawan *et al.* 1997).

Common Sandpiper *Actitis hypoleucos*

This species is widespread in visited areas, but not numerous. A combined total of at least 15 birds were recorded at three sites during this survey. In Java, it is reported as a very common visitor and can be seen almost year round (Mackinnon 1988).

Figure 2. Typical condition of coastal habitat in south-east Java, which contains a combination of sandy beaches, a small river, wet grassland and rice fields (©Muhammad Iqbal).

Figure 3. Javan Plover at Tempurejo on 13 December 2012 (© Waskito Kukuh Wibowo).

Table 2. Annotated checklist of the shorebirds recorded at south-east coast Java.

Species	**Sources**				
	Kooiman (1940)	**Seidensticker *et al.* (1980)**	**Indrawan *et al.* (1997) Grantham (2000)**	**Noni & Londo (2006)**	**This Survey**
Pheasant-tailed Jacana	+			+	
Javan Lapwing	+				
Grey Plover			+		
Pacific Golden Plover			+	+	+
Kentish Plover			+	+	
Javan Plover	+		+	+	+
Red-capped Plover			+		
Malaysian Plover			+		
Greater Sand Plover			+		
Lesser Sand Plover			+	+	
Little Ringed Plover					+
Oriental Plover			+	+	
Whimbrel			+	+	
Eastern Curlew			+		
Eurasian Curlew			+		
Little Curlew	+				
Bar-tailed Godwit			+		
Marsh Sandpiper			+	+	+
Common Greenshank				+	+
Common Redshank			+		
Wood Sandpiper			+	+	+
Terek Sandpiper			+		+
Common Sandpiper		+	+	+	+
Grey-tailed Tattler	+		+	+	+
Ruddy Turnstone			+		
Curlew Sandpiper			+		
Sharp-tailed Sandpiper	+				
Broad-billed Sandpiper			+		
Long-toed Stint	+				
Red Knot	+				
Great Knot			+		
Sanderling	+	+	+		
Rufous-necked Stint			+		
Red-necked Phalarope			+		
Beach Thick-knee		+	+		
Swinhoe's Snipe				+	
Common Snipe				+	
White-headed Stilt	+		+	+	
Australian Pratincole	+			+	
Total number of species	11	3	28	16	9

Grey-tailed Tattler *Tringa brevipes*

This species was only recorded at a sandy beach on the Watu Pecak coast, with a total of six birds on 13 December 2012. This is an occasional coastal visitor to Java, preferring the southern coastline to the north (Mackinnon 1988). However, on the south-eastern coast of Java, there appears to be only one old and one recent record at Lumajang coast (Kooiman 1940, Noni & Londo 2006).

DISCUSSION

This survey recorded small numbers of nine shorebird species wintering on the coast of south-eastern of Java. The shorebird community was dominated by Wood Sandpiper (38.9%), followed by Javan Plover (20%). The most widespread species were Javan Plover and Common Sandpiper, which were the only species recorded at all three survey sites.

We found historical records of 37 species on the south-east coast of Java (Kooiman 1940, Seidensticker *et al.* 1980, Grantham 2000, Noni & Londo 2006). These species, included 26 which were not found on the recent survey. The first information on shorebirds in southeast Java derived from Kooiman (1940), which listed 11 shorebird species from Lumajang, Puger and Nusa Barung Island including the Javan Lapwing *Vanellus macropterus*, which is now listed as Critically Endangered and suspected to be Extinct. Seidensticker *et al.* (1980) compiled bird information from Meru-Betiri National Park and listed three shorebird species in the park. Observations of shorebirds during November 1989 to February 1993 and January 1994 in Alas Purwo National Park recorded 16 shorebird species (Indrawan *et al.* 1997). Further intensive avifauna surveys from May 1997 to September 1999 in Alas Purwo National Park recorded 17 shorebird species (Grantham 2000). More recent surveys during 2005-2006 recorded 16 species from Lumajang to Meleman (Noni & Londo 2006). The most recent survey in December 2012 recorded nine species, two of which were new records for the area: Little Ringed-Plover and Terek Sandpiper Both species are common and regular visitor in Java (Mackinnon 1988). These additional records bring the number of shorebird species recorded on the south-east coast of Java to 39 (Table 2).

In Java, the largest numbers of shorebirds occur on the north coast (Noor & Silvius 1997). Our short shorebird survey helps fill a gap of our knowledge of shorebird distribution in south-eastern Java. Combined with surveys conducted by local birdwatchers (Paguyuban Pengamat Burung Jogja or Jogja birdwatchers community with their programme Jogja Bird Banding and Monitoring Burung Pantai Indonesia or Indonesian Shorebird Monitoring) and other reports on the adjacent southern coastlines of Yogyakarta and Central Java Province (Crossland *et al.* 2010, Taufiqurrahman *et al.* 2010, Taufiqurrahman *et al.* 2011, Iqbal *et al.* 2013), we suggest that the southern coast Java has potential as a stop-over site for migratory shorebirds flying between western Indonesia (Sumatra, Java and Kalimantan) and Australia. The first record for Indonesia of Red Phalarope *Phalaropus fulicaria* on 20 April 2008 and the discovery of 1,845 Sanderling (37% of the estimated Indonesian population) on 2 January 2010 in Trisik beach (Yogyakarta) show the importance of the south coast of Java for shorebirds (Taufiqurrahman *et al.* 2010, Taufiqurrahman *et al.* 2011). Further study during the wintering period (October-February) is needed to improve our understanding of the composition, numbers and distribution of shorebirds along the southern coast of Java.

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FIRST RECORD AND BREEDING OF GREATER PAINTED SNIPE IN BALI, INDONESIA

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Greater Painted Snipe *Rostratula benghalensis* is resident in Africa, Madagascar, the Indian subcontinent, China, Thailand, southern Japan, the Greater Sundas, and Phillipines (Kirwan 1996, Robson 2008). The species occurs widely in the Greater Sundas (Mackinnon & Phillips 1993) but has not been recorded in Bali (Mason 2011). In this short communication, we give an account of an observation of Greater Painted Snipe in Bali (Indonesia), including two chicks, indicating that the species is breeding there.

On 3 March 2013, we observed a male, two females and two chicks in a grassy swamp in Banyuwedang (08°09'S, 114°34'E). Banyuwedang is part of Bali Barat National Park, and is administratively located in Gerokgak subdistrict, Buleleng district, Bali province (Figure 1). Adults have distinct characters compared to other shorebirds, with a slightly drooping bill. The females we observed had a mostly plain dark reddish head, neck, upper breast and upperside, broad whitish spectacles, a buffish median crown-stripe and mantle-lines, and an unmarked white lower breast to vent. The male we observed had a mostly greyish-brown head, neck, upper breast and upperside and buffish spectacles (Figure 2). These characters fitted well with those of Greater Painted Snipe (Hayman *et al.* 1986). At one point, a male was seen with two chicks (Figure 3).

There have been no previous records of Greater Painted Snipe for Bali (Mason & Jarvis 1989, Mason 2011), although it has been recorded breeding on the major islands of the Greater Sundas: Sumatra, Borneo and Java (Marle & Voous 1988, Mackinnon 1988, Mann 2008). The occurrence of Greater Painted Snipe on Bali has possibly been overlooked in the past. Alternatively, it is possible that the Javan population has expanded to Bali recently.

Figure 1. Map of Bali and location (Banyuwedang) where Greater Painted Snipe observed in Bali.

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Figure 2. A male Greater Painted Snipe on 3 March 2013 at Banyuwedang, Bali (©Budi Hermawan).

Figure 3. A male Greater Painted Snipe with two chicks on 3 March 2013 at Banyuwedang, Bali (© Rusman Budi Prasetyo).

SURVEY OF SHOREBIRD POPULATIONS AND HABITATS IN THE PILLIGA FOREST IN NORTHERN INLAND NEW SOUTH WALES, AUSTRALIA

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The Pilliga forest is the largest surviving woodland remnant in the agriculture-dominated landscape of the New South Wales inland western slopes and this study describes the area's contribution to supporting shorebird communities in Australia. Key shorebird habitats in the Pilliga forest area include ephemeral wetlands and dry woodlands as well as dry farmland and ground tanks. Sixty diurnal surveys in the Pilliga forest over a 22 month period in 2011-2013 recorded four resident shorebirds, Bush Stone-curlew *Burhinus grallarius*, Black-fronted Dotterel *Elseyornis melanops*, Masked Lapwing *Vanellus miles* and Banded Lapwing *Vanellus tricolor*, one migratory shorebird, Latham's Snipe *Gallinago hardwickii*, and two nomadic shorebirds, Black-winged Stilt *Himantopus himantopus* and Red-kneed Dotterel *Erythrogonys cinctus*. A review of data from secondary sources identified records of another two nomadic shorebirds, Australian Painted Snipe *Rostratula australis* (in 2003) and Australian Pratincole *Stiltia isabella* (in 1981). The nomadic Red-necked Avocet *Recurvirostra novaehollandiae* has also been recorded nearby (in 1992 and 1993) and may occasionally occur in the Pilliga forest.

INTRODUCTION

Populations of both migrant and resident shorebirds in Australia are currently in serious decline (Nebel *et al*. 2008, Hansen 2011), and identification and protection of a broad range of shorebird habitats is important. The significance of inland habitats for shorebirds in Australia is increasingly being recognised, particularly for resident Australian species but also for some international migrants (Smith 1991, Nebel *et al*. 2008). Inland wetlands are generally ephemeral in nature, requiring many shorebird species to make nomadic movements in response to flood and drought patterns. Inland woodlands and open plains are also important for some terrestrial shorebird species, but are poorly covered in general shorebird surveys targeting wetlands (Lane 1987). In the present study I examined the shorebird values of the Pilliga forest, the largest surviving woodland remnant on the inland western slopes of New South Wales (NSW), Australia. I did ground surveys to identify the shorebird habitats present and document the local distribution, habitat preferences and status of shorebirds in the area.

STUDY AREA AND METHODS

The 450,000 ha Pilliga forest (30°25'-31°15'S, 148°40'-149°50'E) is located in *Gamilaraay* Aboriginal Country on the western slopes of the Great Dividing Range in northern inland NSW, 370 km NNW of Sydney, and is between 290 and 420 km inland from the Australian east coast. The climate is temperate with a summer-dominant rainfall pattern and an annual rainfall of about 600-750 mm. The geology is dominated by coarse sandstone in the south-eastern Pilliga forest, eroding as a compound alluvial outwash fan towards the north and west. The forest comprises a mosaic of woodland and forest communities with various *Eucalyptus*, *Angophora*, *Callitris*, *Corymbia*, *Acacia* and *Allocasuarina* species. The majority of native vegetation on more productive clay and loam soils in the surrounding area has been cleared for agriculture, with the Pilliga forest left as a large dry woodland remnant on the poorest sandy soils. The Pilliga forest is within the Murray-Darling Basin, the major river system of inland south-eastern Australia. Aquatic and wetland habitats in the Pilliga forest are predominantly ephemeral and of limited extent and variety, fluctuating between a few small isolated waterholes along dry stream beds for much of the year and temporarily flowing streams and shallow ephemeral lagoons and gilgai wetlands following occasional heavy rain events, complemented by small anthropogenic earth-walled ground tanks (Murphy 2011). The study area (Figure 1) was defined as the Pilliga forest with a 5 km buffer of surrounding farmland including along Baradine Creek, which narrowly separates the northern and western outwash forests. The study area also included several small towns.

Prior to the field survey, sites with potential value as shorebird habitat were identified through field knowledge of the author (six years experience working in the Pilliga forest), reference to maps and aerial photography and reference to previous shorebird records on the Atlas of NSW Wildlife database (NSW Office of Environment and Heritage 2011). Additional potential habitat areas were identified during the course of fieldwork and included in subsequent surveys. Field surveys for shorebirds in the study area were done during daylight hours on 60 days between November 2011 and September 2013 (Appendix 1).

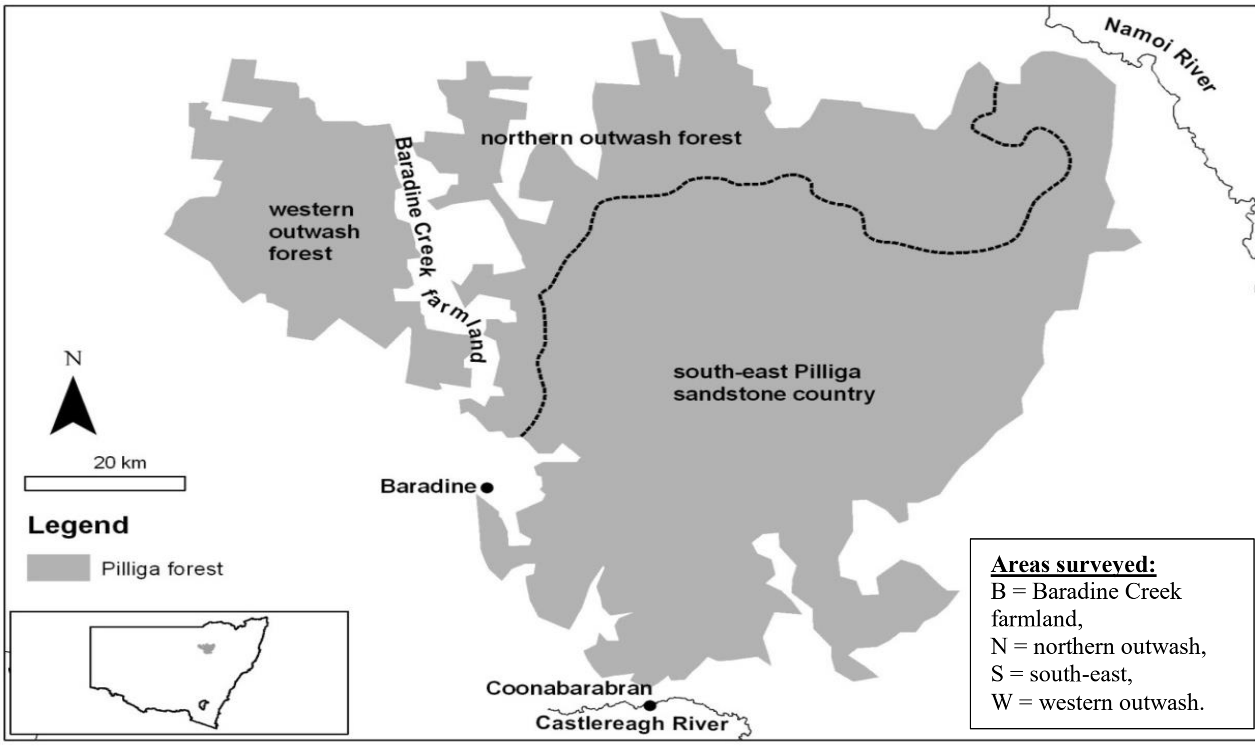

Figure 1. Map of the Pilliga forest study area. The inset map shows the location of the Pilliga forest in NSW. Locations of the four study area regions and nearby towns are indicated. The dotted line marks the boundary between the sandstone country and the outwash plain.

