Final Report:

2015 Coorong Shorebird Census

Prepared for

Department of Environment, Water and Natural Resources

Prepared By

BirdLife Australia

June 2015

birds are in our nature

AWSG

Australasian Wader Studies Group

birdlife

AUSTRALIA

Acknowledgements

The survey was supported with funds from the Department for Environment, Water and Natural Resources (Coorong and Lower Lakes Program). Thanks to Paul McEvoy and Paul Wainwright for arranging funding.

Many thanks to the following Coorong fishermen, who supplied and piloted boats with great skill - Gary Hera-Singh, Robert Brooks, Rod Ayres and Glen Hill. Also of great assistance with boat support was Stuart Hicks from DEWNR. Thanks also to Ross and Janette Brittain for also supplying and piloting a boat, Richard Owen for organising the surveys upstream of the barrage, and David and Margaret Dadd for undertaking additional surveys in section 18 and 20.

The survey team consisted of Gavin Campbell, Brenton Carle, Margaret Dadd, David Dadd, Stuart Hicks, Keith Jones, Kieran Smith, Ken Jones, Peter Gower, Ross Brittain, Janette Diment, Jonathon Starks, Richard Owen, Rod Ayers, Gary Hera-Singh, Robert Brooks, Glen Hill, Joris Driessen, Andrew Silcocks, Caroline Wilson, Kerryn Herman and Dan Weller.

Ken Gosbell, Maureen Christie and Paul Wainwright are acknowledged for their help with the provision of historical data and significant components of the project methodology.

The following BirdLife Australia personnel contributed to the preparation of the report:

Kerryn Herman and Dan Weller.

Contents

Project Background

Introduction

The Coorong is the name given to 130km of saltwater lagoons that are sheltered from the Southern Ocean by the coastal dunes of the Younghusband Peninsula. The region is approximately 180km southeast of Adelaide and with Lake Alexandrina, Lake Albert and associated wetlands and the Murray Mouth (Coorong, Lower Lakes and Murray Mouth (CLLMM)) this area supports one of Australia's most important wetland areas. This region was listed as a Wetland of International Importance under the Ramsar Convention on Wetlands in 1985.

The hydrology of the CLLMM area, which directly affects the habitat and resources available for waders, is complex and highly regulated. Drivers including climate, rainfall in and out of the immediate catchment, tidal movements and the active management of water flow through a system of barrages (Phillips and Muller 2006). The Northern Channel and Northern Lagoon areas (see Map Figure 2) are permanent estuarine – saline environments. The salinity is controlled through fresh water inflows primarily through the system of barrages in place across the River Murray, tidal inflows though the Murray Mouth and inflows from the South Lagoon (Phillips and Muller 2006). These flows ensure that the North Lagoon is a permanent water body. However areas of inundation can vary diurnally and seasonally with the tide and inflows, resulting in varying exposure of mudflats and intertidal marshes along the shoreline. This provides necessary habitat for a wide range of wader birds including resident and migratory shorebirds (Phillips and Muller 2006). Under natural conditions the North Lagoon was dominated by tidal input of marine water from the Murray Mouth and fresh water coming down from the River Murray. The construction of the barrages in the 1930's – 1940's has resulted in a severe reduction in the area of estuarine habitat, as well as disruptions in the transition between saline and fresh water conditions. The North Lagoon has been subject to hypermarine conditions in the past decade which has had impacts on much of the flora and fauna in the system (Phillips and Muller 2006), although conditions have been improving in recent years.

The South Lagoon is a naturally saline – hyper saline system of both permanent and ephemeral lakes. Water levels vary seasonally with higher levels in the winter. The reduction in water levels in summer results in extensive areas of mud flats interspersed with shallow and ephemeral salt lakes (Phillips and Muller 2006). Water inflow into the South Lagoon is predominately from the North Lagoon and rainfall events. Historically, inflow had occurred from number of ground water soaks and Saltwater Creek at the south east end of the lagoon. These water sources have reduced significantly since European settlement (Phillips and Muller 2006), however projects are planned for 2016 to address this loss of fresh water inflow in the south east (http://www.naturalresources.sa.gov.au/southeast/projects/se-flows).

From the early 2000's, prolonged drought and continued elevated water diversions greatly reduced freshwater inflows to the system, compounding the effects of historical management and driving the CLLMM to a point of crisis (Kingsford et al. 2011). This resulted in the development of a long term plan for the CLLMM recognizing the impacts of over-allocation, changed drainage in the south-east, the need to effectively manage water levels as well as climatic and sea-level impacts (DEH 2010). Rainfall in 2010 provided much needed

relief to the system and effectively reset the system. Migratory shorebirds are recognized as important biological components of the system. Australia is signatory to several international agreements such as the JAMBA, CAMBA, ROKAMBA and Ramsar agreements, meaning we have a legal requirement to protect the Coorong system for these bird groups. The ongoing and long-term monitoring of these species provides the necessary data to satisfy these legislative requirements as well as our responsibilities for biodiversity conservation.

Wader surveys across the Coorong have been undertaken by the Australian Wader Study group (AWSG) since the early 1980's. Since the turn of the century these surveys have been done annually, with only 2009 and 2014 not surveyed. The current report is designed to build on previous surveys and as such the 2012 report produced by Australian Wader Study Group (AWSG; Wainwright 2012) has been used as the basis for the current report. Wainwright (2012) summarized data from a number of previous counts and for consistency these data have been used in the current report for the periods 1981, 1982, 1987 and 2000 to 2008 (Jaensch and Barter 1988; Wilson 2000, 2001; Gosbell et al 2002, 2003, 2004; Gosbell and Christie 2005, 2006, 2007, Wainwright and Christie 2008).

Data for 2010 – 2012 has been extracted from Wainwright (2012). Additional unpublished data for 2013 has been included in this report, along with the results of the 2015 survey.

Data from Watkins (1993) is displayed to allow for historical comparisons. This data is the highest count recorded for each species at the time of the 1993 publication.

Project Area

The Coorong and Lakes Alexandrina and Albert Ramsar site is located at the downstream end of the Murray River, in south-east South Australia. It is also a Living Murray Icon site. The Murray River flows into Lake Alexandrina and out to the Southern Ocean through the Murray Mouth Estuary. Lake Albert is a terminal lake connected to Lake Alexandrina by a narrow channel. Its primary source of water is from Lake Alexandrina, supplemented by groundwater discharge and surface water runoff.

The region is approximately 180km southeast of Adelaide and with Lake Alexandrina, Lake Albert and the Murray Mouth (Coorong, Lower Lakes and Murray Mouth (CLLMM)), this area supports one of Australia's most important wetland areas (Map Figure 1).

The Coorong, and Lakes Alexandrina and Albert Wetland are one of 64 wetland areas in Australia that are listed as Wetlands of International Importance under the Convention on Wetlands of International Importance (Ramsar Convention). The Coorong, and Lakes Alexandrina and Albert Wetland were listed as a Ramsar site under the Convention in 1985 in recognition of their outstanding coastal wetland values and features, particularly for waterbird abundance and diversity.

Monitoring sites for waterbirds and shorebirds build on previous monitoring programs being undertaken by the AWSG as part of the national shorebird monitoring program, and more recently, BirdLife Australia's Shorebirds 2020 program.

The Coorong is divided up into shorebird count areas, numbered 6 – 31, shown on Map Figure 2. Neighboring wetlands of significance were also surveyed, namely Morella Basin.

Methodology

Count Period and Coverage

The Coorong was counted by Birdlife Australia staff and experienced volunteers, over three consecutive days in March 2015 (5th, 6th and 7th).

The count Sections were the same as used in 1987, Jaensch & Barter 1988, Wilson 2000, Wilson 2001a and Gosbell, Christie and Wainwright 2002 to 2010, and Wainwright 2012. Overall, coverage was similar to that achieved in previous years due to the availability of excellent resources (counters and boats) and favourable weather conditions.

Additional surveys were undertaken at Morella Basin in 2015 as well as upstream of the barrage. These data are included in the current report but presented separately. Due to access issues in 2015 section 9, 11 and 13 were not comprehensively surveyed. As with previous years surveys were undertaken by either walking the shoreline or surveying from boats.