On each survey day between five and fifteen potential habitat sites were searched by either walking around the margins of wetlands and ground tanks or walking or slowly driving through terrestrial areas. Sites were generally 1-10 ha in area. In addition, call playback for the nocturnal Bush Stone-Curlew was done at night at five sites in the western outwash forest in April 2012 and six sites in the northern outwash forest in March 2013. Opportunistic observations of shorebirds made during the study period were also recorded and additional records were collated from secondary data sources.

RESULTS

Seven species of shorebird were recorded during the daylight field surveys and records of two additional species in the study area were obtained from secondary sources. This total comprised four resident species, one migratory species and four nomadic species (Table 1). Nocturnal surveys did not detect any additional Bush Stone-curlews. Another nomadic species, the Red-necked Avocet *Recurvirostra novaehollandiae*, was recorded marginally (less than 1km) outside the western edge of the defined study area in 1992 and 1993 (Atlas of NSW Wildlife) and may occasionally occur within the study area.

No shorebird species were recorded as abundant in the Pilliga study area but the most common were the Masked Lapwing and Black-fronted Dotterel, together comprising 90% of all records from the field survey, followed by the Banded Lapwing (7%). The remaining four species observed together comprised only 3% of the field survey records. Species richness at sites was low, with the highest diversity being four species (at Old Boo gilgai wetland in the northern outwash forest). A 2 km^2 area in the northern outwash (including a woodland site, a ground tank site and a dry farmland site) had a total of five species recorded. A representative sample of records from the study was provided to the Atlas of NSW Wildlife.

Shorebird habitats identified in the study area were ephemeral gilgai wetlands (2 ha or less in size), ephemeral streams and associated wetlands, anthropogenic ground tanks in woodland and farmland, dry woodland, dry farmland, areas of bare ground and grassy urban areas. The habitats used by each species are shown in Table 1, together with the general regions of the study area where species were found. There were three areas that are considered the most important for shorebirds in the Pilliga study area: (1) a complex of ephemeral gilgai wetlands in the northern outwash forest (supporting Masked Lapwing, Black-fronted Dotterel, Red-kneed Dotterel and Black-winged Stilt); (2) dry farmland and ephemeral stream wetlands in the Baradine Creek valley (supporting Banded Lapwing, Masked Lapwing, Black-fronted Dotterel, Black-winged Stilt and Australian Pratincole); and (3) dry woodlands of Bimble Box *Eucalyptus populnea* and Pilliga Box *Eucalyptus pilligaensis* in the northern and western outwash (supporting Bush Stone-curlew).

This study also documented the value of anthropogenic ground tanks for shorebirds, particularly in the south-east Pilliga forest where natural water bodies are scarce. Species recorded at small ground tanks were the Masked Lapwing, Black-fronted Dotterel, Latham's Snipe and Black-winged Stilt.

Other species listed under international migratory bird agreements that were recorded in the Pilliga forest study area (Murphy *pers. obs*.; Atlas of NSW Wildlife) are the White-throated Needletail *Hirundapus caudacutus*, Fork-tailed Swift *Apus pacificus*, Eastern Great Egret *Ardea modesta*, Cattle Egret *Ardea ibis*, Glossy Ibis *Plegadis falcinellus* and White-bellied Sea-Eagle *Haliaeetus leucogaster*.

DISCUSSION

The Pilliga forest is known as a significant habitat area for woodland birds, including many threatened and declining species (Date *et al*. 2002). The present study is the first published account concentrating on the shorebird values of the area. The Pilliga's shorebird fauna is dominated by Australian resident species, with only one international migrant. A key aspect of the shorebird values of the Pilliga forest is the extremely variable status of wetland and aquatic habitats. In dry (*El Niño*) years surface water is restricted to scattered small ground tanks and a few small waterholes along dry stream beds (Murphy 2011). When the shallow gilgais and streamside wetlands are full in *La Niña* years, resident Masked Lapwings and Black-fronted Dotterels increase in numbers and are joined by Australian nomadic visitors such as the Black-winged Stilt, Red-kneed Dotterel and Australian Painted Snipe. Habitat availability for terrestrial shorebirds such as the Bush Stone-curlew and Banded Lapwing is more stable.

The study identified several species of conservation significance. The migratory Latham's Snipe is listed under the China-Australia Migratory Bird Agreement (CAMBA), the Japan-Australia Migratory Bird Agreement (JAMBA) and the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA). Two records from ground tanks in the south-east Pilliga forest in November and February suggest the Pilliga forest is a stopover for small numbers of Latham's Snipe during both southward and northward passage.

The nomadic Australian Painted Snipe was recorded from a 2 ha wetland in farmland on the southern margin of the western outwash forest in October 2003, with a female and three males seen (A. Morris *pers. comm*.). This cryptic species is currently listed as endangered (higher risk) under the NSW *Threatened Species Conservation Act 1995* (TSC Act) and endangered nationally under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The dramatic decline of the Australian Painted Snipe in the Murray-Darling Basin is of particular concern as this was formerly a stronghold for the species (Lane & Rogers 2000).

Figure 2. Banded Lapwing, Baradine Creek farmland, July 2013. (Photo: MJ Murphy).

The resident Bush Stone-curlew was previously widespread and abundant in NSW but its numbers have been substantially reduced and its distribution fragmented (Smith 1991), and it is currently listed as endangered under the TSC Act. It remains relatively common in northern Australia (Marchant & Higgins 1993). Key threats to the species in southern Australia are loss of woodland habitat for agriculture and predation by the introduced Red Fox *Vulpes vulpes* (Lane 1987; Marchant & Higgins 1993), and it is noteworthy that several recent records in the Pilliga forest were in or near areas with regular fox-baiting programmes. On the basis of extent of potential habitat available and the number and distribution of recent opportunistic records, it is considered that the Pilliga forest area may be an important stronghold for the Bush Stone-curlew in northern inland NSW.

The Banded Lapwing (Figure 2) has been identified as a declining woodland bird of regional conservation concern in Australian temperate woodlands (Traill & Duncan 2000). Morris *et al*. (1981) and Hollands and Minton (2012) classed the species as nomadic; however, it is considered to be resident in the Pilliga study area, with records in all months and locations in the Baradine Creek farmland where it can be found with reasonable reliability and where breeding was recorded (in July).

Accounts of the bird fauna of the Pilliga forest in the early 20th century (Cleland 1918; Chisholm 1936) noted only three shorebird species; the Bush Stone-curlew, Banded Lapwing and Black-fronted Dotterel. A long-term Pilliga forest resident and ornithologist Mr D. Johnston has noted that in the 1930s to 1940s the call of the Bush Stone-curlew was a familiar sound on moonlit nights (D. Johnston *pers. comm*.). The stone-curlew is now less common but remains widespread in the Pilliga forest, particularly in the northern and western outwash forests. The Banded Lapwing was the common lapwing species in the Pilliga forest up until the 1930s to 1940s, subsequently replaced by the Masked Lapwing (D. Johnston *pers. comm*.). The now uncommon Banded Lapwing favours sparsely vegetated dry farmland in the study area while the common Masked Lapwing favours ephemeral wetlands, ground tanks and grassy urban areas. The Black-fronted Dotterel remains common, particularly in the gilgai area of the northern outwash forest. The Latham's Snipe, Australian Painted Snipe, Black-winged Stilt, Red-kneed Dotterel and Australian Pratincole may have long been only rare visitors to the area.

It is interesting to compare the shorebirds of the predominantly dry Pilliga forest with those of nearby major riverine floodplains. A survey of Namoi River floodplain wetlands near the town of Wee Waa, 20 km north of the Pilliga forest, recorded six shorebird species (Broome & Jarman 1983). Five species were shared with the present study while one (the Sharp-tailed Sandpiper *Calidris acuminata*) was additional and four species (the terrestrial Bush Stone-curlew, Banded Lapwing and Australian Pratincole and wetland-dependent Australian Painted Snipe) were not recorded.

CONCLUSION

This study has demonstrated that the Pilliga forest study area has noteworthy habitat values for shorebirds, with both wetland and terrestrial habitats supporting a range of resident, nomadic and migratory species including several species of identified conservation concern. Key threats to shorebirds in the Pilliga forest include predation on eggs and young by foxes, degradation of wetlands and predation on eggs and young by the Feral Pig *Sus scrofa*, removal of woody debris for firewood, high frequency large-scale wildfires and the anticipated reduction in the extent and duration of ephemeral wetland and stream habitats through anthropogenic climate change (NSW Department of Environment Climate Change and Water 2010). An encounter observed during the present study, in which feral pigs displaced a Black-fronted Dotterel from a remnant puddle in a drying gilgai wetland, may be emblematic of a troubled future for the Pilliga forest's shorebirds.

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Table 1. Summary of records of shorebirds in the Pilliga forest, inland NSW, Australia.

	Current survey				All data sources [2]			
Species	**No. records [1]**	**No. sites [1]**	**Prop. surveys recorded**	**Maximum daily count at single site [1]**	**Habitats used †[2]**	**Local Status [2]**	**Spatial distribution of records [2]**	**Temporal distribution of records [2]**
Resident shorebirds								
Bush Stone-curlew *Burhinus grallarius*	1	1	2%	3	W	U	Most records – NW Some records – S	Sep - Feb
Black-fronted Dotterel *Elseyornis melanops*	101	26	58%	10	BGST	C	Most records – N Some records – BS	All months
Masked Lapwing *Vanellus miles*	155	28	75%	7	FGS TU	C	Most records – BNS Some records – W	All months
Banded Lapwing *Vanellus tricolor*	20	7	27%	21	F	U	Most records – B Some records – NS	All months
Migratory shorebirds								
Latham's Snipe *Gallinago hardwickii*	1	1	2%	1	T	R	2 sites – S	Feb & Nov
Nomadic shorebirds								
Black-winged Stilt *Himantopus himantopus*	3	3	5%	8	GST	R	2 sites – N 1 site each – BW	Mar, Jul, Sep & Nov
Red-kneed Dotterel *Erythrogonys cinctus*	5	1	8%	3	G	R	1 site each – NW	Sep - Nov
Australian Painted Snipe *Rostratula australis*	0	0	0%	-	G	VR	Single record – W	Oct
Australian Pratincole *Stiltia isabella*	0	0	0%	-	F	VR	Single record – B	Nov

† Habitats used: B = bare ground, F = dry farmland, G = ephemeral gilgai wetland, S = ephemeral stream and associated wetlands, T = ground tank, U = urban grassy area, W = dry woodland. Local status: C = common, U = uncommon, R = rare, VR = very rare. Spatial distribution: B = Baradine Creek farmland, N = northern outwash, S = south-eastern Pilliga, W = western outwash (see Figure 1).

[1] Based on combined systematic and opportunistic records from current survey.

[2] Based on current survey, previous records by the author, Atlas of NSW Wildlife records for period 1990-2013, a 1981 record of Australian Pratincole (Atlas of NSW Wildlife) and a 2003 record of Australian Painted Snipe (A. Morris *pers. comm.*).

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Appendix 1. Survey dates for Pilliga forest shorebird systematic survey.

Spring	Summer	Autumn	Winter
10 Nov 2011 (N)	10 Dec 2011 (N & B)	4 Mar 2012 (W)	17 Jun 2012 (S)
12 Nov 2011 (W & B)	11 Dec 2011 (N)	18 Mar 2012 (N)	14 Jul 2012 (B & N)
13 Nov 2011 (S)	2 Dec 2012 (B)	13-Apr-2012 (S)	23 Jul 2012 (B)
27 Nov 2011 (B)	24 Dec 2012 (S, B & N)	14-Apr-2012 (S)	4 Jun 2013 (S)
29 Nov 2011 (W & B)	29 Dec 2012 (S & N)	26 Apr 2012 (W) #	5 Jun 2013 (N & B)
30 Nov 2011 (S)	30 Dec 2012 (W)	1-May-2012 (S)	6 Jun 2013 (S)
17 Sep 2012 (N)	1 Jan 2013 (N & B)	5 Mar 2013 (S, N & B)	8 Jun 2013 (W & B)
23 Oct 2012 (N)	2 Jan 2013 (S)	7 Mar 2013 (S)	9 Jun 2013 (N)
25 Oct 2012 (S)	10 Jan 2013 (S, N & B)	8 Mar 2013 (all areas)	10 Jun 2013 (W & S)
27 Oct 2012 (S)	11 Jan 2013 (S)	10 Mar 2013 (S, N & B)	21 Jun 2013 (B & W)
30 Oct 2012 (N)	25 Jan 2013 (S)	21 Mar 2013 (S)	22 Jun 2013 (S)
3 Nov 2012 (W, N & S)	29 Jan 2013 (W & B)	26-27 Mar 2013 (N) #	24 Jun 2013 (N & S)
27 Nov 2012 (N)	10 Feb 2013 (B, W & S)	6 Apr 2013 (all areas)	1 Jul 2013 (all areas)
29 Nov 2012 (S)	14 Feb 2013 (S)	21 Apr 2013 (N & W)	24 Jul 2013 (N)
15 Sep 2013 (N, W & S)	23 Feb 2013 (W, B & N)	4 May 2013 (N & B)	3 Aug 2013 (B, N & S)
			14 Aug 2013 (B, N & S)
			22 Aug 2013 (S & N)

Areas surveyed:
B = Baradine Creek farmland, N = northern outwash, S = south-east, W = western outwash (see Figure 1).
# nocturnal call play-back survey for Bush Stone-curlew.