Commencing on the morning of 5 March 2015 five land based teams and one team based in a boat counted the Southern Section of the Coorong. Teams were deployed as follows:

DAY 1 – South Lagoon			**Notes**
Team 1	Sections 10 (part),12	NE side, 'Braeside' to south.	Land Based
Team 2	Sections 6,8 (part)	NE and SW side, Tea Tree Crossing to Policeman's Point.	Land Based
Team 3	Sections 14, 15	NE side, 'Braeside' to Magrath Flat including Hacks Point and S side of Parnka Point	Land Based
Team 4	Sections 16,17	Magrath Flat, N side of Parnka Point including Rabbit and Snake Islands to the Needles.	Land Based
Team 5 (Private Boat)	Section 11	Younghusband Peninsula side, Salt Creek to Jack Point	Boat
Team 7	Sections 10 (pt) and 8(pt)	NE side from Jack Point south	Land Based

On the morning of 6 March 2015 two land based and four teams utilising four boats counted the Northern Section of the Coorong. These teams were deployed as follows:

DAY 2 – North Lagoon			**Notes**
Team 2	Sections 22 and 24	NE side, Long Point to Pelican Point	Land based
Team 3 (Fisher Boat)	Sections 19,21,23	Younghusband Penninsula side, Long Point to the Needles.	Boat
Team 4 (DEWNR Boa	Sections 23,25	Younghusband Penninsula side, Pelican Point to Long Point	Boat
Team 5, 6 (Fis Boats)	Sections 26,27,28,29	Pelican Point to Murray Mouth and up Mundoo channel to barrage.	Boat

Day 3 – Goolwa to Murray mouth			
Team 1	Sections 18,20	NE side, The Needles to Long Point	Land based
Team 2 (Fisher Boat)	Sections 30,31	Goolwa (19th Beacon) to Murray Mouth.	Boat

Survey Methodology

Fourteen counters and one boat (private) were involved on Day 1, 19 counters and four boats (1 DEH and 3 fisher) were involved with Day 2, and 4 counters and one boat (fisher) were involved in Day 3 of the count. Each team had at least one experienced counter with telescope and all counters had binoculars. In general, movements of birds within and between areas were noted in order to minimise the possibility for double counting.

Most sites were surveyed either by boat or on foot, depending on the proximity of the site to the nearest public road access point. Boats will be used to access more remote locations, particularly on the eastern side of Younghusband Peninsula. All surveys utilised 10x42 binoculars and a spotting scope of between 20-75x magnification and noted records onto the supplied datasheets.

All surveys were undertaken by teams of two or more observers for occupational health and safety reasons.

Methodology proposed to be implemented is outlined below:

- The survey sites consist of pre-determined areas as shown on Figure 2. GPS waypoints were provided for each site to locate the start and finish point of the survey area.
- Weather conditions and any other observations relevant to the visit were recorded at the start of each survey. Numbers of each species observed, method of observation and any notes relating the species (e.g. feeding, flying etc) were recorded. These data were recorded on datasheets which were provided at the start of each day.
- At each count area a count of all waterbird and shorebird species visible was undertaken.
    - counts conducted ideally while the sun is at counters' backs.
    - counts during significant rainfall or strong winds were avoided.
    - Large flocks were ideally counted by 3 people: 1 scribing data and 2 counting different species.
    - If birds were unable to be identified they were included as e.g. unidentified small, medium or large waders etc.

Database

All information collected on datasheets in the field was entered into the Shorebirds 2020 and BirdLife Australia Atlas Databases. All data collected was subjected to the standard level of scrutiny and vetting prior to being accepted and entered into these databases. This involves the review of all datasheets and count results from each surveyor by a suitably experienced shorebird survey coordinator who is familiar with the species that frequent the region and their relative historical abundance. Records that are deemed questionable require additional information to be submitted by the surveyor to be accepted by the survey coordinator before they can be entered into either database.

A routine data extraction can be undertaken on an annual basis and forwarded to the Department of Environment and Natural Resources upon request.

Results

Ongoing shorebird count data for the Coorong monitoring surveys is presented in Appendix 1. This data only includes counts from the 4 regions defined in Map Figure 2, to allow direct comparisons between years. Surveys in 2015 were also undertaken at Morella Basin. These counts are present separately later in this report. Appendix 1 also includes previously unpublished results from the last AWSG shorebird survey in 2013.

Whilst the number of different wader species recorded in 2015 is up on the diversity of previous years, counts of individual birds continue to decline. Figure 1 shows the total number of individual birds counted over these survey periods. The linear trend within these counts shows a gradual decline, however there is quite large variation in the annual counts which accounts for the poor fit of the linear trend (R2 =0.11).

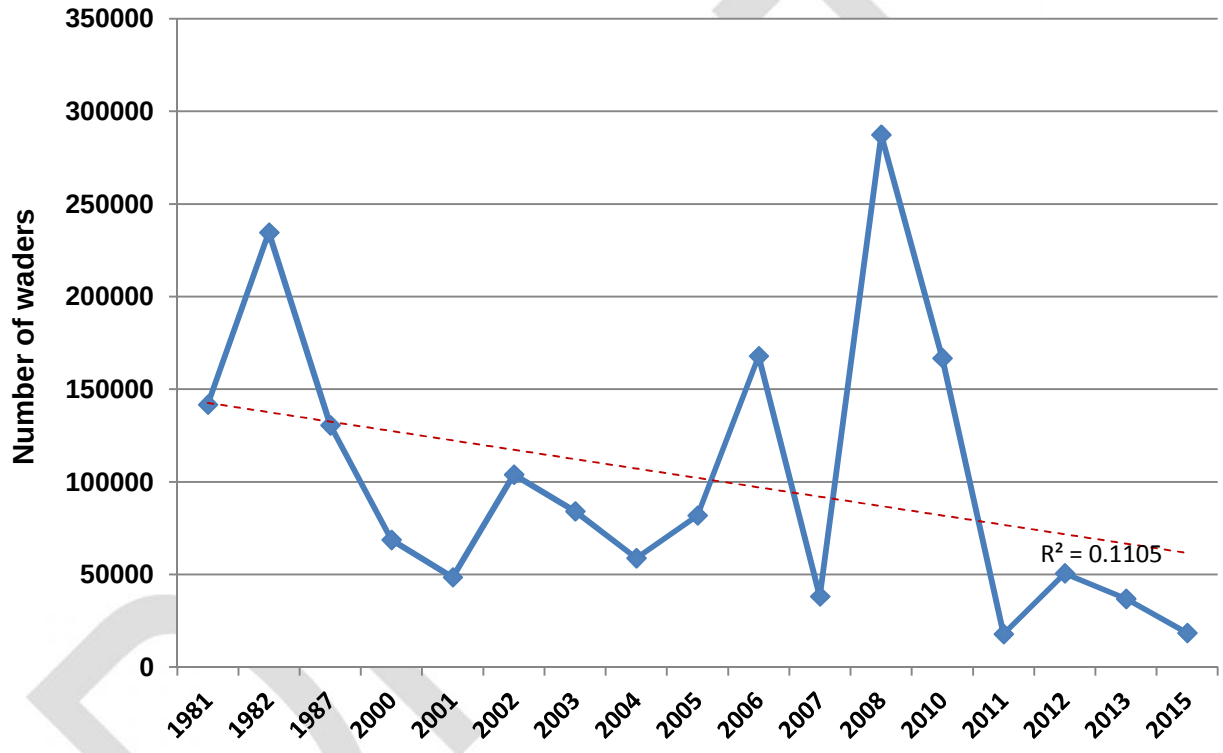
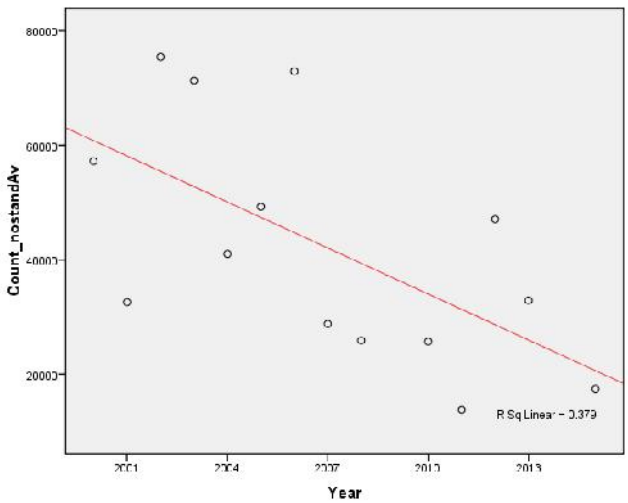


Figure 1 Total wader counts recorded for the Coorong from 1981 to 2015.



Regression analysis of this data (removing Banded Stilt and Red-necked Avocet counts) shows an ongoing decline in counts of other waders between 2000 and 2015 (Figure 2). This linear relationship was found to be statistically significant (table 1).

Figure 2 (left) Scatter plot and linear trend of count data (not including Red-necked Avocets and Banded Stilt) across the Coorong count area from 2000 – 2015.

Table 1 Results of linear regression of total counts of wader species (not including red- necked avocets and banded stilts) across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.092E9	1	2.092E9	7.331	.019[a]
	Residual	3.425E9	12	2.854E8		
	Total	5.517E9	13			

a. Predictors: (Constant), Year

b. Dependent Variable: Count_nostandAv

Shorebird abundance in the Coorong

The total number of waders recorded in the Coorong in 2015 was 18,349. This compares with 17,782 counted in 2011, 50,533 in 2012 and 36,765 in 2013 (Appendix 1). Table 2 shows aggregated figures for the four distinct areas of the Coorong from the south to the north.