OVERLOOKED EVIDENCE OF THE EARLIER ARRIVAL OF BLACK-WINGED STILT IN JAVA, INDONESIA

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Most Indonesian references treat Australian White-headed Stilt *Himantopus leucocephalus* as a full species, separate with its congener Black-winged Stilt *H. himantopus* (e.g. Mackinnon *et al.* 1998, Sukmantoro *et al.* 2007). We follow this treatment here. In addition to the taxonomic considerations, we think an advantage of treating White-headed Stilt and Black-winged Stilt separately is that it will result in more careful monitoring and improved population estimates for use in reviews of global and local shorebird populations developed by Wetlands International (Delany & Scott 2006, Bamford *et al.* 2008). In the remainder of this paper, we therefore use the following terminology: Black-winged Stilts from the Eurasian subspecies *H. h. himantopus*, which are characterised by pure white to dusky grey hindneck, and White-headed Stilts from the subspecies *leucocephalus*, which are characterised in adult plumages by a bold black ridge of feathers on the hindneck.

In Indonesia, both taxa are recorded and appear to be expanding their range, with White-headed Stilt moving west having been noted year round in South Sumatra, and Black-winged Stilt moving south and east (Iqbal *et al.* 2009, Iqbal *et al.* 2010, Jamaksari and Iqbal 2011). Black-winged Stilt were reported for the first time in Java on 2 November 2010 in Indramayu district, West Java (Jamaksari & Iqbal 2011). After this report, discussions on Black-winged Stilt in Java have been raised. Photos have been shared and examined carefully in the Facebook group of Indonesian birdwatchers (Pengamat Burung Indonesia Facebook group). From these, a photo of two birds, or a possible pair, taken by AK were confirmed as Black-winged Stilt. One bird was identified as a breeding male by its long pinkish-red legs, pure white head and neck-sides, and bright black mantle, scapular and wing. Another bird has similar characteristics but browner mantle, scapular and wing (Figure 1). The photo was taken on 27 December 2006 in a fish pond at Muara Gembong, Bekasi district, West Java province. The area is geographically located at $5^0$59.57' S; $107^0$02.84' E. In addition, possibly the same birds were regularly observed during November-December 2006 in same location (S. Purnama, *in litt.*).

The earlier occurrence of Black-winged Stilt in Java in 27 December 2006 is interesting. Numbers of Black-winged Stilt in Peninsular Malaysia have increased since the late 1980s, and breeding was first recorded in 1998 (Jeyarajasingam & Pearson 2012). Black-winged Stilt were recorded for the first time in East Kalimantan in 2004, followed by Sumatra in 2007 and Java in 2010 (Iqbal *et al.* 2010, Jamaksari & Iqbal 2011). The bird is now known to be breeding in Sumatra (Abdillah *et al.* 2012).

Bakewell (2012) reported that the extent and pattern of black on the nape and head of Black-winged Stilt in Asia is far more variable than most literature suggests, showing White-headed Stilt plumage characteristics. It is possible that Black-winged Stilt arrived in Java earlier than previously documented. The presence of individual Black-winged Stilt having the black nape could have led local birdwatchers to misidentification in the past.

Figure 1. Two Black-winged Stilts on 27 December 2006 in Muara Gembong, West Java, Indonesia.

Beside Sumatra and Kalimantan, Java is an area where the Black-winged Stilt and White-headed Stilt meet. In view of the apparent expansion in the breeding ranges of both taxa, hybrids may be increasing. As recommended by Bakewell (2012), great caution is needed in identification of Stilts in overlapping areas such as Java. If birds are handled, measurements of wing, bill and especially tarsus should be recorded.

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OVERLOOKED EVIDENCE OF JAVA (INDONESIA) AS A POTENTIALLY IMPORTANT STAGING AREA FOR RED-NECKED STINT *CALIDRIS RUFICOLLIS* IN THE EAST ASIAN-AUSTRALASIAN FLYWAY

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The Red-necked Stint *Calidris ruficollis* is a small shorebird breeding in the north-east Palearctic and north-west USA (Alaska), and wintering in south Asia (East India and Bangladesh), south China, south-east Asia to New Guinea, Australia and New Zealand (van Gils & Wiersma 1996, Robson 2008). The total East Asian-Australasian Flyway (EAAF) population is estimated at 325,000 (Bamford *et al.* 2008).

All listed important non-breeding sites of Red-necked Stint are in Australia, while sites important during migration are in Australia, Indonesia, Malaysia, Thailand, China, South Korea and Russia (Bamford *et al*. 2008). Throughout south-east Asia the species is an uncommon to common coastal winter visitor and passage migrant (Robson 2008). In Java and western Indonesia, the species is classified as a regular and common coastal visitor (Mackinnon 1988, Mackinnon & Phillips 1993).

Despite this classification, most records of Red-necked Stint are reporting on rather small numbers only. The record of 325 birds at Pantai Sejara (North Sumatra) on 29 March 2002 is possibly the largest published record for this species in Indonesia (Crossland *et al.* 2009), followed by a record of 250 birds in 1989 at Mahakam Delta (East Kalimantan) (Mann 2008) (Figure 1). Since these and other historical records mostly report on small numbers (i.e. below the 1% and 0.25% flyway thresholds for non-breeding and migratory staging sites, respectively), not a single staging area in Indonesia is listed as a site of importance for Red-necked Stints (Bamford *et al.* 2008).

On 16 December 2012, we visited Wonorejo on the north-east coast of Java in East Java province (approximate location 112^{0}49' S, 07^{0}18' E). In this area, we spent two hours bird watching in a fish pond (locally called 'tambak'), 50x100 m in size. A total of up to 250 Red-necked Stints were recorded (Figure 2). Although there are several similar fish ponds in the area, we unfortunately did not have enough time to extend our excursion to other 'tambaks'. However, based on our observation at the one 'tambak', we speculate that there may have been as many as 1,000 Red-necked Stints present in the Wonorejo wetland area at the time. This estimate was derived by extrapolating across the number of tambaks in the Wonorejo wetlands, determined by inspecting Google Earth images. There are at least 100

Figure 1. Map of Indonesia and localities mentioned in this paper. The triangles give the location of records of more than 100 Red-necked Stints, and circles are where only a few birds were recorded.

tambaks of about the same condition and surface area of 5,000 m^2 outside the wetlands, but the actual number of tambaks could be double this (Figure 3). If it is assumed all tambaks having the same condition held 250 birds, this would mean that the 100 tambaks may support up to 25,000 birds. Since a site is classified as a staging area of importance if bird numbers surpass the 0.25% threshold of the flyway population or more than 813 birds in the case of Red-necked Stints in the EAAF (Bamford *et al.* 2008), the Wonorejo wetland area on Java should thus potentially be listed as staging threshold area for Red-necked Stint.

Stimulated by this notion, we searched the (grey) literature for further references to significant Red-necked Stint numbers on Java. However, similar to other areas in Indonesia, we found that most records for Java concerned only small numbers of birds. For example, only eight birds were found in the Solo Delta on 10 February 1988 and 52 birds on 13 October 1997 in Alas Purwo National Park (Erftemeijer & Djuharsa 1988, Grantham 2000). However, much to our surprise we also found a report of around 8,000 Red-necked Stints observed in Karang Mulya (approximately 06°54' S, 107°1' E) on the north-west coast of Java in West Java province between 31 August and 5 September 1984 by Bowler *et al.* (1985). They reported it to be the commonest shorebird present in the area at the time (42%), with large numbers on all open 'tambak' and smaller numbers on vegetated 'tambak' (Bowler *et al.* 1985). The occurrence of approximately 8,000 Red-necked Stints in Karang Mulya represents 2.5% of the flyway population estimate. The observation shows the importance of Karang Mulya for Red-necked Stint in Java.

The number of Red-necked Stint during the non-breeding period in Indonesia is about 7,000 (Bamford *et al.* 2008). The occurrence of up to 25,000 individuals on 16 December 2012 in Wonorejo and approximately 8,000 in Karang Mulya on August-September 1984 show the potential importance of Java for this species. Possibly, due to its small size Red-necked Stints have been overlooked in the past. We recommend observers in Java to pay more attention to Red-necked Stints in the future, to determine the potentially overlooked significance of parts of Java as sites of international importance for Red-necked Stint conservation along the East Asian-Australasian Flyway.

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Figure 2. Red-necked Stints in a small fish pond in Wonorejo (north-east Java) on 16 December 2012 (©Muhammad Iqbal).

Figure 3. Map showing Wonorejo wetlands and tambaks surrounding the area.

THE ACTION PLAN FOR AUSTRALIAN BIRDS 2010

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THE ACTION PLAN FOR AUSTRALIAN BIRDS 2010
Author: Garnett, S., J. Szabo & G. Dutson. 2011.
Publisher: CSIRO Publishing, Collingwood
Pp. 442, ISBN 9780643103689
Price: AUD$49.95

This action plan is the third in a series that have appeared at the start of each of the last three decades: Garnett (1992), referred to as the 'blue book', Garnett and Crowley (2000) and this action plan. Stephen Garnett has been the lead author on the two previous action plans, thus he is presumably well qualified as lead author on this one. His co-authors are experienced ornithologists who have previously published on Australian birds. The aim of this publication is to: 1) disseminate a national overview on the status of all Australian birds, which uses the categories and criteria of the International Union for Conservation of Nature (IUCN) Red List; 2) identify threats; 3) identify important habitats of threatened birds; and 4) highlight data-gaps and recommend appropriate research and management actions.

The action plan presents the status and associated data of the Australian avifauna to the sub-species level, including Australia's off-shore territories. To do this it draws on published research and surveys, including records accumulated since Europeans settled in Australia, unpublished data derived from workshops conducted across Australia and wide-ranging personal communications. This action plan utilises the current knowledge, recent taxonomic changes and adopts IUCN categories and criteria as the primary tools to identify and explain the current status of Australian birds. The authors' decision to follow IUCN criteria allows for greater consistency in defining threat categories. From this framework each taxon can be discussed uniformly following internationally accepted standards. This methodology has identified a change in status of 66 taxa since the last action plan in 2000. Some taxa have improved their situation while others have fared less well. Seven have been downgraded due to effective management. For example, the nominate subspecies of the Western Corella (*Cacatua pastinator pastinator*) has been removed from Endangered to Least Concern with management leading to large increases in its numbers and range. However, another 39 taxa have had their status elevated to greater threat categories, four of which have been upgraded to Critically Endangered. Most of the new additions to the 2010 list are migratory waders, perhaps due, at least in part, to the loss of critical habitat in East Asia from reclamation for farming (Moores *et al*. 2008, Kim *et al*. 2009).

The book is divided into the usual sections expected in such a work; introductory material with concise definitions of the threat categories and their criteria, which includes two explanatory tables and enough methodological description to visualise the process of managing and collating the vast information available. A third table, of eight pages, provides a quick guide to each taxon's status and their page numbers for quick reference. The profiles of the taxa amount to 409 pages. A taxon profile consists of headings, identification to subspecies, conservation status, a coloured distribution map, status given in previous assessments (these follow Garnett 1992, Garnett & Crowley 2000), taxonomic uniqueness data (e.g. how many species per genus—how many subspecies per species), range, abundance, ecology, threats, conservation objectives, information required, management actions required, a bibliography and a list of additional contributors. Two tables per taxon are also given: the first with criteria eligibility data set against IUCN categories (A-E) and the second giving a relative reliability measure against IUCN Red List assessment data. Two appendices are provided: the first a single page with two maps showing amalgamated results per category for threatened birds in terrestrial, coastal, freshwater and marine habitats. The second of six pages gives taxa included in Garnett and Crowley (2000) but is omitted from this action plan. An index finishes the book.

The action plan is suitable for (and aimed at) an audience of conservation and avian biologists, managers, administrators, and their honours and postgraduate students. It will also be informative to serious birdwatchers who are interested in the biology of Australian birds.

To my mind the strength of this action plan lies in the work of countless researchers and conservation workers who have researched and published their data and opinions on the Australian avifauna. The extraction, compilation and organisation of the data have been done by a much larger team than the three authors given; these three authors are simply the last link in a long chain. The product of all this effort is an essential reference text that delivers the status of the threatened avifauna of Australia.

The action plan identified four objectives which have been met adequately. The status of all Australian birds is described by going beyond species and exploring subspecies. In addition, some responsibility for regional birds is taken with the inclusion of taxa that partially overlap with the greater Australian territory. For example, New Caledonian Fairy Tern (*Sterna nereis exsul*) has a range that extends into coastal waters off Queensland. This taxon is dealt with in some detail and the status is given for its conspecifics in Australia and New Zealand. The action plan has identified threats and habitats as well as they are understood. A particular strength of the action plan is in proposing management actions based on known data (or the lack of it). For example, Grey Plover (*Pluvialis squatarola*) is declining in East Asia presumably due to the loss of staging habitats. Thus, a proposed management action is to lobby the Chinese Government to protect remaining tidal flats such as those at Bohai Bay. However, I recommend adding the Republic of Korea (South Korea) and to lobby for the cessation of all sea wall construction such as those of at Saemangeum and Seosan on Korea's West Sea and the adoption of improved farming practices to halt the destruction of wader nests in such reclaimed areas (Moores *et al*. 2008; Kim *et al*. 2009).

The organisation of the book, which is predominately into species profiles, is entirely appropriate for this kind of reference text. The depth of research is appropriate and thorough. This is not to say enough is known about the threatened taxa; clearly some taxa are still data deficient and all taxa require further research. The text is intended to give a starting point to further manage the Australian avifauna. This includes supplying the current understanding of each taxon's status with enough general autecology to know why the status applies and why the conservation actions recommended are appropriate. An audience of biological and conservation professionals, for example students, will benefit by being led through a taxon's taxonomy and autecology, and finally to its references. These references may then act as starters to direct researchers to delve deeper into any particular taxon. However, the book is about the status of individual birds and the threats that impact on each of them; it is not a general ecological text about the birds or the processes that threaten them.

The style of writing is clear and appropriate in each of the species summaries that I have gone through carefully. The quality of the supplementary material throughout the book is generally of a high standard. Clear and well laid out tables are used effectively. The quality of maps throughout the text is of a high standard. They are simple and clear with a logical colour code that is explained in the introduction. Species specific bibliographies are given at the end of each species' profile—they are thorough, pertinent and not over numerous. However, the index falls short of the standard set in the rest of the book. The entries appear to be computer generated with Latin names mixed through the English names and the names of "threats". Mixing these together makes searching more awkward, particularly in this book where only those birds considered threatened are present. In many cases there are too many page numbers per entry, for example, the word "fox" has 47 page entries, "fishing" has 54 and "predation" a whopping 97—in all cases no page entry is highlighted to show the page of greatest importance. Lantana and *Lantana camara* are two consecutive entries that unnecessarily repeat the same page information. Buffel Grass (*Cenchrus ciliaris*) and other grasses are not given Latin names and they have been indented under a generic heading of Grass, whereas Lantana was not given the same treatment. Given the depth and breadth of work amassed in this book along with its important utility as a reference text more effort in this area of its production was warranted.

I recommend this volume to avian researchers working with Australian birds and to conservation managers and administrators in Australia. I encourage all tertiary and college libraries to acquire a copy for students as an essential reference text. It is also a text that must be read by researchers that work with the many birds that appear in the world's flyways to gain an increased understanding of threatening processes that are at work in Australia that may have parallels in other parts of the world. To this end, I would like to see the data within its pages widely available by being placed on the Internet as is now the case for the previous action plan.

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SHOREBIRD COUNTS AT THE SERPENTINE RIVER RESERVE 2012-2013

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INTRODUCTION

The Serpentine River wetlands form part of a chain of shorebird feeding and roosting grounds that fringe the Peel Inlet and Harvey Estuary, in the south of Western Australia. The Peel Inlet and Harvey Estuary are classified as an Important Bird Area and contain several shorebird sites such as Austin Bay, Creery Island, Boundary Island and Kooljerrenup Nature Reserve.

The Serpentine River Reserve (32°34' S, 115°45' E) is located in the northern part of Peel Inlet, between the suburb Nairns and Jennala Island (Figure 1). Shallow mud banks and samphire wetlands have formed on both sides of the river outlet. There is a variety of shorebird habitats, and suitable feeding areas are available throughout most of the year, meaning the reserve supports a good variety of shorebird species. Its accessibility makes the site relatively easy to count within a reasonable time frame. For these reasons, there is a good collection of shorebird data from this site, which may mirror what is going on at the scale of the whole Inlet (in terms of shorebird arrival and departure cycles).

METHODS

The Serpentine River wetlands were previously surveyed in 1985 (Baker 1988) and again between 1996 and 2002 (Singor 2003). Three hundred and forty three individual counts were made between August 2012 and August 2013 and these consisted of multiple counts each week. These surveys were conducted on foot by traversing the wetlands on the western side of the Serpentine River estuary, and by viewing the mudflats and shallow lakes on the eastern side of the river from a vantage point at its mouth. Surveys typically took between 1 and 1.5 hours, depending on the number of shorebirds present (i.e. more birds sometimes required more time to count). The survey circuit replicates those conducted during the 1996-2003 shorebird surveys.

From July 2012 to August 2013 surveys were conducted on a near-daily basis, and sometimes even twice a day in the morning and afternoon. Due to the high frequency of the counts all stages of the tide cycle were covered. Shorebird numbers were highest at low tides when a larger expanse of mud flats was available. Findings from the 2012-2013 shorebird season (austral

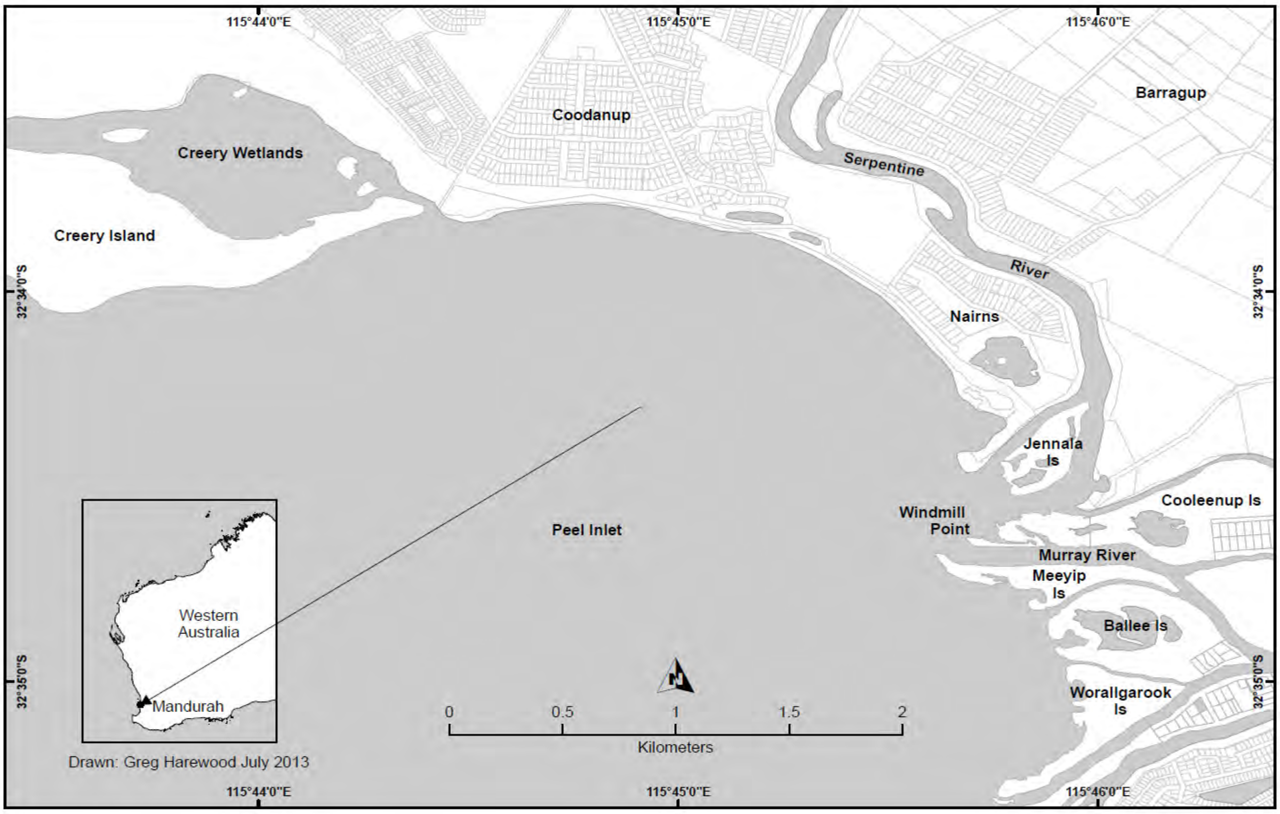

Figure 1. Map showing the location of the Serpentine River Reserve between Nairns and Jennala Island, southern Western Australia.

spring-autumn) are compared with the results of the 1985 and 1996 to 2002 surveys (Table 1).

RESULTS AND DISCUSSION

A total of 24 species were recorded in the surveys between 2012-2013 (Table 1) compared with 31 species overall from previous surveys. Red-necked Stint (*Calidris ruficollis*) had the highest count (n=450) of all species recorded.

Shorebird numbers peaked in September and gradually tailed off towards April (Table 2). The highest shorebird count of 592 was made in September 2012. However, the highest number of migratory shorebird species (n = 12-14) was recorded during October to December (Table 2). Different patterns in monthly counts may be due to the drying out of ephemeral wetlands as summer progresses, which creates more suitable shorebird habitat to which birds can move. The increased number of migrant shorebird species arriving over spring and summer is a natural progression of shorebirds moving down the WA coast to the lower south-west. High shorebird counts in late winter / early spring may be due to the presence of both arriving migratory shorebirds and residential shorebirds that have not yet moved back to their breeding grounds.

Shorebirds were most commonly recorded on tidal pools in samphire wetlands and in shallow water off the beach and within the estuary (Table 3).

Migratory shorebirds

Less than thirty years ago large flocks of shorebirds were seen in the Peel Inlet (M. Singor *pers. obs.*). Bar-tailed Godwit (*Limosa lapponica*) numbered 527 at Point Birch in 1985 and 200 Grey Plover (*Pluvialis squatarola*) were reported in 1987 near Coodanup Island. The surveys conducted at the Serpentine River wetlands during 2012-2013 show that shorebirds continue to frequent the Peel Inlet though in lesser numbers.

Small flocks of Red-necked Stint are known to overwinter around the Peel Inlet and Harvey Estuary and as winter recedes the number of Red-necked Stint increases (Figure 2). They are the first migratory shorebirds to arrive in numbers. Red-necked Stint showed a reduction in numbers over the season though their numbers are known to fluctuate on an annual basis and flocks of over one thousand Red-necked Stint have been recorded previously. The fluctuations in the number of Red-necked Stint relate to their mobility as flocks

Table 1. Highest annual shorebird counts from Serpentine River Reserve. The maximum is the highest shorebird count made during the period 1985 to 2013. The year of the highest count is given in the last column. The data for 2013 only goes up to and including August 2013.

Species	1985	1998	2001	2002	2010	2012	2013	Maximum 1985-2013	Year of max.
Migratory shorebirds									
Black-tailed Godwit	13					2		13	1985
Bar-tailed Godwit		5	52	46	94	64	36	94	2010
Whimbrel						3		3	2012
Eastern Curlew		3	2	1		1	1	3	1998
Terek Sandpiper			1		1	2		2	2012
Common Sandpiper	2	1	2	1		2	1	2	2001
Grey-tailed Tattler			3	1		6	3	6	2012
Common Greenshank	10	14	79	39	2	45	10	79	2001
Marsh Sandpiper					1			1	2010
Wood Sandpiper						2		2	2012
Ruddy Turnstone						2		2	2012
Great Knot			43	1	2	5	3	160	2004
Red Knot			37	70	3	4	1	70	2002
Sanderling								1	2011
Little Stint						1		1	2012
Red-necked Stint	1520	700	300	260	220	1500	450	1520	1985
Long-toed Stint							1	2	2000
Sharp-tailed Sandpiper	5	6	5	6		32	40	40	2013
Curlew Sandpiper	44	16	8	10	160	11	7	160	2010
Broad-billed Sandpiper		1				2		2	2012
Ruff						1		1	2012
Grey Plover	7	7	11	9	5	4	3	18	2000
Greater Sand Plover		1	1	1		2		6	1999
Resident shorebirds									
Australian Pied Oystercatcher	2	3	6	6	2	6	11	11	2013
Black-winged Stilt	148	150	28	34		100	180	180	2013
Red-necked Avocet	37	20	252	220	43	250	165	276	1996
Banded Stilt	10	33	110	245	2	20	68	245	2002
Red-capped Plover	32	76	69	90	5	200	50	200	2012
Inland Dotterel								3	2011
Black-fronted Dotterel	4	9				7	6	9	1998
Red-kneed Dotterel		2				8	35	35	2013
Number of counts	9	12	13	15	5	152	214		

Table 2. The average monthly number of shorebirds present at the Serpentine River Reserve 2012-2013.

	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
Average monthly count	204	292	202	154	163	118	57	39	22	77	40	117
No. migratory species	7	8	12	12	14	10	8	8	5	3	3	4
No. resident species	6	5	5	4	5	5	5	5	7	7	5	6

move between the different sites in the Peel-Harvey Inlet and adjacent lake systems. The first Common Greenshank (*Tringa nebularia*) arrive towards the end of August and numbers build up through September, with a few remaining during winter (Figure 3). The Curlew Sandpiper (*Calidris ferruginea*) was mainly observed during September and October with a few sightings in the ensuing months. Curlew Sandpiper numbers peaked early in the 2012-2013 season but overall, counts were low (Figure 4). Bar-tailed Godwit numbers peaked from late November to January (Figure 5). The highest count of Bar-tailed Godwit was 64 in November 2012 and only a small number overwinter in the Peel-Harvey Inlet.

Sharp-tailed Sandpiper (*Calidris acuminata*) sightings peaked in January and February with a maximum number of 40 recorded (Figure 6). There were fewer sightings made of Grey Plover, which differs from past surveys when they were more common and counts were higher (Figure 7, Table 1). Common Sandpiper (*Actitis hypoleucos*) numbers have remained consistent throughout the years and generally one or two are seen along the banks of the Serpentine River. Occasional or one-off sightings were made of Whimbrel (*Numenius phaeopus*), Eastern Curlew (*Numenius madagascariensis*), Terek Sandpiper (*Xenus cinereus*), Grey-tailed Tattler (*Tringa brevipes*) and Ruff (*Philomachus pugnax*) (Table 1).