Table 2 Wader abundance across the difference regions of the Coorong 2015

	Southern Lagoon	Hells Gate	Northern Lagoon	Northern Channels	Total
Banded Lapwing					
Banded Stilt	250			204	**454**
Bar-tailed Godwit			20	16	**36**
Black winged Stilt		29	9	121	**159**
Black-fronted Plover					
Black-tailed godwit				30	**30**
Common Greenshank	11	10	60	59	**140**
Common Sandpiper	0	1	1	1	**3**
Cox's Sandpiper					
Curlew Sandpiper	735	22	13	3	**773**
Double-banded Plover		8			**8**
Eastern Curlew				4	**4**
Great Knot			7		**7**
Grey Plover					
Hooded Plover	7	0	3		**10**
Lesser Sand Plover					
Marsh Sandpiper					
Masked Lapwing	103	32	77	165	**377**
Oriental Plover					
Pacific Golden Plover					
Pectoral Sandpiper					
Pied Oystercatcher		89	27	124	**240**
Red Knot			10	4	**14**
Red necked Avocet	265	170		1	**436**
Red-capped Plover	561	201	12	78	**852**
Red-kneed Dotterel					

Red-necked Phalarope					
Red-necked Stint	10019	3116	424	1160	**14719**
Ruddy Turnstone					
Ruff					
Sanderling		5			**5**
Sharp-tailed Sandpiper			45	32	**77**
Sooty Oystercatcher				3	**3**
Terek Sandpiper				2	**2**
Total	**11951**	**3683**	**708**	**2007**	**18349**

Figure 3 compares the abundance of Banded Stilt and Red-necked Avocet, with the abundance of all other waders. Both Banded Stilts and Red-necked Avocets are resident species across the Coorong (Wainwright 2012), however the populations of these species will fluctuate with climatic conditions. Both species show coastal movements from inland populations during periods of dry weather (Hayman et al 1986) and the peaks in the numbers of these species tend to correspond with drier inland periods (1982, 2006,2008 and 2010).

Whilst these species fluctuate widely with counts, since 2011 numbers have been very low.

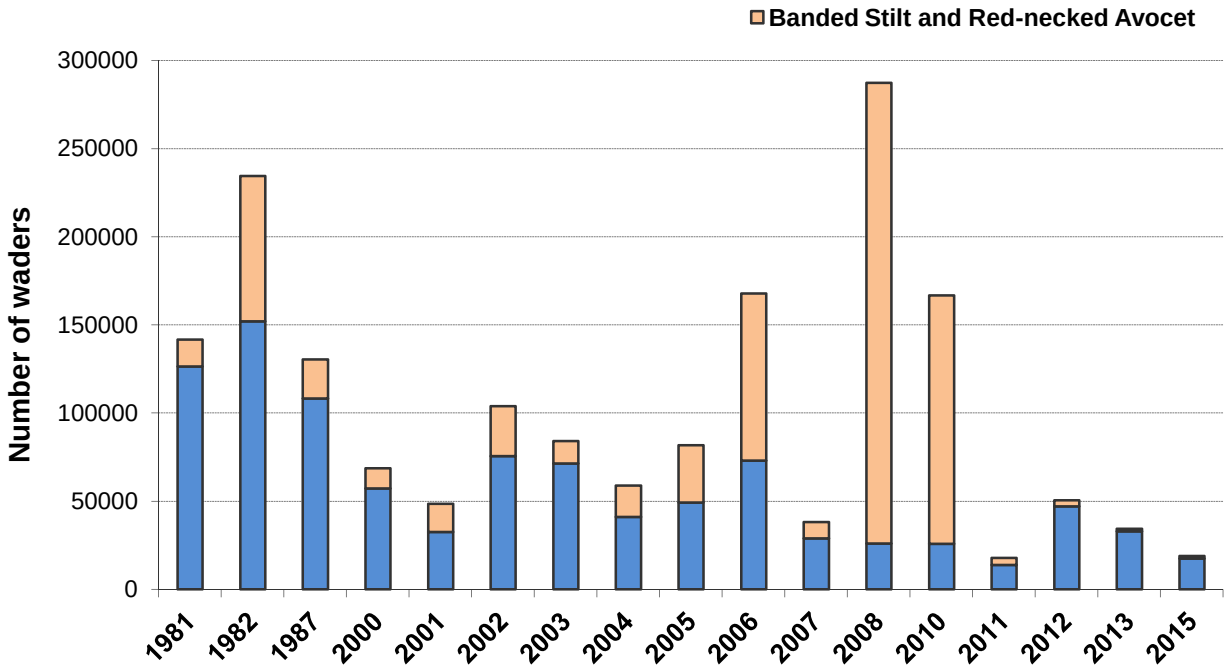


Figure 3 Abundance of Banded Stilt and Red-necked Avocet compared with all other waders (aggregated).

Shorebird distribution in the Coorong

Figure 4 shows the distribution of waders across the Coorong according to count section.

Total abundances vary from year to year, but a few general trends appear in the date. Since 2003 a greater proportion of birds have been counted in the South Lagoon area than earlier periods (other than 2012). North Lagoon seems to fluctuate between years and Northern Channel has been fairly consistent (either side of 20%) except in 2002 and 2003. However, little evidence is available in these figures to determine if large scale shifts in use have occurred between the four survey regions within the wader populations.

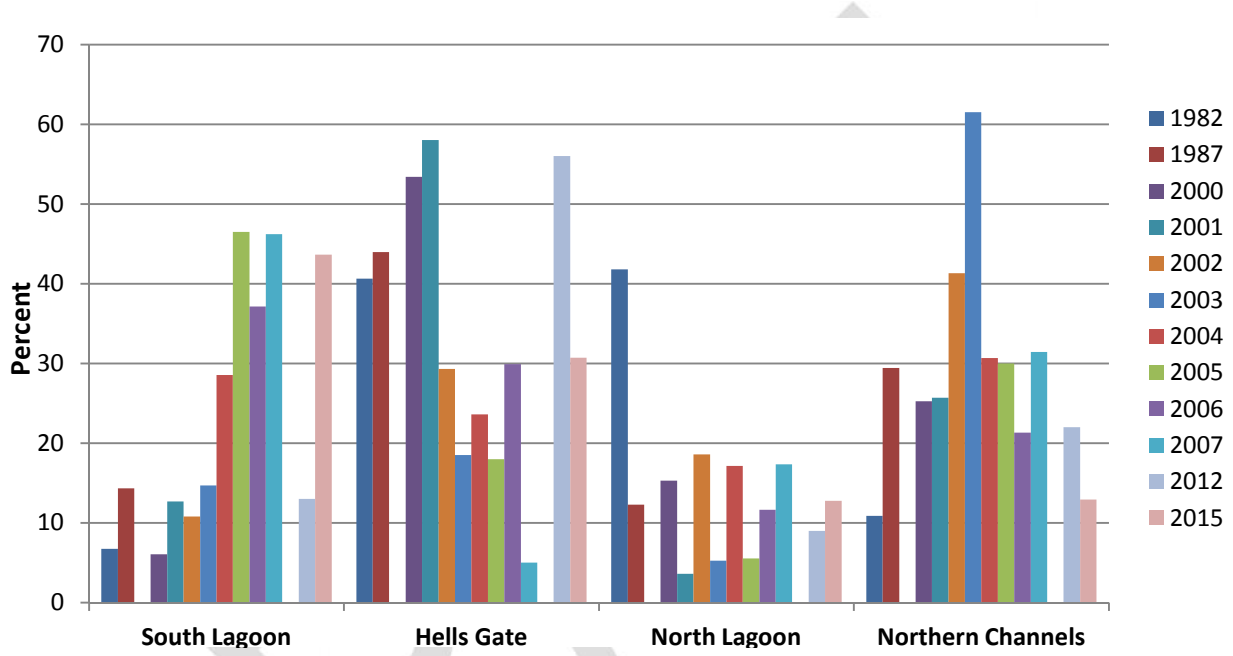


Figure 4 Distribution of all waders across survey areas at the Coorong, from 1982 – 2015. Note spaces between 1980's counts and 2000 counts as well as between 2007 and 2012.

Population changes in individual species

Sanderling

These are normally found on the sandbanks in the vicinity of the Murray Mouth both on the ocean beach and on the lagoon side. In 2012, 20 birds were recorded on the lagoon side while none were seen on the Ocean Beach. This compares with the 131 birds observed during the 2011 count. Sanderling are known to roam along the South Australian beaches and flocks of 500-1000 are regularly observed at Danger Point in the Lower SE (Christie pers. comm). In February 2007 there was approximately 600 Sanderling at Green Point Jeff Campbell pers. com. Only 5 birds were recorded in 2015.

Common Greenshank

Numbers have varied between a maximum of 717 in 1982 and a minimum of 277 in 2001 (Figure 5). There were 252 counted in 2012 mainly roosting in the Northern Channels. Numbers for 2015 were lower again, with 140 birds recorded across the region. Of these 120 were in the Northern Lagoon and Northern Channels.

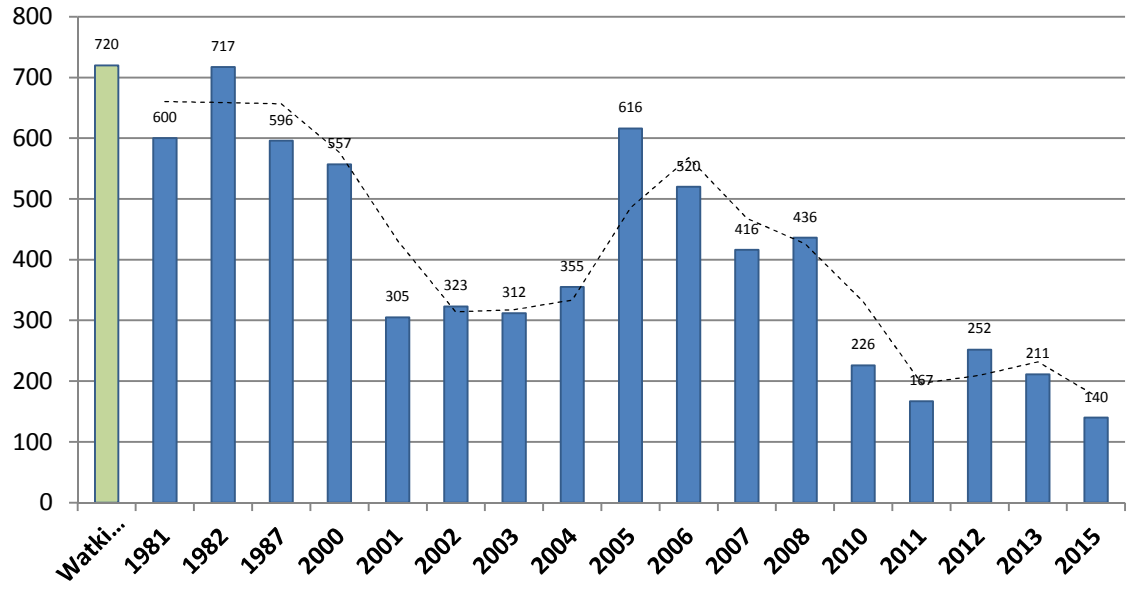


Figure 5 Abundance of Common Greenshank at the Coorong 1981-2015. The broken line shows the moving average between consecutive years.

Sharp-tailed Sandpiper

Sharp-tailed Sandpiper numbers at the Coorong vary significantly through time. Abundances have ranged from 340 to 55,000 in the early 1980's. The 2012 count of 14,222, significantly more than the 342 counted in 2011. Numbers of Sharp-tailed Sandpipers decreased from the 2012 count in 2013 (4292) and again in 2015 (77) (Figure 6). Presence is influenced by the availability of other freshwater environs for feeding. In years when the interior of the Australian continent is wet, numbers at the Coorong are generally low.

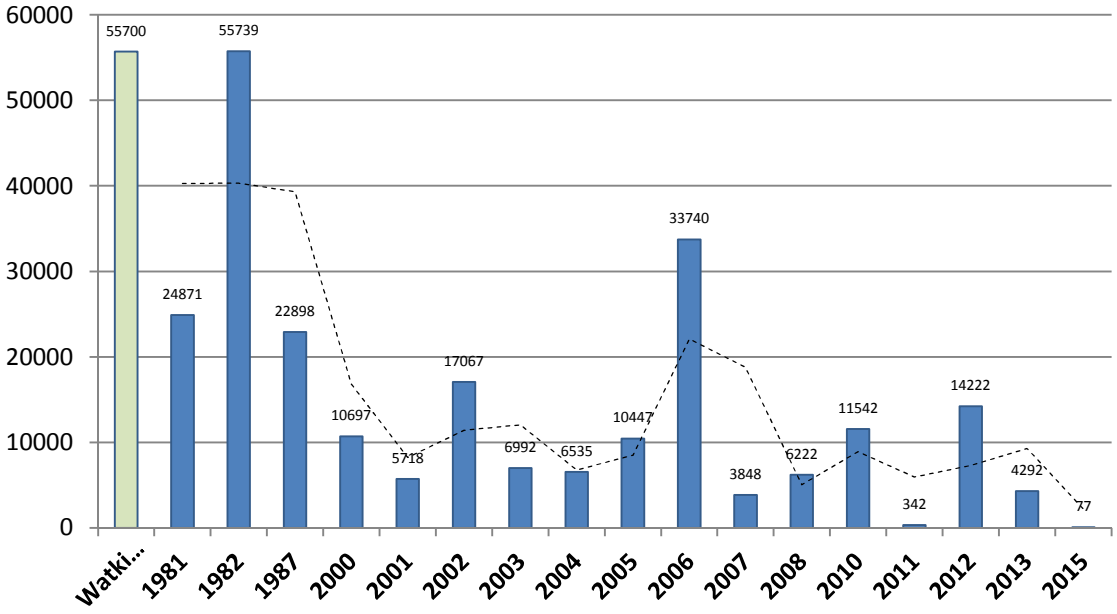


Figure 6 Abundance of Sharp-tailed Sandpiper at the Coorong 1981-2015. The broken line shows the moving average between consecutive years.

Red-necked Stint.

There were about 50,000-60,000 Red-necked Stint in the Coorong in the 1980's. Though showing large fluctuations between years, numbers are generally decreasing (Figure 7).

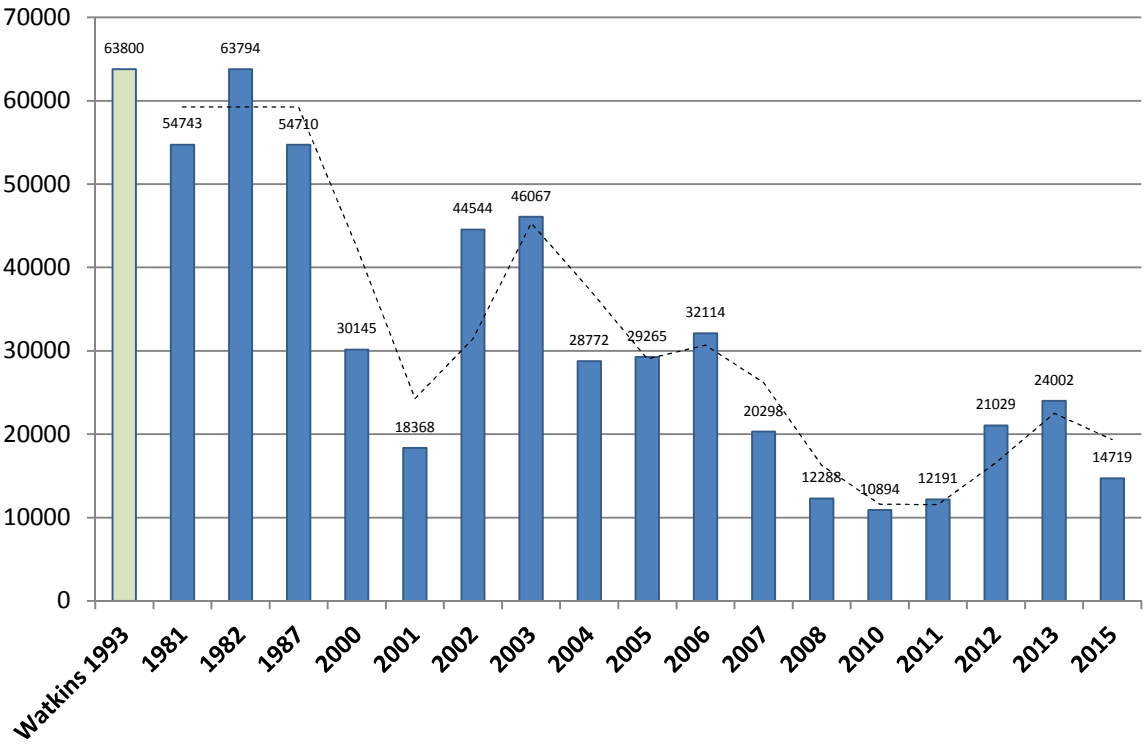


Figure 7 Abundance of Red-necked Stint at the Coorong, 1981- 2015. The broken line shows the moving average between consecutive years.

Curlew Sandpiper.

Curlew Sandpiper have shown a very widespread and large population decline in southern Australia since the 1980s. Gosbell and Clemens (2006) show that there has been a significantly declining trend in this species at a number of sites in Victoria and South Australia. The large fall (up to 95% reduction) in this species in the Coorong is of particular significance and concern. While Gosbell and Clemens (2006) suggest this is due to lower survival rates in migrating birds, in part arising from influences at stopover sites, the impact of local factors in the non breeding areas needs further research.

In the 1980's the Curlew Sandpiper population varied from 22,000 to 40,000, but over time this species has shown a sustained decline in abundance at the Coorong (and at many other sites in southern Australia). In 2012, 806 individuals were observed (Figure 8). This declined to a 200 individuals in 2013, but increased to 773 in 2015. Whilst the 2015 count shows an increase in the counts of this species, compared to historic counts, current numbers are disconcertingly low.