Resident shorebirds

Red-capped Plover (Charadrius ruficapillus) were common throughout the surveys and were more numerous than in past surveys (Table 1). Red-capped Plover numbers peaked in September and October and then declined from January onwards (Figure 8). Black-winged Stilt (Himantopus himantopus) were present throughout the surveys and their highest numbers were recorded from November to January with another peak in May and June (Figure 9). Australian Pied Oystercatcher (Haematopus longirostris) numbers were marginally higher than in previous surveys with a peak in late January 2013 (Figure 10, Table 1). Red-necked Avocet (Recurvirostra novaehollandiae) numbers have remained constant over the years (Table 1). In 2012-2013, Red-necked Avocet numbers peaked during September and October when moderate sized (200-250) flocks appeared in the northern section of the Peel Inlet (Figure 11). Red-kneed Dotterel (Erythrogonys cinctus) were observed during the months August and September and reappeared in April, and numbers peaked in the latter half of May (Figure 12). Red-kneed Dotterel were reported more often than in past surveys. In contrast Black-fronted Dotterel (Elseyomis melanops) were observed more frequently in past surveys. Occasional sightings of Black-fronted Dotterel were made between April and August and up to seven birds were reported (Figure 13).

CONCLUSION

The surveys documented here are the most extensive ever carried out at Serpentine River Reserve and provide detailed information on the current usage of these wetlands by shorebirds, as well as the arrival and departure patterns of the migratory shorebirds visiting the Peel Inlet. Short-term fluctuations in shorebird numbers can be attributed to factors such as tidal regimes and the exchange of birds between different sites in the Peel-Harvey Inlet. However, shorebirds that frequent the Serpentine River Reserve are subject to disturbance from dog owners, crabbers, holiday makers and boating traffic on the river, particularly during summer months. These activities may have a detrimental impact on the roosting and feeding behaviour of shorebirds.

Shorebird sites within the Peel-Harvey Inlet are under pressure from rapid urbanisation and development of land around the Inlet, and reclamation of wetlands. Disturbance of sub-soils on the edges of the estuary due to draining causes the release of sulphates from the native previously undisturbed soils (Kraal *et al.* 2012). Wetlands are sprayed to keep mosquitoes and flies under control. Nutrient enrichment, in particular increased Total Phosphorus (TP) levels from catchment and urbanisation areas, has reduced water quality (Kraal *et al.* 2012). The deterioration of water quality, combined with the build-up of potentially toxic sediment, is likely to have an impact on the food chain and on the availability of invertebrate prey for shorebirds. Preservation of the wetlands in the Inlet should be a priority.

ACKNOWLEDGEMENTS

We wish to acknowledge the shorebird observations made by John Graff and Mark Newman at the Serpentine River Reserve. We would also like to thank Greg Harewood for the production of the map.

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Table 3. Habitats shorebirds were recorded using in Serpentine River Reserve, 2012-2013.

	Banks along Serpentine River	Tidal pools in samphire wetlands	Exposed tidal mudflats	Banks of washed up seagrass	Open water along beach and estuary
Migratory shorebirds					
Black-tailed Godwit					X
Bar-tailed Godwit					X
Eastern Curlew					X
Common Sandpiper	X	X			
Grey-tailed Tattler		X			
Common Greenshank	X	X	X		X
Ruddy Turnstone				X	
Great Knot					X
Red Knot					X
Red-necked Stint		X	X		
Sharp-tailed Sandpiper		X			X
Curlew Sandpiper		X			X
Resident shorebirds					
Australian Pied Oystercatcher					X
Black-winged Stilt	X	X	X		X
Red-necked Avocet					X
Banded Stilt		X			X
Grey Plover		X			X
Red-capped Plover		X	X		
Greater Sand Plover		X	X		
Black-fronted Dotterel		X		X	
Red-kneed Dotterel		X			

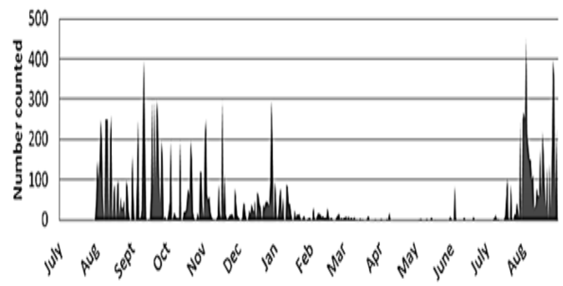

Figure 2. Population counts for Red-necked Stint at the Serpentine River Reserve 2012-2013.

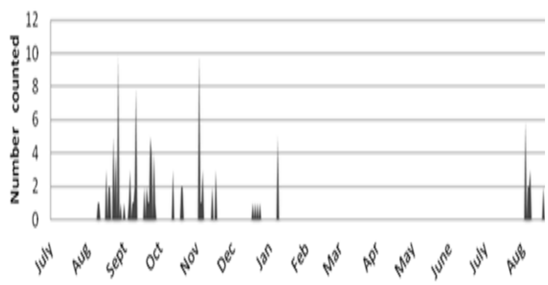

Figure 4. Population counts for Curlew Sandpiper at the Serpentine River Reserve 2012-2013

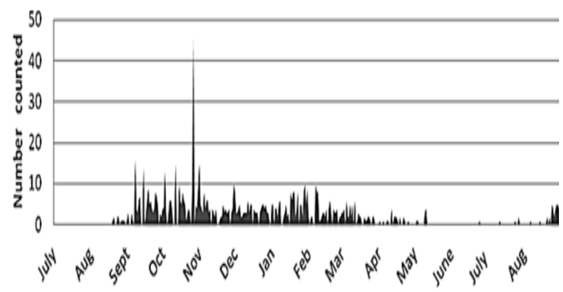

Figure 3. Population counts for Common Greenshank at the Serpentine River Reserve 2012-2013.

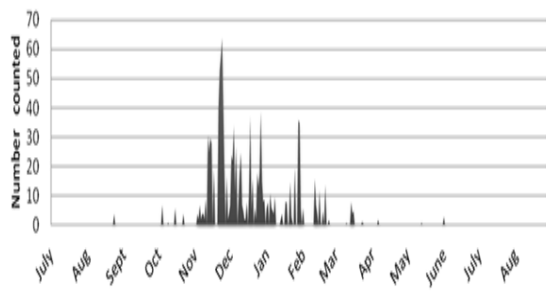

Figure 5. Population counts for Bar-tailed Godwit at the Serpentine River Reserve 2012-2013.

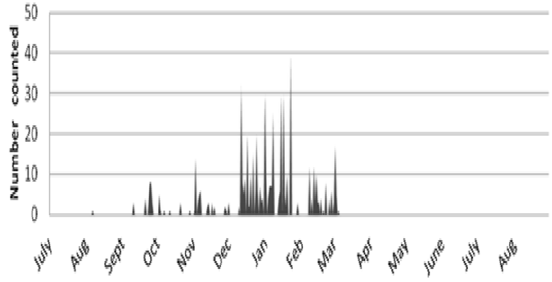

Figure 6. Population counts for Sharp-tailed Sandpiper at the Serpentine River Reserve 2012-2013.

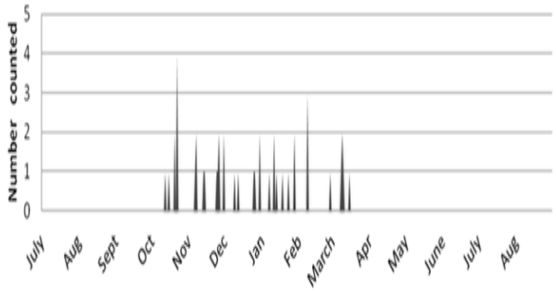

Figure 7. Population counts for Grey Plover at the Serpentine River Reserve 2012-2013.

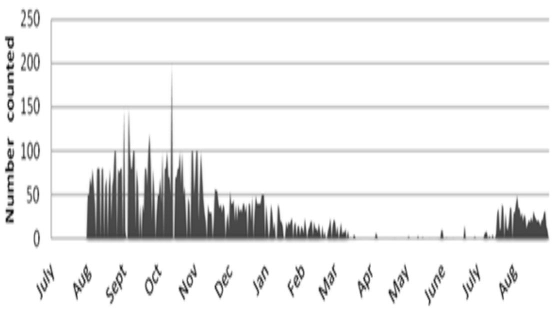

Figure 8. Population counts for Red-capped Plover at the Serpentine River Reserve 2012-2013.

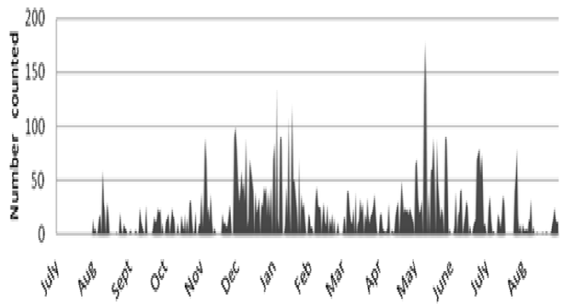

Figure 9. Population counts for Black-winged Stilt at the Serpentine River Reserve 2012-2013.

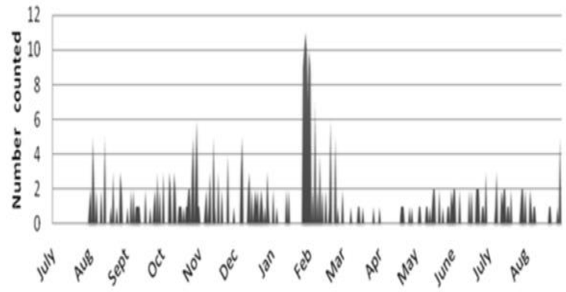

Figure 10. Population counts for Australian Pied Oystercatcher at the Serpentine River Reserve 2012-2013.

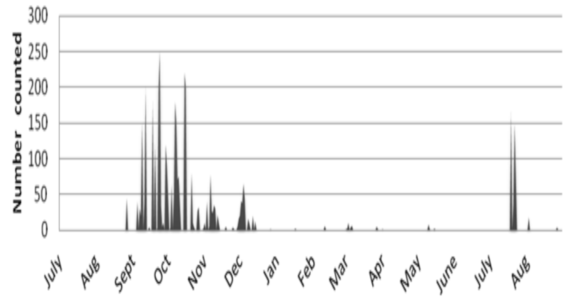

Figure 11. Population counts for Red-necked Avocet at the Serpentine River Reserve 2012-2013.

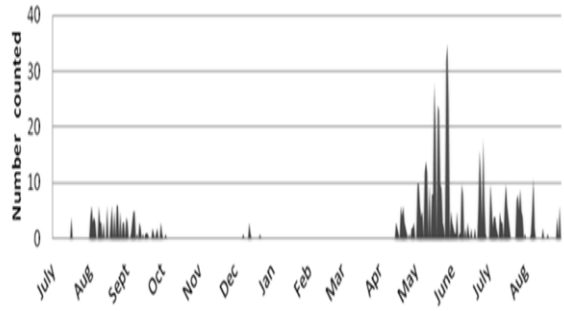

Figure 12. Population counts for Red-kneed Dotterel at the Serpentine River Reserve 2012-2013.

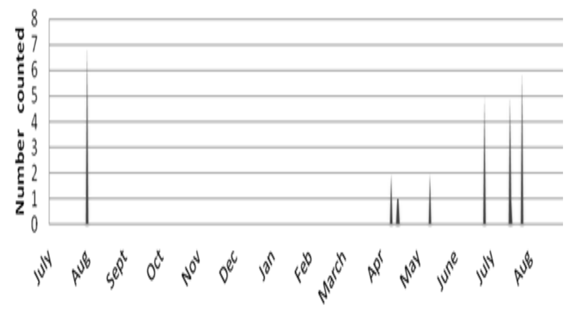

Figure 13. Population counts for Black-fronted Dotterel at the Serpentine River Reserve 2012-2013.

HUNTER ESTUARY POPULATION COUNTS 1999-2010

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INTRODUCTION

In the recent report on Australian shorebird population counts for winter 2009 and summer 2010 (Scholten *et al.* 2012), most of the available data for the Hunter Estuary were inadvertently omitted. Data for just two of the Hunter Estuary monitoring sites were presented in the Tables in the report. Since the Hunter Estuary is consistently the most important shorebird site in New South Wales, in this supplementary report we present the missing Hunter Estuary data. We also take the opportunity to describe the monitoring protocols used in the Hunter Estuary since early 1999, and to present January and July count data for 1999–2010. This will thereby align Hunter Estuary reporting with future Shorebirds 2020 reports.

METHODS

Data Collection

Regular monthly monitoring of Hunter Estuary shorebird sites commenced in April 1999. Thirty-eight count sites around the Hunter Estuary have been registered in the Shorebirds 2020 database. For simplified reporting purposes we have since consolidated some of the smaller sites and now report on 17 sites that are surveyed every month (see Figure 1 for locations of the main sites). Some other registered sites are ephemeral wetlands or generally are more suitable for waterbirds than they are for shorebirds; surveys of them are done on an opportunistic basis and when shorebirds are present, the results are included into the overall Estuary numbers.

The 17 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. Four teams survey sub-sections of the Hunter Estuary simultaneously, each team visiting 2–5 sites during a period of ~3 hours centred around the time of peak tide. The sites in three of the Hunter Estuary sub-sections are all surveyed from land. The Kooragang Dykes, a major shorebird roost site, is only accessible by boat.

Each team always includes at least one core member familiar with the general methodology and with the sub-section being surveyed. At each site the numbers of all waterbirds, including shorebirds, are recorded. In 2012, two sites adjoining the Hunter Estuary (Hexham Swamp, Tomago Wetlands) began to be suitable for shorebirds. Currently these continue to be surveyed by teams on a different day to the main survey day.

Data Management

After each survey, the data are collated and circulated to the leaders of the sub-section surveys for review. Considerable care is taken to prevent the possibility of any double-counting occurring due to movements of birds between sites during the survey. To facilitate that process, the start and finish times for the counts at each site are recorded, and the times of any departures/arrivals of birds are noted as well as the direction they flew in.