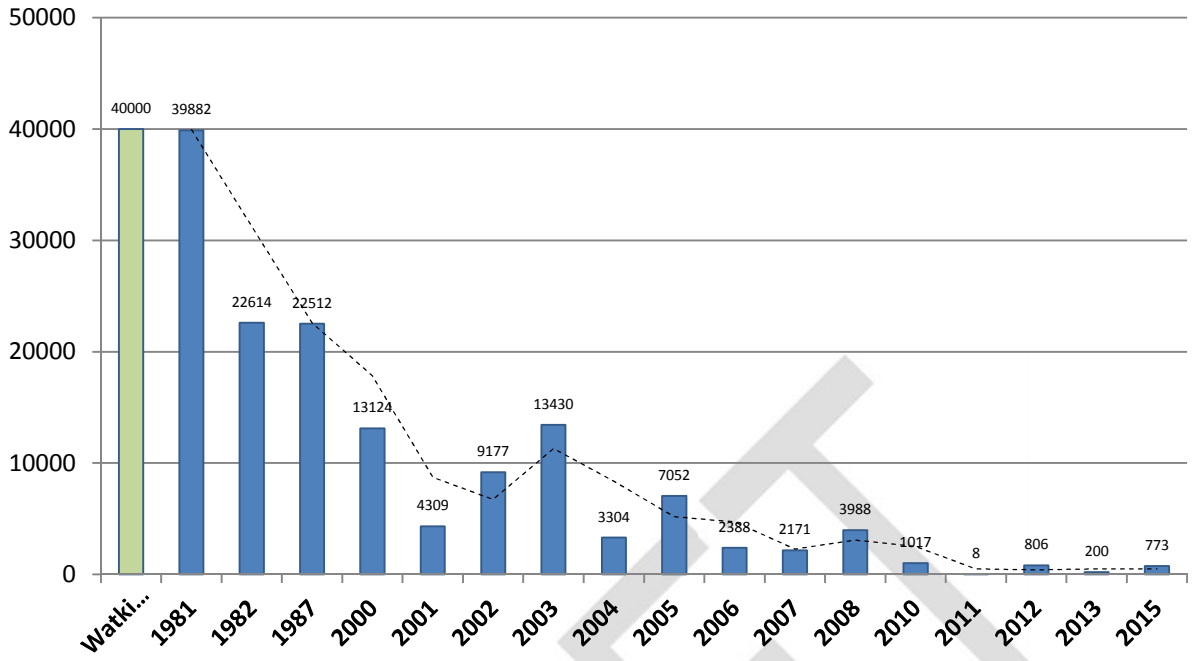


Figure 8 Abundance of Curlew Sandpiper at the Coorong, 1981-2015. The broken line shows the moving average between consecutive years.

Pied Oystercatcher

The numbers of Pied Oystercatchers recorded within the Coorong during these surveys have never been in the league of other wader species. Watkins (1996) tally was 630 individuals and whilst no one count has reached this number, counts have been around the 150 -200 mark. 2012 saw a very low count of 14 birds, however this has climbed back to 240 individuals in 2015.

Black-winged Stilt

The Black-winged Stilt is generally less numerous across the Coorong than the Banded Stilt. Numbers have remained variable, but fairly constant over the survey period.

Banded Stilt

Banded Stilt numbers are highly variable from year to year. There have been two recent peaks in numbers with 261,229 individuals recorded in 2007, and 140 400 in 2010. These numbers are possibly the result of drought conditions inland, pushing individual birds to coastal areas and supplementing the local populations. Inland rainfall in 2010 and the retention of water saw much of this large flock leave the Coorong, and it is believed that many of the birds that left turned up in the breeding colony establish further inland at Lake Torrens. Since these events numbers of Banded Stilt have been substantially lower than pre 2007 counts, indicating a drop in the local population. Wainwright (2012) noted that in 2007 the Banded Stilt was single-handedly exploiting the hyper-saline conditions in the southern lagoon. All Banded Stilt were found in the south lagoon or in the south of the Hells Gate section, reflecting the attractive food resources available in the marine to hyper-marine conditions (Figure 9).

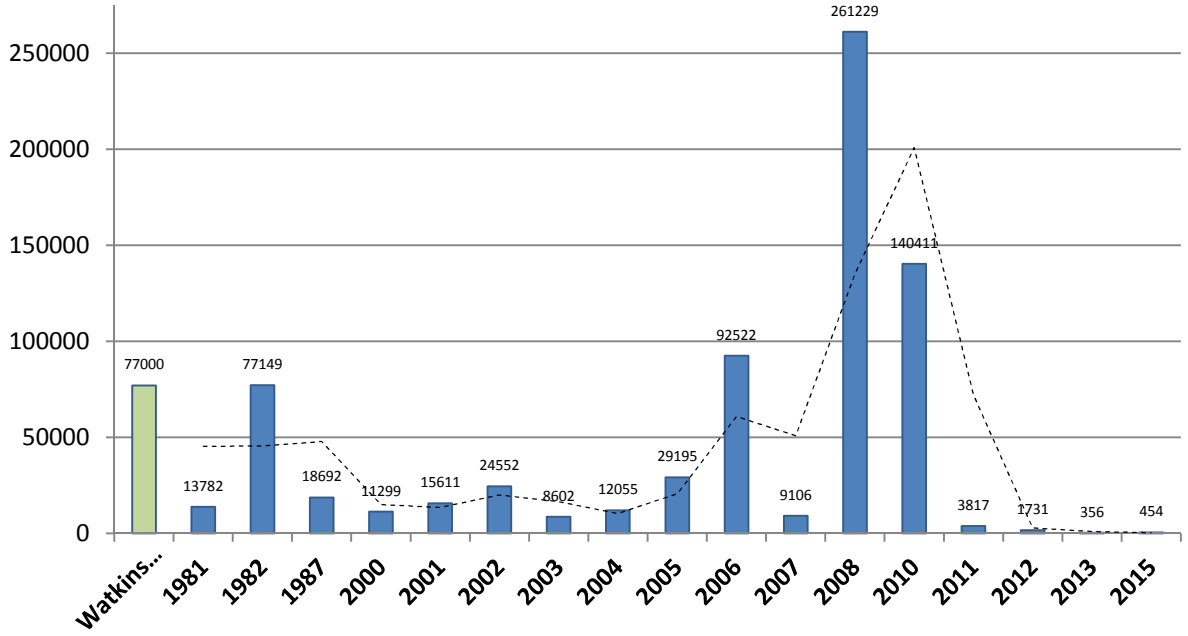


Figure 9 Abundance of Banded Stilt at the Coorong, 1981-2015. The broken line shows the moving average between consecutive years.

Red-necked Avocet.

Red-necked Avocet numbers show high variability between years. Numbers through the mid 2000's were consistent until 2007 where they declined significantly. Increased numbers were counted during 2013, but these have not been sustained (Figure 10).

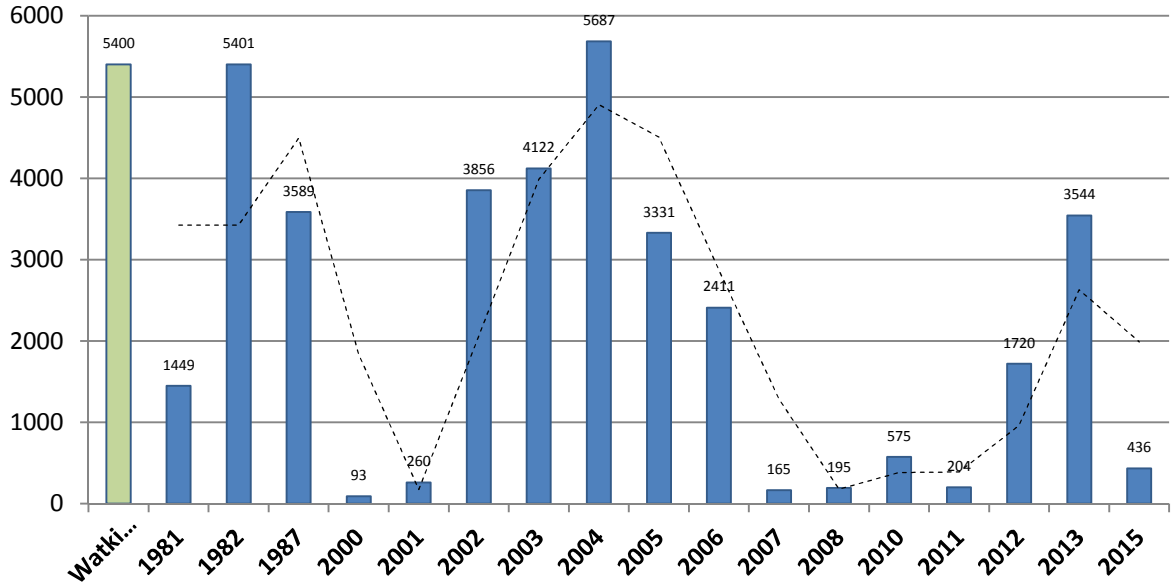


Figure 10 Abundance of Red-necked Avocets at the Coorong, 1981-2015. The broken line shows the moving average between consecutive years.

Red-capped Plover.

Red-capped plover numbers show reasonable stability at the Coorong. This species has historically showed a preference for the areas south of Parnka Point where there are usually extensive areas of dry mud-salt being exposed. In 2012 60% of the population was observed on sand flats in the Hells Gate section; 30 % were observed in the south lagoon (Wainwright 2012) (Figure 11).