Once confirmed, the data are archived in the Hunter Bird Observers Club's database. Key stakeholders, e.g. local natural resource managers, receive an annual summary and the results are published in the annual Bird Reports for the Hunter Region. As all waterbirds are recorded, the results are sent to the BirdLife Australia Atlas database to be shared with Shorebirds 2020.

Detailed analyses of data for some specific sites / species have been reported in other forums (for example, Herbert 2007, Lindsey 2008, Crawford & Herbert 2009) and further articles containing such analyses are anticipated.

RESULTS

One hundred and thirty four monthly surveys were carried out in the Hunter Estuary between April 1999 and June 2010. Only one month has been missed (June 2007, when prolonged severe storm conditions prevented access to many of the key sites). Twenty-eight species have been recorded in the January surveys over 2000–2010. Details for the January (summer) and July (winter) surveys are given in Tables 1 and 2 (which use the current BirdLife Australia taxonomic order). On average, nearly 4,000 shorebirds have been present in the Hunter Estuary in January. In the July surveys over 1999–2009, 22 species have been recorded at an average count of over 2,600 birds. The January and July counts generally are consistent with the counts in adjacent months, and hence are a reliable estimate of the Hunter Estuary shorebird population. However, the peak counts in the non-breeding and breeding seasons do not always occur in January and July respectively.

Of the 17 sites surveyed regularly, just five of them contain between 90 and 95% of the shorebird numbers in the Estuary at any given date (Kooragang Dykes, Stockton Sandspit, Fern Bay, Ash Island Swan Pond, Kooragang Island Deep Pond).

DISCUSSION

The significance of the Hunter Estuary for shorebirds in both the New South Wales and national context is readily apparent from comparing the July 2009 and January 2010 data with those published for other sites in Australia (Scholten *et al.* 2012). In July 2009, the Hunter Estuary had 1,845 shorebirds representing 12 species (including 1300 Red-necked Avocet *Recurvirostra novaehollandiae*). Every other site in NSW had <11 species present, with the highest count being 529 birds at Shoalhaven Estuary. In a national context, only six other sites around Australia had >1,000 birds present in July 2009 and only four sites had >12 species present.

In January 2010, the Hunter Estuary had 2,645 shorebirds representing 21 species (and with only a few Red-necked Avocets). All other NSW sites had <18 species and only Port Stephens had >800 shorebirds present. Around Australia, although more than 20 sites recorded >2,000 shorebirds, only 11 of them had >20 species present.

Two species have regularly been recorded in numbers greater than 1% of their total population. On average, over 1,000 Red-necked Avocet have been present in January and more than 1,800 birds in July. The average January count for Eastern Curlew *Numenius madagascariensis* over 2000–2010 is 303 birds.

CONCLUSIONS

The Hunter Estuary is the most important site for shorebirds in NSW and it is significant in a national context. It is essential that shorebird numbers in the Hunter Estuary continue to be monitored and that all possible steps be taken to maintain existing habitat and restore lost habitat in such a highly industrialised area that is subject to frequent threats from additional industrial development.

ACKNOWLEDGEMENTS

Seventy-three members of Hunter Bird Observers Club and visiting birdwatchers have participated in surveys. Since mid-2006, the Kooragang Wetland Rehabilitation Project (KWRP) has provided the boat we use and KWRP has also assisted in other ways throughout the entire program. Some of the surveyed sites lie within the Hunter Wetlands National Park and we thank the NSW National Parks and Wildlife Service for their cooperation. Some sites are on private land and we thank the landowners for access permission and in some cases, for providing an escort. Thanks also go to Mike Newman who stimulated us into action to produce this report.

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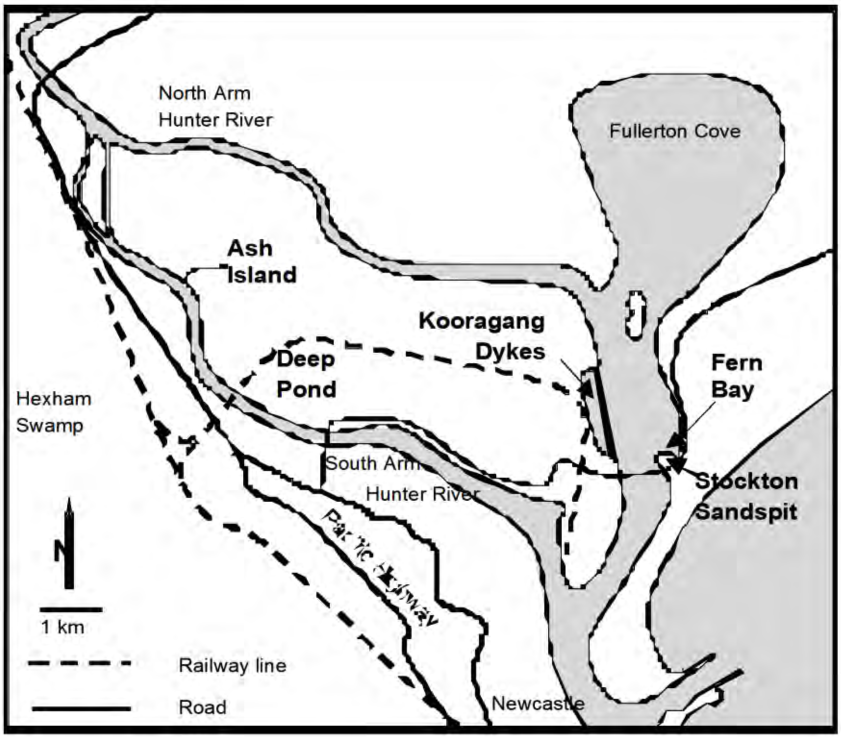

Figure 1. Main shorebird survey sites in the Hunter Estuary.

Table 1. Details of January shorebird counts in the Hunter Estuary, 2000–2010.

	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**Mean**[1]	**SD**
Australian Pied Oystercatcher *Haematopus longirostris*	2	5	5	10	10	12	4	2	4	11	21	8	6
Sooty Oystercatcher *Haematopus fuliginosus*					2		2	5	19	10		8	7
Black-winged Stilt *Himantopus himantopus*	345	222	617	728	356	141	226	423	9	12	303	307	225
Red-necked Avocet *Recurvirostra novaehollandiae*	31		1499	2686	1555	82	2266	2151	70	101	5	1045	1093
Banded Stilt *Cladorhynchus leucocephalus*			1										
Pacific Golden Plover *Pluvialis fulva*	88	60	63	146	73	86	22	264	161	155	225	122	75
Grey Plover *Pluvialis squatarola*						1							
Red-capped Plover *Charadrius ruficapillus*		4		12	51	44	31	18	18	6	3	21	18
Lesser Sand Plover *Charadrius mongolus*					3	1		3			1	2	1
Black-fronted Dotterel *Elseyornis melanops*		14	1	4	1	1		2		2	4	4	4
Red-kneed Dotterel *Erythrogonys cinctus*										37			
Masked Lapwing *Vanellus miles*	53	67	70	86	106	96	116	81	116	72	75	85	21
Latham's Snipe *Gallinago hardwickii*										8			
Black-tailed Godwit *Limosa limosa*	300	200	223	425	219	155	141	170	212	142	106	208	89
Bar-tailed Godwit *Limosa lapponica*	1601	1204	1020	750	734	641	1000	1077	764	799	1002	963	274
Whimbrel *Numenius phaeopus*	10	6	24	41	162	4	65	76	71		22	48	48
Eastern Curlew *Numenius madagascariensis*	571	492	136	372	307	89	357	325	276	178	225	303	146
Terek Sandpiper *Xenus cinereus*	50	68	38	3		28	18	7	16		12	27	22
Common Sandpiper *Actitis hypoleucos*		2	2		2	6	4					3	2
Grey-tailed Tattler *Tringa brevipes*	16	13	26		16	31	28	20	52		19	25	12
Common Greenshank *Tringa nebularia*	170	152	140	194	295	153	115	151	104	119	109	155	54
Marsh Sandpiper *Tringa stagnatilis*	176	13	161	31	140	124	160	143	42	47	49	99	62
Ruddy Turnstone *Arenaria interpres*			1				1		1				
Great Knot *Calidris tenuirostris*	9		7	30	15	2	4			2	1	9	10
Red Knot *Calidris canutus*		10	32		54	28	10		8	3	2	18	18
Red-necked Stint *Calidris ruficollis*	53	25	78	50	85	70	44	23	19		6	45	27
Sharp-tailed Sandpiper *Calidris acuminata*	25	51	205	432	325	665	54	683		1	264	271	255
Curlew Sandpiper *Calidris ferruginea*	400	350	407	812	200	381	200	276	260	185	241	337	178
Total number of birds	**3900**	**2958**	**4756**	**6812**	**4711**	**2841**	**4868**	**5900**	**2222**	**1890**	**2695**	**3959**	**1584**

[1]Mean count when present on more than two occasions

Table 2. Details of July shorebird counts in the Hunter Estuary, 1999–2009.

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean[1]	SD
Australian Pied Oystercatcher *Haematopus longirostris*	2	2	1	17	3	8	8	4	2	2	18	6	6
Sooty Oystercatcher *Haematopus fuliginosus*							2	9	2	1		4	4
Black-winged Stilt *Himantopus himantopus*	1	99	495	542	415	502	321	360	32	238	270	298	190
Red-necked Avocet *Recurvirostra novaehollandiae*	2001	6	1725	2500	4963	853	2315	3650	49	1500	1300	1897	1471
Red-capped Plover *Charadrius ruficapillus*		14		10	6	41	44	17	48	41	6	25	18
Double-banded Plover *Charadrius bicinctus*						6							
Black-fronted Dotterel *Elseyornis melanops*	42		3	6	47	48	30	2	36	17	4	24	19
Red-kneed Dotterel *Erythrogonys cinctus*	2		9	7	8	3		1			3	5	3
Masked Lapwing *Vanellus miles*	30	49	31	45	33	54	40	37	30	54	32	40	9
Latham's Snipe *Gallinago hardwickii*	2												
Black-tailed Godwit *Limosa limosa*	6	5	1	1	3	11	7	2	2		1	4	3
Bar-tailed Godwit *Limosa lapponica*	370	370	250	90	163	142	163	215	305	201	164	221	93
Whimbrel *Numenius phaeopus*	11	19		32	7	45	6	46			4	21	17
Eastern Curlew *Numenius madagascariensis*	88	80	126	130	85	108	75	56	74	59	38	84	29
Terek Sandpiper *Xenus cinereus*				1									
Grey-tailed Tattler *Tringa brevipes*	2	2	6			1	4	2				3	2
Common Greenshank *Tringa nebularia*		3	2	14		11		20	1	9	5	8	7
Marsh Sandpiper *Tringa stagnatilis*					14								
Great Knot *Calidris tenuirostris*		1			3	4						3	2
Red Knot *Calidris canutus*				3	11	8	1					6	5
Red-necked Stint *Calidris ruficollis*						5	26		9			13	11
Curlew Sandpiper *Calidris ferruginea*							3						
Total number of birds	**2557**	**650**	**2649**	**3398**	**5761**	**1850**	**3045**	**4421**	**590**	**2122**	**1845**	**2626**	**1528**

[1]Mean count when present on more than two occasions

NORTH-WEST AUSTRALIA WADER & TERN EXPEDITION REPORT 23RD FEBRUARY TO 16TH MARCH 2013

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INTRODUCTION

This was another successful annual expedition to north-west Australia, though it wasn't without its problems! It had to happen that we would eventually encounter bad weather problems when we decided to change, three years ago, the timing of our annual visits to coincide partly with the wet season. This year the first five days of the expedition were severely disrupted by a large, slow moving, intense cyclone which dumped 200mm of rain on us at Broome and blew a bit. We made only two small catches in this period – in dry interludes and getting birds into keeping cages before the next downpour – and our travel to 80 Mile Beach was delayed by a day because the main road was closed. Nevertheless a satisfactory total of 3160 birds, close to the usual level, was caught and provided estimation for reproductive success via the percentage of juveniles.
Some of the key outcomes of the expedition are detailed below.

MAIN ACHIEVEMENTS

Catching

A total of 11 cannon-net catches was made, with a record average of 287 birds per catch. Catch sizes of 200 – 350 were regularly achieved at both Broome and 80 Mile Beach, but one much larger catch of 900 was also made at the latter (Table 1). The field techniques employed were similar to the previous year, with only small mesh nets used and with keeping cages pre-erected at Broome (where it is hotter than at 80 Mile Beach). A total of 1387 birds were caught at Broome and 1773 at 80 Mile Beach (Table 2).

On the extremely high tides at 80 Mile Beach, catches on four successive days were made on the beach at a point 40km south of Anna Plains Station. This is where the highest concentration (30-50,000) of waders occurs at high tide along the 220km of 80 Mile Beach. We have only occasionally caught there in the past, but have now learned that it is an excellent location on extremely high tides, with a good mix of species (and numbers of Grey-tailed Tattlers and Terek Sandpipers). We successfully resorted to catching birds well before the extremely high tide in Broome, with the net situated low down on the beach.

Great Knot (899) as usual topped the species composition list. But, unusually, this was followed by 584 Grey-tailed Tattlers. Red-necked Stint catches totalled 583 and Greater Sand Plover a rather lower than usual 393. On two occasions there were significant numbers of Broad-billed Sandpipers in a catch, totaling 22 (Table 3).