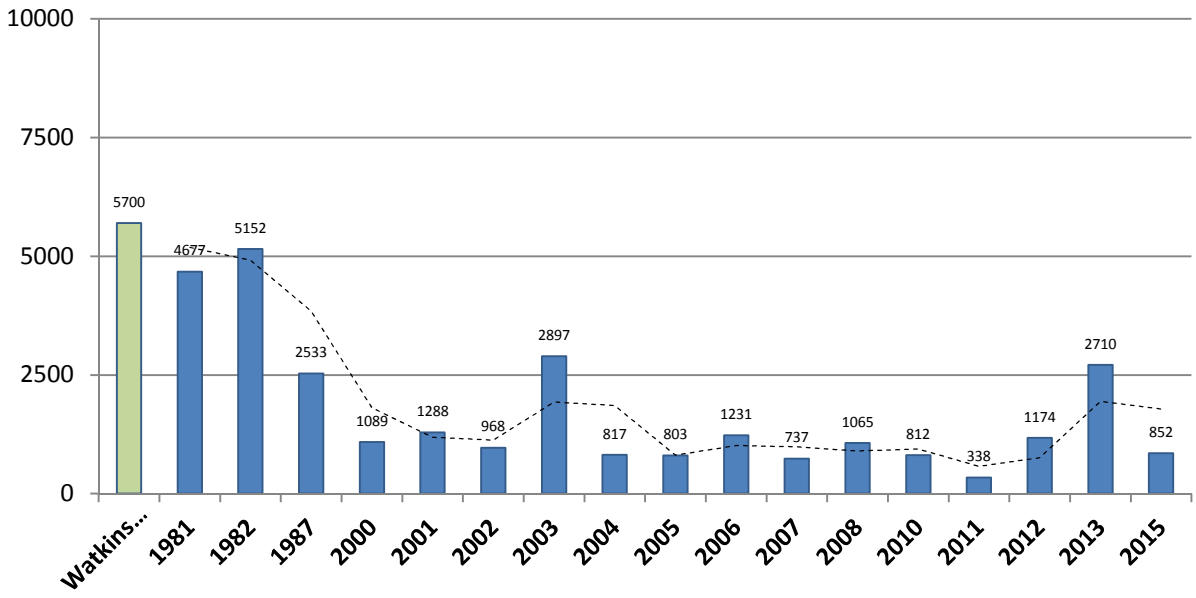


Figure 11 Abundance of Red-capped Plover at the Coorong, 1981-2015. The broken line shows the moving average between consecutive years.

Masked Lapwing

The number recorded in 2012 was 345. This species shows reasonable stability in population size at the Coorong. Similar numbers were recorded in 2013 and 2015. The maximum number recorded was 863 in 1982.

Statistical Analysis

The above seven species with graphs presented above were run through a linear regression to determine if trends were statistically significant. Data was run from 2000 – 2015 with missing survey years (2009 and 2014) included as missing data. For Banded Stilts, Red-capped Plovers and Sharp-tailed Sandpipers outlying counts were removed from the regression analyses to normalize data.

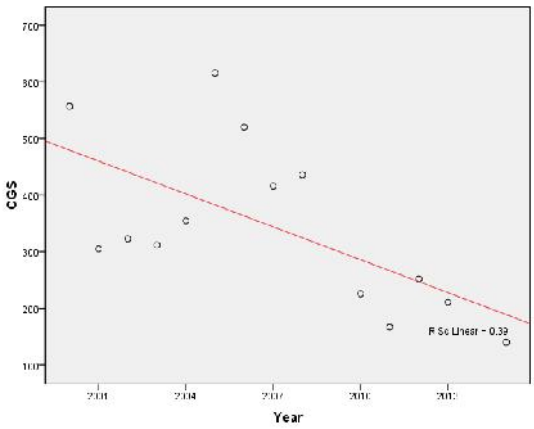


Figure 12 Scatter plot and linear trend of count data Common Greenshank across the Coorong count area from 2000 – 2015.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	109166.539	1	109166.539	7.665	.017[a]
	Residual	170910.889	12	14242.574		
	Total	280077.429	13			

a. Predictors: (Constant), Year

b. Dependent Variable: CGS

Table 3 (above) results of linear regression of Common Greenshank counts across the Coorong between 2000 – 2015.

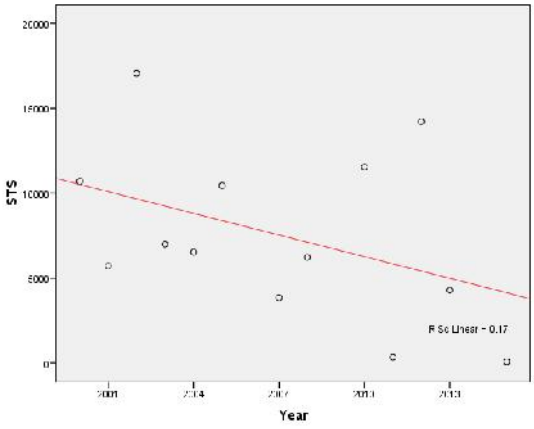


Figure 13 Scatter plot and linear trend of count data Sharp-tailed Sandpiper across the Coorong count area from 2000 – 2015.

Table 4 (below) results of linear regression of Sharp-tailed Sandpiper counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.242E7	1	5.242E7	2.257	.161[a]
	Residual	2.555E8	11	2.323E7		
	Total	3.079E8	12			

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5.242E7	1	5.242E7	2.257	.161[a]
	Residual	2.555E8	11	2.323E7		
	Total	3.079E8	12			

a. Predictors: (Constant), Year b. Dependent variable: STS

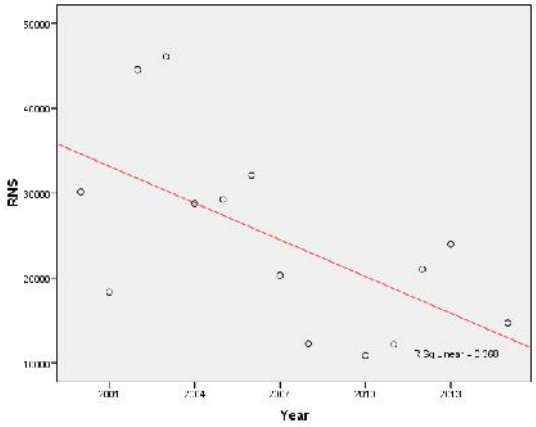


Figure 14 Scatter plot and linear trend of count data Red-necked Stint across the Coorong count area from 2000 – 2015.

Table 5 (below) Results of linear regression of Red-necked Stint counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	6.061E8	1	6.061E8	6.990	**.021**[a]
	Residual	1.040E9	12	8.670E7		
	Total	1.646E9	13			

a. Predictors: (Constant), Year

b. Dependent Variable: RNS

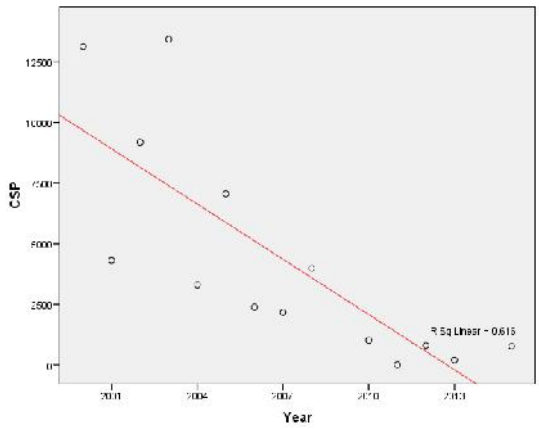


Figure 15 Scatter plot and linear trend of count data Curlew Sandpiper across the Coorong count area from 2000 – 2015.

Table 6 (below) Results of linear regression of Curlew Sandpiper counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.676E8	1	1.676E8	19.210	**.001**[a]
	Residual	1.047E8	12	8726053.449		
	Total	2.723E8	13			

a. Predictors: (Constant), Year; b. Dependent Variable: CSP

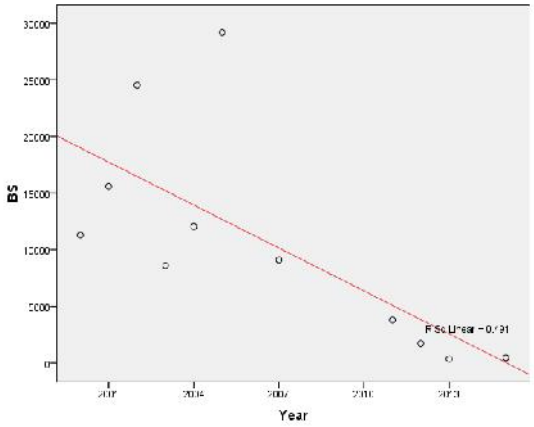


Figure 16 Scatter plot and linear trend of count data Banded Stilt across the Coorong count area from 2000 – 2015.

Table 7 Results of linear regression of Banded Stilt counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.457E8	1	4.457E8	8.695	.016[a]
	Residual	4.613E8	9	5.125E7		
	Total	9.069E8	10			

a. Predictors: (Constant), Year

b. Dependent Variable: BS

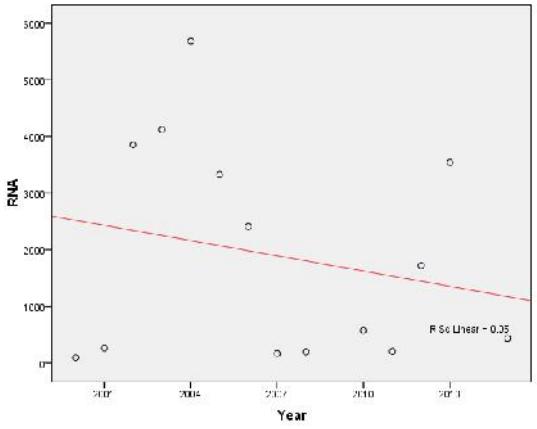


Figure 17 Scatter plot and linear trend of count data Red-necked Avocet across the Coorong count area from 2000 – 2015.

Table 8 Results of linear regression of Red-necked Avocet counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2346003.192	1	2346003.192	.633	.442[a]
	Residual	4.445E7	12	3704169.978		
	Total	4.680E7	13			

a. Predictors: (Constant), Year

b. Dependent Variable: RNA

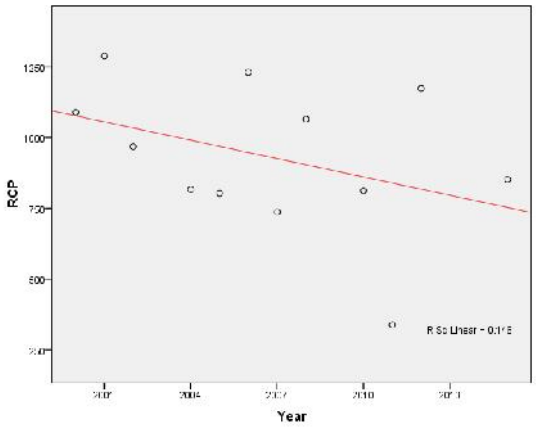


Figure 18 Scatter plot and linear trend of count data Red-capped Plover across the Coorong count area from 2000 – 2015.

Table 9 (below): Results of linear regression of Red-capped Plover counts across the Coorong between 2000 – 2015.

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	111170.880	1	111170.880	1.714	.220[a]
	Residual	648682.786	10	64868.279		
	Total	759853.667	11			

a. Predictors: (Constant), Year

b. Dependent Variable: RCP

For all seven species, linear trends from 2000 to 2015 show a decline in the counts, however for Red-necked Avocets, Sharp-tailed Sandpipers and Red-capped Plovers, these linear trends are a poor fit to the data (R2 values of 0.05, 0.17 and 0.146 respectively) and are not statistically significant. Counts of these species are highly variable and no conclusions can be made about long term count trends.

The remaining four species (Common Greenshank, Curlew Sandpiper, Banded Stilt and Red-necked Stint) all show statistically significant linear trends, with total survey counts declining over the last 15years.

Morella Basin

Surveys were also undertaken at Morella Basin in 2015.

Morella Basin sits to the east of South Lagoon. Surface water in this area is collected via a network of channels and drains and diverted into Morella Basin for storage. Water held in the basin is then released into South Lagoon via Salt Creek. Counts from the Morella basin have been undertaken erratically in previous years. Wainright and Christie (2008) provide a summary of these counts (see figure 21 which is Table 4 from Wainwright and Christie 2008).

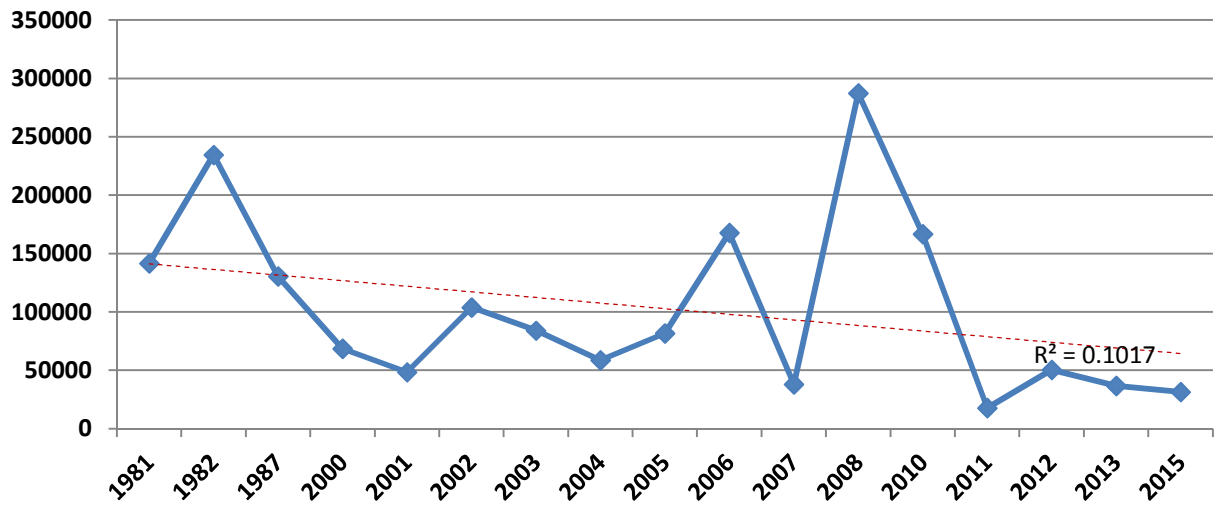
In 2015 Morella Basin was surveyed by a team of two observers.

Table 10 Morella Basin shorebird numbers, extracted from Wainwright and Christie 2008

Year / Species	2/02/2001	2/02/2002	10/02/2003	2/02/2004	24/01/2005	6/02/2006	7/02/2007	5/11/2007	6/03/2015
Marsh Sandpiper			8		2				
Common Greenshank	28	n/c	10	7	23	37	12	9	
Ruddy Turnstone		n/c							
Red Knot									
Red-necked Stint	151		546		1351	60	184	3	12390
Sharp-tailed Sandpiper	565	600	185	41	1240	3345	1	10	12
Curlew Sandpiper	2		16						993
Black-winged Stilt	190	60	2			1		46	
Banded Stilt	337	8000	110	150	10	28			480
Red-necked Avocet	3						8		1
Red-capped Plover	29		41	5	85	2	100	3	143
Black-fronted Dotterel			2						
Red-kneed Dotterel	3	2	10	12	3			19	
Banded Lapwing	9								
Masked Lapwing	50	30	29		7	14	10	34	24
Unidentified Small Wader	182	2000							
Total	**1549**	**10692**	**959**	**215**	**2721**	**3487**	**315**	**124**	**14043**

Table 10 provides count data for this area. Very high numbers of red-necked Stint were recorded in Morella Basin in 2015, effectively doubling the numbers of this species in the Coorong area during the wader surveys. Figure 22 shows full wader counts for all years with the Morella Basin birds included for 2015. Total counts for 2015 are still well below historic levels.

Figure 22 Total wader counts recorded for the Coorong including Morella Basin data from 1981 to 2015.



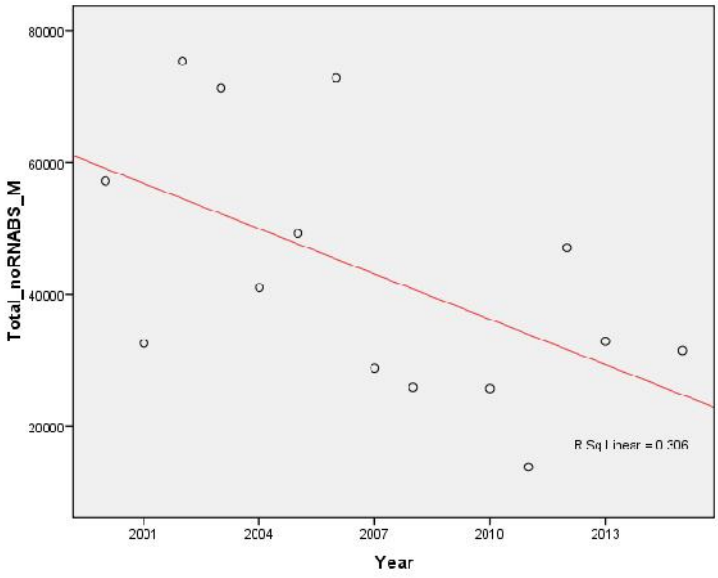


Figure 23 Scatter plot and linear trend of count data for all waders (not including Red-necked Avocets and Banded Stily) across the Coorong and Morella Basin count area from 2000 – 2015.

Table 12 (below) Results of linear regression of all wader counts across the Coorong and Morella Basin between 2000 – 2015

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.530E9	1	1.530E9	5.282	.040[a]
	Residual	3.476E9	12	2.896E8		
	Total	5.005E9	13			

a. Predictors: (Constant), Year

b. Dependent Variable: Total_noRNABS_M

Regression analyses were re-run to incorporate the Morella Basin data into the models. Total numbers of waders still show a significant decline on counts over the past 15 years (Figure 23, Table 12)

Significant linear trends remain for three of the four species above except the Red-necked Stint. The addition of the Morella Basin data lifts the 2015 count and whilst a decline in the total counts is still shown, the linear fit is no longer statistically significant (p=0.084, Figure 24).