Catches of terns (7) were disappointing and lower than on any previous expedition. There were no concentrations of Common or Roseate Terns around Broome Port and very few terns of any species along 80 Mile Beach. It seems that most Whiskered, White-winged Black and Australian Gull-billed Terns had dispersed to ephemeral inland wetlands. A good collection of Asian Gull-billed Terns was assembling in front of the nets at 80 Mile Beach on one occasion,

Table 1. NWA 2013 expedition catch total

Catch date	Location	New	Re-trap	Total	
25/02/2013	BROOME	150	74	224	
26/02/2013	BROOME	18	6	24	
Sub-total		***168***	***80***	***248***	
1/03/2013	80 MILE BEACH	207	6	213	including 2 terns
2/03/2013	80 MILE BEACH	868	32	900	
3/03/2013	80 MILE BEACH	305	14	319	
4/03/2013	80 MILE BEACH	178	10	188	
5/03/2013	80 MILE BEACH	143	10	153	
Sub-total		***1701***	***72***	***1773***	
9/03/2013	BROOME	229	110	339	
10/03/2013	BROOME	204	156	360	including 5 terns
12/03/2013	BROOME	131	68	199	
13/03/2013	BROOME	177	64	241	
Sub-total		***741***	***398***	***1139***	
TOTAL		**2610**	**550**	**3160**	

but these moved away before the tide brought them within catching range.

It is normal to have regular disturbance of roosting wader flocks by passing birds of prey along the shores of north-west Australia. But this year an added problem was the seabirds blown ashore by Cyclone Rusty. These were principally Common Noddies, frigatebirds and Brown Boobies but also the occasional Skua. Although the Noddies are most unlikely ever to prey on waders, the birds seemed to be considerably disturbed by them, presumably because their presence is unusual.

Re-traps and Controls

Nine waders banded elsewhere were recaptured during the Expedition – eight from overseas and one from Victoria (Table 4). Particularly pleasing was Great Knot F07-4245 which carried an engraved (EC) orange flag over a green flag. This bird had been marked by Hebo Peng, of Professor Zhijun Ma's team at Fudan University in China, at Yalu Jiang at the northern end of the Yellow Sea in 2012. Hebo was the person who took this bird out of the keeping cage when we recaptured it on March 5! Another pleasant recapture was a Greater Sand Plover carrying engraved flags from Hong Kong – a bird which had been seen regularly around Roebuck Bay during previous months.

Several of the Chinese birds carried metal bands, which were extremely heavily corroded or worn. These were removed and replaced with the much more wear and corrosion resistant Australian bands. It is only in recent years that China has started using these more satisfactory bands for waders. One band turned out to be completely unreadable and another had already been lost from a bird – it carried Chinese leg flags only.

The Red Knot from Victoria further illustrates just how far this species can change its non-breeding area. It had been marked as an adult in the middle of the non-breeding season in Victoria, 3000km away, seven years previously.

As usual some old birds were recaptured (Table 5). The oldest was a Great Knot in its 22nd year, followed by a Curlew Sandpiper and a Greater Sand Plover, both in their 20th year. Re-trap rates were again very much higher at Roebuck Bay, Broome (34%), than at 80 Mile Beach (4%). This is the result of all-year-round catching over many years at Broome but only one week per year catching of the much larger wader population on 80 Mile Beach. The 50% recapture rate on Greater Sand Plovers reflects the special effort put in on this species at Roebuck Bay over the last three years while deploying and attempting to retrieve geolocators.

Proportion of Juveniles

Satisfactory samples were accumulated of the 10 species on which we try to monitor breeding success annually (Table 3), as well as of Broad-billed Sandpiper (Table 6). As for the 2011 breeding season, it seems that the more southerly breeding species had

Table 2. Comparison of catches made during this expedition (in bold) and previous expeditions (2006-2012).

Catch location	Year	New	Re-trap	Total
BROOME (1st period)	2006	857	174	1031
	2007	985	223	1208
	2008	807	184	991
	2009	1374	208	1582
	2011	6	3	9
	2012	48	27	75
	2013	***168***	***80***	***248***
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***
BROOME (2nd period)	2006	1120	176	1296
	2007	861	192	1053
	2008	567	88	655
	2009	1172	296	2068
	2011	1072	484	1556
	2012	1093	383	1476
	2013	***741***	***398***	***1139***
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**

better success in 2012 than those species which breed in the Arctic. Only Greater Sand Plover and Grey-tailed Tattler had good breeding outcomes in 2012. Bar-tailed Godwit and Great Knot had poor results and the outcome from Sanderling, Curlew Sandpiper, Red Knot and Ruddy Turnstone was disastrous. They are surely due some breeding success in 2013! Presumably this year's results are again a function of poor weather situations (snowmelt date, temperatures, late snowfalls at chick hatching, etc.) and/or high predation levels.

Geolocators

Fifty-seven new geolocators were deployed on Great Knot. These were all of the Migrate Technology Intigeo design, which has an extremely low weight of 0.65g. Two of the 6 Biotrack units put on Great Knot in 2012 have been retrieved but both failed prematurely and provided little information on migration. Even more disastrous is that we failed completely to recapture any of the 44 geolocators put on to Red Knot at Roebuck Bay in March 2012. Only one of these was even seen on the recent expedition, and this was on a bird that had moved to 80 Mile Beach. The lack of faithfulness to a particular non-breeding site is a characteristic of Red Knot and the prime reason for this poor return on investment.

We did retrieve a geolocator from a Greater Sand Plover but this had been put on only last November and, in any event, it had suffered ingress of seawater and failed prematurely. Also, we recaptured a Greater Sand Plover that had been seen regularly around Broome for the last two years missing the geolocator from its orange flag and having also shed its engraved yellow flag.

A special visit to Broome to try and retrieve geolocators from Great Knot is planned, from Friday 1 Nov to Sunday 10 Nov 2013.

Flag Sightings

More time was allocated on this year's expedition for scanning feeding and roosting wader flocks to look for flags, especially engraved flags, and colour-band combinations. This was particularly productive on 80 Mile Beach, where Red Knots were the main target.

Passerine Banding

Passerine banding was rather less productive than usual, and was not possible at all at Broome Bird Observatory itself. This was because there was so much ephemeral water resulting from the cyclone that birds were not attracted to the usual drinking areas (natural or artificial). Nevertheless there was an opportunity to handle some honeyeaters at Anna Plains and mangrove birds at Broome (Table 8).

OTHER MATTERS

Participants

The NWA 2013 team was rather smaller (25) than other recent years (typically 30), As usual a significant proportion (36%) was from overseas. A full list of participants is provided at the end of this report but their origins are summarized below:

16 Australia (7 VIC, 3 WA, 2 SA, 2 Q, 1 TAS, 1 NSW)
2 Taiwan
2 Japan
1 China (Hong Kong)
1 China (mainland)
1 Singapore
1 Germany
1 United Kingdom (BBO Assistant Warden)

In addition the BBO Warden and the other Assistant Warden regularly participated in activities at Roebuck Bay and for a three-day period at 80 Mile Beach.

Table 3. NWA 2013 Expedition - wader and tern catch details.

Species	New	Re-trap	TOTAL	Juveniles	% Juv.
Bar-tailed Godwit	168	16	184	*14*	*7.6*
Broad-billed Sandpiper	16	6	22	*4*	*18.2*
Curlew Sandpiper	88	20	108	*2*	*1.9*
Great Knot	824	75	899	*59*	*6.6*
Greater Sand Plover	249	144	393	*111*	*28.2*
Grey Plover	4	0	4	*0*	*0.0*
Grey-tailed Tattler	505	79	584	*104*	*17.8*
Lesser Sand Plover	2	1	3	*0*	*0.0*
Red Knot	119	11	130	*2*	*1.5*
Red-capped Plover	1	0	1	*0*	*0.0*
Red-necked Stint	391	192	583	*86*	*14.8*
Ruddy Turnstone	21	3	24	*0*	*0.0*
Sanderling	31	0	31	*1*	*3.2*
Terek Sandpiper	185	2	187	*23*	*12.3*
Sub-total	**2604**	**549**	**3153**		
Little Tern	5	1	6	*1*	
Common Tern	1	0	1	*0*	
Sub-total	**6**	**1**	**7**		
TOTAL	**2610**	**550**	**3160**		

Table 4. Recaptures (controls) during NWA 2013 of waders banded elsewhere.

Species	Band number	Country of origin	Condition of band	Age at capture	Recapture date	Recapture location	Flags	Australian band	Banding details
Great Knot	F05-0829	China	very worn removed	2+	2/03/2013	80 Mile Bch (40km S of AP)	W/BK	063-19164 (added)	
Great Knot	F05-8713	China	band OK	2+	2/03/2013	80 Mile Bch (40km S of AP)	BK/W	none	
Great Knot	F06-6647	China	very worn removed	2+	3/03/2013	80 Mile Bch (40km S of AP)	BK/W	063-19517 (added)	
Great Knot	F06-2911	China	very worn removed	2+	03 & 04/03/2013	80 Mile Bch (40km S of AP)	BK/W	063-19518 (added)	
Great Knot	unreadable	China	unreadable removed	2+	3/03/2013	80 Mile Bch (40km S of AP)	W/BK	063-19605 (added)	
Great Knot	F07-4245	China	band OK	2+	05/03/2013	80 Mile Bch (23km S of AP)	Orange flag engraved G/O (EC)	none	
Bar-tailed Godwit	band missing	China	band missing	2+	2/03/2013	80 Mile Bch (40km S of AP)	W/BK	073-65479 (added)	
Grey-tailed Tattler	F05-4376	China	very worn left on bird	2+	25/02/2013	Broome (West Quarry)	BK/W	062-88573 (already on bird)	
Greater Sand Plover	NW 26021 (British Mus.Band)	Hong Kong	band OK	2+	9/03/2013	Broome (Wader Spit)	Both flags engraved W(K6)/Y(K6)	none	
Red Knot	052-29806	Australia (Victoria)	band OK	2+	1/03/2013	80 Mile Bch (40km S of AP)	O (replaced by Y (4LPYB)	none added	3+ 5/02/2006 at Corner Inlet Victoria

Table 5. Oldest recaptures during NWA 2013

Species	Band	Date Banded	Banding Location	Age at banding	Re-trap Date	Re-trap Location	Minimum age at re-trap
Bar-tailed Godwit	072-56804	4/04/1996	80 Mile Beach	1	5/03/2013	80 Mile Bch (23km S AP)	17
Curlew Sandpiper	041-81071	28/07/1994	Broome	1	9/03/2013	Broome (Wader Spit)	19
Great Knot	061-90330	13/10/1992	Broome	2	12/03/2013	Broome (Two Dog Hermit)	21
Great Knot	062-14289	2/05/1995	Broome	1	9/03/2013	Broome (Wader Spit)	18
Great Knot	062-43234	29/08/1998	Broome	3+	9/03/2013	Broome (Wader Spit)	17 3/4 +
Greater Sand Plover	051-81709	4/03/1994	Broome	1	10/03/2013	Broome (Two Dog Hermit)	19
Greater Sand Plover	051-99421	11/10/1998	Broome	3+	10/03/2013	Broome (Two Dog Hermit)	17 3/4 +
Grey-tailed Tattler	062-15934	26/07/1998	Broome	1	25/02/2013	Broome (Quarry)	15
Grey-tailed Tattler	062-15934	25/02/2013	Broome (Quarry)	1	13/03/2013	Broome (Quarry)	15
Red Knot	052-26109	10/11/2001	80 Mile Beach	2+	1/03/2013	80 Mile Bch (40km S AP)	12 3/4 +
Red-necked Stint	034-96451	10/04/1996	Broome	1	10/03/2013	Broome (Two Dog Hermit)	17

Table 6. Percentage juveniles in NWA 2013 cannon-net catches.

Species	Total Catch	% juvenile 2012	Average % juvenile 1998/99 to 2011/12 *	Assessment of 2012 breeding success
Red-necked Stint	583	*14.8*	*21.3*	Average
Curlew Sandpiper	108	1.9	*18.0*	Very poor
Great Knot	899	6.6	*12.7*	Poor
Red Knot	130	1.6	*19.0*	Poor
Bar-tailed Godwit	184	7.6	*10.6*	Very poor
Greater Sand Plover	393	28.2	*23.3*	Very good
Terek Sandpiper	187	12.3	*12.7*	Average
Grey-tailed Tattler	584	17.8	*16.5*	Good
Ruddy Turnstone **	24	3.2	-	Very poor?
Sanderling **	31	0.0	-	Very poor
Broad-billed Sandpiper	22	18.2	-	-

* All birds cannon-netted in the period 1 November to mid-March. Averages (for previous 14 years) exclude years with small sample sizes.

** Compared against previous year (Minton *et al*. 2012).

Itinerary

Because of the delay caused by the cyclone only six catching days were spent at 80 Mile Beach, with another day allocated to scanning and local bird watching. Eleven days were spent at Broome but catching was attempted on only nine of these. Weather prevented catching on one day and another day was allocated to local mist-netting and birdwatching.

Finances

The projected income for the expedition was slightly lower than usual at $38,868. Most of this resulted from the contributions of participants. However generous donations were received from the two television crews who joined us at various times, from the West Australian Department of Environment and Conservation, and from AQIS (indirectly) in recognition of loan of the cannon-netting equipment for catching ducks. Expenditures are not yet complete but it appears likely that the final outcome will be close to break even. The final financial outcome from the NWA 2012 Expedition was a small surplus of $297, which will be carried forward for future use.

Seabirds

As indicated earlier a considerable number of seabirds were blown ashore by the prolonged strong on-shore winds associated with Cyclone Rusty. The commoner species are mentioned above. In addition, several Streaked Shearwaters were seen. Quite a few birds seemed to have succumbed eventually to the effects of the storm (probably due to the prolonged loss of feeding opportunities) with dead Noddies in particular being washed ashore at 80 Mile Beach.

NEXT EXPEDITION

In spite of the interruption caused by Cyclone Rusty during the recent expedition it is still considered that February / early March is a good time to hold these annual visits. The main reason it that in February there is more cloud present and this slightly reduces temperatures and particularly the direct heating effects of sunlight on birds in the net and in keeping cages. It also means that the Expedition does not clash with the annual NWA wader counts in November/early December, which would take away some key members of the team for part of the expedition period.

It has been decided to make slight changes to the format of the three-week NWA Expedition in 2014. It had always been rather an anti-climax to come back and start catching again at Broome after the completion of a long period at 80 Mile Beach (and the last night party!). It also, this year in particular, led to a number of people leaving the Expedition early, which meant that a noticeably greater workload fell on everyone during the last week at Broome with a diminished team.

Examination of the February/March 2014 tide tables has indicated that it is possible to divide the three-week itinerary into just two sections, with the first nine days being spent at Broome and the last ten days at 80 Mile Beach. Such an itinerary has the advantage of enabling us to move location on a day of neap tides and therefore to maximize the catching opportunities of the larger spring tides.

Table 7. Results of mist-netting in Broome and at Anna Plains station.

Species	New	Re-trap	Total	Juvenile
Anna Plains Passerine Bore, 7th March 2013				
Singing Honeyeater	2	0	2	0
Brown Honeyeater	17	0	17	0
TOTAL	**19**	**0**	**19**	
Mangroves Crab Creek, Roebuck Bay, 15th March 2013				
Yellow White-eye	16	5	21	0
Brown Honeyeater	2	0	2	0
White-breasted Whistler	1	0	1	0
Rufous-throated Honeyeater	1	0	1	0
TOTAL	**20**	**5**	**25**	

Next year's expedition will start on Sunday 16 February and will disperse on Sunday 9 March.

Mike Dawkins and Prue Wright will formally join the Leadership Team for NWA 2014.

ACKNOWLEDGEMENTS

The NWA 2013 team is particularly indebted to all those who took part and through whom it was financially possible. A huge amount of physical effort was put in to achieve results, often in somewhat difficult climatic circumstances.

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Permits to carry out research were provided by the WA Department of Environment and Conservation and bands and banding permits were issued by the Australian Bird and Bat Banding Scheme.

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

WADER BREEDING SUCCESS IN THE 2012 ARCTIC SUMMER, BASED ON JUVENILE RATIOS OF BIRDS WHICH SPEND THE NON-BREEDING SEASON IN AUSTRALIA

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INTRODUCTION

Reproduction rate is one of the two key parameters controlling wader populations. Each year since 1999 (Minton *et al*. 2000) the results of percentage juvenile monitoring (a proxy for reproductive rate) in Australia by the Victorian Wader Study Group (VWSG) and the Australasian Wader Studies Group (AWSG) have been published in the journals Arctic Birds and *Stilt*. The publications in Arctic Birds facilitates comparison between annual breeding success results obtained by this method with information generated from a variety of other sources / methods across the whole of the Arctic breeding areas, also published in Arctic Birds. The paper in *Stilt* informs Australian and other wader researchers in the East Asian - Australasian Flyway of the results of this key element of their fieldwork programmes. Another objective of the parallel publication of these results is to set the data on permanent record for use by those who are interested in analysing long term data sets for relationships and causes of variations in reproductive success of Arctic breeding birds worldwide.

Percentage juvenile results are considered to be a measure of recruitment in the previous Arctic breeding season. The rationale behind using percentage juvenile data in this manner, and caveats concerning the interpretation and use of such data, can be found in last year's paper (Minton *et al.* 2012).

This paper presents the results of percentage juvenile sampling of waders in south-east Australia (SEA) and north-west Australia (NWA) during the November 2012 to March 2013 non-breeding season. This data provides estimates of wader breeding success for a range of species in the 2012 Northern Hemisphere summer.

METHODS

Information was again obtained from cannon-net catches of waders at high-tide roosts at a variety of locations throughout the non-breeding season (Minton *et al.* 2005). The usual sampling period was used in NWA (1 November to 21 March) and in SEA from mid-November (see Footnote in Table 1 for end dates). This year the sampling of Sanderling and Ruddy Turnstone in SEA was continued beyond the end of March because tide / logistical constraints forced key visits to the two main sampling areas to take place rather later than usual. However detailed recovery, flag-sighting and geolocator information obtained over recent years has shown that the sampling dates used this year were before any adult birds of either species were likely to have departed on northward migration.

The 2012 breeding success results are assessed in the same way as previous years (Minton *et al.* 2012), that is, two different measures of the average / typical annual percentage juvenile figures are presented, the median and mean. As the long data series is now available for SEA (over 30 years in three species) the *median* percentage juvenile figure is quoted for comparison. In the shorter term, in the data sets presented in Table 3 for SEA and in Table 4 for NWA, the *mean* of the percentage juvenile figures for the previous 14 years (the limit of the NWA data set) are given. In general these two figures are similar but on some species there are differences, the reasons for which have not yet been investigated.

RESULTS

The figures for 2012 / 2013 are given in Table 1 (SEA) and Table 2 (NWA). In the former all the usual species

Table 1. Percentage of juvenile / first year waders in cannon-net catches in south-east Australia in 2012 / 2013.

Species	No. of catches		Total caught	Juv. / 1st year		Long term median* % juvenile (years)	Assessment of 2012 breeding success
	Large (>50)	Small (<50)		No.	%		
Red-necked Stint *Calidris ruficollis*	6	7	1902	414	**21.8**	14.5 (34)	Good
Curlew Sandpiper *C. ferruginea*	1	6	329	11	**3.3**	9.8 (33)	Very poor
Bar-tailed Godwit *Limosa lapponica*	0	2	77	15	**19.5**	17.9 (23)	Average
Red Knot *C. canutus*	0	1	1	0	**-**	58.0 (18)	-
Ruddy Turnstone *Arenaria intepres*	1	22	546	13	**2.4**	10.1 (22)	Very poor
Sanderling *C. alba*	4	4	674	19	**2.8**	10.1 (21)	Very poor
Sharp-tailed Sandpiper *C. acuminata*	0	8	116	21	**18.1**	10.7 (31)	Good

All birds cannon-netted in period 15 November to 25 March except Sharp-tailed Sandpiper and Curlew Sandpiper to end February only and some Ruddy Turnstone and Sanderling to early April.
* Does not include the 2012 / 2013 figures

were sampled, except Red Knot. The population of this species appears to have declined so much over the years that few catching opportunities are available. We have no good alternative information available to judge breeding success, although the visible presence of juveniles at some locations and numbers of overwintering birds in the 2013 austral winter suggests that Red Knot may have had at least some breeding success in 2012.

All the usual species caught in previous years were sampled in NWA except for Sharp-tailed Sandpiper. Results are also given this year for Broad-billed Sandpiper.

Table 3 (SEA) and Table 4 (NWA) show that annual percentage juvenile results for each of the main species for each year since 1998 / 1999, which is when annual sampling commenced in NWA. These tables facilitate comparisons between the two geographic regions of the non-breeding areas (3000 km apart, SEA which is temperate and NWA which is tropical) and also in some cases facilitate comparisons between the same species in the two different areas.

DISCUSSION

The 2012 breeding season appears, unfortunately, to have been even poorer than the 2011 breeding season for most of the wader populations which visit SEA and NWA (Minton *et al.* 2012). This was especially so in NWA where in the Arctic-breeding species four out of seven were rated "very poor" and none achieved even average breeding success. In SEA Sanderling and Curlew Sandpiper also experienced a second successive very poor breeding outcome, but Red-necked Stint and Sharp-tailed Sandpiper were rated as being "good". This variation between species in some years has been noted previously, with Sharp-tailed Sandpiper particularly being a species frequently differing in its breeding outcome from the majority of other species (Minton *et al.* 2005).

In contrast the NWA results show that species which breed less far north in Siberia (i.e. predominantly not in the Arctic) had a rather better breeding performance in 2012 than Arctic-breeding species. They also performed better than in 2011. Greater Sand Plover in particular showed a marked improvement (28.2% juveniles) after a couple of years with lower than average productivity.

The link between breeding success of waders and weather / predator conditions in their breeding areas continues to receive attention worldwide (Fraser *et al.* 2013, Nolet *et al.* 2013). Our own new analysis, mentioned in last year's paper and being carried out by Yaara Rotman and Marcel Klaassen of Deakin University, is still continuing. It does seem to confirm, as other researchers have also suggested, that the fairly rigorous Lemming cycles present in the Arctic for several decades in the second half of the last century, have broken down in the last 20 or so years. With wader breeding success shown to be critically related to the Lemming / predator numbers (Summers & Underhill 1987), it is not surprising therefore that the cycles of wader breeding success have also shown less regularity in the last two decades. One of the problems is that several critical factors vary independently – snow depth, date of snowmelt, June and July temperatures, late snowfalls during the hatching period and predator numbers. Sometimes variations in one factor will mask variations in another. Also it may be difficult to know about potentially devastating late snowfalls if these occur in only a limited area and for a short duration (i.e. without greatly affecting the monthly average temperature). The variable performance between species in a year may well relate to the chance mix of the critical factors which may occur in the main breeding location of a particular species.

CONCLUSION

Overall, 2012 was again a poor breeding season for most wader species which spend their non-breeding season in Australia. Given the pressures on many species of waders caused by loss of feeding habitat in key stopover locations in the Flyway it is desirable that they have the opportunity of offsetting survival losses due to this cause

Table 2. Percentage of juvenile / first year waders in cannon-net catches in north-west Australia in 2012 / 2013.

Species	No. of catches		Total caught	Juv. / 1st year		Assessment of 2012 breeding success
	Large (>50)	Small (<50)		No.	%	
Great Knot *Calidris tenuirostris*	6	4	899	59	6.6	Poor
Bar-tailed Godwit *Limosa lapponica*	2	6	184	14	7.6	Below average
Red-necked Stint *C. ruficollis*	3	5	583	86	14.8	Below average
Red Knot *C. canutus*	1	8	130	2	1.5	Very poor
Curlew Sandpiper *C. ferruginea*	0	7	108	2	1.9	Very poor
Ruddy Turnstone *Arenaria intepres*	0	8	24	0	0	Very poor
Sanderling *C. alba*	0	4	31	1	3.2	Very poor
Non-arctic northern migrants						
Greater Sand Plover *Charadrius leschenaultii*	4	7	393	111	28.2	Good
Terek Sandpiper *Xenus cinereus*	1	7	187	23	12.3	Average
Grey-tailed Tattler *Heteroscelus brevipes*	3	6	584	104	17.8	Average
Broad-billed Sandpiper *Limicola falcinellus*	0	2	22	4	18.4	Average?

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

Table 3. Percentage of first year birds in wader catches in south-east Australia 1998 / 1999 to 2012 / 2013

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	*Average (14 yrs)*
Ruddy Turnstone *Arenaria interpres*	6.2	29	10	9.3	17	6.7	12	28	1.3	19	0.7	19	26	10	24	*13.9*
Red-necked Stint *Calidris ruficollis*	32	23	13	35	13	23	10	7.4	14	10	15	12	20	16	21.8	*17.1*
Curlew Sandpiper *C. ferruginea*	4.1	20	6.8	27	15	15	22	27	4.9	33	10	27	(-)	4	3.3	*16.6*
Sharp-tailed Sandpiper *C. acuminata*	11	10	16	7.9	20	39	42	27	12	20	3.6	32	(-)	5	18.1	*18.8*
Sanderling *C. alba*	10	13	2.9	10	43	2.7	16	62	0.5	14	2.9	19	21	2	2.8	*15.6*
Red Knot *C. canutus*	(2.8)	38	52	69	(92)	(86)	29	73	58	(75)	(-)	(-)	78	68	(-)	*58.1*
Bar-tailed Godwit *Limosa lapponica*	41	19	3.6	1.4	16	2.3	38	40	26	56	29	31	10	18	19.5	*23.5*

All birds cannon-netted between 15 November and 25 March, except Sharp-tailed Sandpiper and Curlew Sandpiper to end February only and some Ruddy Turnstone and Sanderling to early April. Averages (for previous 14years) exclude figures in brackets (small samples) and exclude 2012 / 13 figures

Table 4. Percentage of first year birds in wader catches in north-west Australia 1998 / 1999 to 2012 / 2013.

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	*Average (14 yrs)*
Red-necked Stint *Calidris ruficollis*	26	46	15	17	41	10	13	20	21	20	10	17	18	24	14.8	*21.2*
Curlew Sandpiper *C. ferruginea*	9.3	22	11	19	15	7.4	21	37	11	29	10	35	24	1	1.9	*18.1*
Great Knot *C. tenuirostris*	2.4	4.8	18	5.2	17	16	3.2	12	9.2	12	6	41	24	6	6.6	*12.6*
Red Knot *C. canutus*	3.3	14	9.6	5.4	32	3.2	(12)	57	11	23	12	52	16	8	1.5	*18.9*
Bar-tailed Godwit *Limosa lapponica*	2.0	10	4.8	15	13	9.0	6.7	11	8.5	8	4	28	21	8	7.6	*10.6*
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	*23.3*
Terek Sandpiper *Xenus cinereus*	12	(0)	8.5	12	11	19	14	13	11	13	15	19	25	5	12.3	*13.7*
Grey-tailed Tattler *Heteroscelus brevipes*	26	(44)	17	17	9.0	14	11	15	28	25	38	24	31	20	17.8	*21.2*

All birds cannon-netted in the period 1 November to mid-March. Averages (for pervious 14 years) exclude figures in brackets (small samples) and exclude 2012 / 13 figures.

by having good breeding success when they are in the Arctic or elsewhere in Siberia. Arctic waders, in particular, badly need an above-average breeding outcome in 2013.

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Members of the VWSG and AWSG are greatly thanked for sustained fieldwork effort over several months in the 2012-13 non-breeding season. Only by their considerable perseverance can the annual long-term monitoring of a range of species in SEA and NWA be successfully carried out. Gaps in the data greatly reduce the practicability of determining the primary factors influencing breeding success.

All those who have facilitated access to our various monitoring sites and the carrying out of fieldwork are greatly thanked, especially Broome Bird Observatory and Anna Plains Station in NWA. Some financial support for fieldwork activities is most generously provided by Coastcare Victoria in SEA and by the WA Department of Environment and Conservation in NWA. The Australian Bird Banding Scheme and the various state environment / conservation bodies also kindly provided appropriate licences and, where necessary, ethics and other animal catcher approvals.

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

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

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

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

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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.

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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.

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