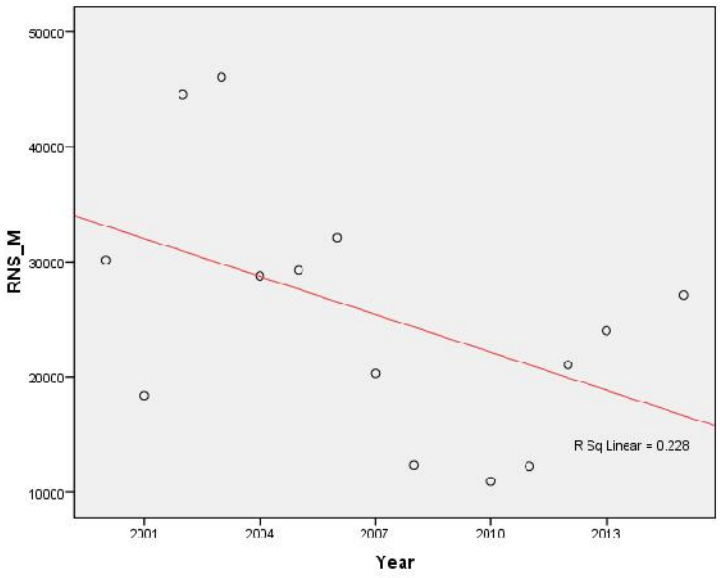


Figure 24 Scatter plot and linear trend of count data Red-necked Stint across the Coorong and Morella Basin area from 2000 – 2015.

Table 13 Results of linear regression of Red-necked Stint counts across the Coorong and Morella Basin 2000 – 2015.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.518E8	1	3.518E8	3.542	.084[a]
	Residual	1.192E9	12	9.932E7		
	Total	1.544E9	13			

a. Predictors: (Constant), Year

b. Dependent Variable: RNS_M

Discussion

Wainwright (2012) provides a good overview on the survey methodology and biases that may be encountered during these counts. Rather than re-hash this information the discussion for this report will focus on the new information provided in the current report.

The Coorong and Coorong National Park is considered an internationally important area for wader species. Watkins (1993) identified nine species that had counts reach the 1% criteria defined by the Ramsar convention. Bamford et al (2008) identify four species of migratory waders that reach the 1% population criteria. In 2012 5 species met this 1% criterion. The current survey found 1 species meeting the 1% criterion – Red-necked Stint. This did not include the count of birds at Morella Basin.

This ongoing decline in total shorebird numbers across the Coorong is well recognised (Wainright and Christie 2008, Paton et al 2009; Paton and Bailey 2012; Wainwright 2012), and whilst individual species may show increases in counts between years the overall trend is downward. Clemens et al (in press) found that on average the Coorong is one of four areas across Australia that is losing more species of waders at a faster rate than other locations across the country. The 2015 surveys confirm that this general decline is ongoing. Whilst post 2009/10 numbers have generally been higher than drought counts, they have not returned to levels seen at the beginning of the century. Paton and Bailey (2012) suggest that whilst a time lag may contribute for the slow recovery of bird counts across the Coorong, factors outside of the region will also play a role, such as available habitat at other sites. Water levels and areas of exposed mud flats, salinity levels and prey items all influence the suitability of the environment to support high numbers of shorebirds. For migratory waders, the impacts of activities along their migratory routes are well documented and are likely to contribute to the decreasing numbers of shorebirds recorded in the Coorong.

The linear regressions performed here show that three species have significantly declined in their counts over the past 15 years. Paton and Bailey (2012) note the historically low abundance of the Common Greenshank. Looking at the numbers counted during the AWSG surveys, the counts of the species have reduced to around a third of the numbers being counted at the beginning of the 15 year period. Since 2010, numbers have been much lower than historically encountered though the species was never as abundant as other waders. The Common Greenshank is a species that is generally considered under-sampled in surveys across its non-breeding range (Bamford et al 2008). This is because the species is naturally widespread and at generally found in low densities. Accounting for this Clemens et al (in press) identified a decline in this species from north to south and west to east; that is numbers of the Common Greenshank counted in the south-east of the non-breeding range are showing greater declines

than in other areas of Australia. This trend seems to be consistent with the counts in the Coorong.

Declines in the counts of Curlew Sandpiper are not unexpected. This species is of major concern in Australia and is now listed as being critically endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). Numbers have drastically declined across their non-breeding distribution, and in the Coorong the counts have declined by ~95% over the past 15 years. However, according to the count data, it appears that the rate of decline in the species may have decreased in the past 5 years, owing to several consecutive years of good breeding success.

The reduction in the numbers of Banded Stilts (after removing the outliers) may be driven by factors outside of the condition of the Coorong itself. In 2008 and again in 2010 large numbers of these birds were present in the area. These increased flocks would have absorbed any resident individuals present at the Coorong at the time of these influxes. When conditions became conducive to breeding inland, the large flocks, plus any local individuals would have moved, possibly explaining the major decline in numbers between 2010 and 2011. Numbers have continued to decrease post this mass migration away from the site.

Red-necked Stints are the most abundant wader encountered across the Coorong (Paton et al 2009). This has been the trend since surveying of waders began in 1981, other than two counts in 2006 and 2010 where Sharp-tailed Sandpipers out-numbered the stints. The 2015 counts found numbers of Red-necked Stint in the actual Coorong lower than the 2012 and 2013 counts. Wainwright (2012) noted that this species had rebounded somewhat post the 2009 crisis point. Paton and Bailey (2012) also noted an increase in the numbers of Red-necked Stint post drought conditions, but as seen here these numbers fail to reach the same levels as pre-drought counts.

The large numbers of Red-necked Stints recorded at Morella Basin in 2015, almost doubling the overall count of this species, highlights the importance of other locations around the Coorong, and the need to monitor and consider these areas in the ongoing management of the region. Whilst these counts lift the 2015 count of Red-necked Stint to numbers comparable to the last few years, they are still far short of records from the 1980s and pre drought 2000's.

Wader numbers continue to decline in the Coorong. The causes are a complex interaction of local conditions and external factors, many of which are outside of our ability to manage. Due to the documented international importance of the Coorong for shorebirds, ongoing surveys should be undertaken on at least a biannual basis, to be able to continue to monitor trends in shorebird numbers, and also the health of the Coorong ecosystem.

References

Bamford, M., Watkins, D., Bancroft, W., Tischler, G., and Wahl, J. (2008). Migratory shorebirds of the East Asian-Australasian flyway; population estimates and internationally important sites. Wetlands International - Oceania. Canberra, Australia.

Clemens, R. S., Rogers, D., Hansen, B. D., Gosbell, K., Minton, C., Straw, P., Bamford, M., Woehler, E. J., Milton, D., Weston, M., Venables, B., Weller, D., Hassell, C., Rutherford, B., Onton, K., Herrod, A/., Studds, C. E., Choi, C-Y., Dhanjal – Adams, K., Skilleter, G. and Fuller, R. (in prep). Local changes in the shorebird abundances in Australia driven largely by external factors.

DEH (2010). Securing the future. A longterm plan for the Coorong, Lower Lakes and Murray Mouth. Department for Environment and Heritage, Adelaide, South Australia.

Gosbell, K. and Christie, M. (2005). Wader Surveys in the Coorong and South East Coastal Lakes, February 2005. Australian Wader Studies Group Report April, 2005.

Gosbell, K. and Christie, M. (2006). Wader Surveys in the Coorong and South East Coastal Lakes, February 2006. Australian Wader Studies Group Report May 2006

Gosbell, K. and Christie, M. (2007). Wader Surveys in the Coorong and South East Coastal Lakes, February 2007. Australian Wader Studies Group Report April, 2007.

Gosbell, K., Collins, P., and Christie, M. (2002). Wader Surveys in the Coorong and South East Coastal Lakes, February 2002. Australian Wader Studies Group Report April.

Gosbell, K., Collins, P., and Christie, M. (2003). Wader Surveys in the Coorong and South East Coastal Lakes, February 2003. Australian Wader Studies Group Report April, 2003.

Gosbell, K., Collins, P. and Christie. M. **(**2004). Wader Surveys in the Coorong and South East Coastal Lakes, January–February 2004. Australian Wader Studies Group Report April, 2004.

Hayman, P., Marchant, J. and Prater, T. (1986).*Shorebirds. An identification guide to waders of the world*. Croom Helm, Sydney.

Jaensch, R.P. and Barter, M. (1988). Waders in the Coorong, South Australia, in February 1987. RAOU Report No. 39, 1988.

Kingsford, R., Walker, K., Lester, R., Young, W., Fairweather, P., Sammut, J., and Geddes, M. (2011). A Ramsar wetland in crisis – the Coorong, Lower Lakes and Murray Mouth, Australia. *Marine and Freshwater Research* **62**, pp 255–265.

Paton, D. C. and Bailey, C. P. (2012). Condition Monitoring of the Lower Lakes, Coorong and Murray Mouth Icon Site: Waterbirds using the Coorong and Murray Estuary 2012. Report for Department of Water, South Australia and Murray – Darling Basin Authority.

Paton, D. C., Rogers, D. J., Hill, B. M., Bailey C. P. and Ziembicki, M. (2009). Temporal changes to spatially stratified waterbird communities of the Coorong, South Australia: implications for the management of heterogenous wetlands. *Animal Conservation*, **12,** pp 408–417.

Phillips, W. and Muller, K. 2006. Ecological Character of the Coorong, Lakes Alexandrina and Albert Wetland of International Importance. South Australian Department for Environment and Heritage.

Wainwright, P. (2012). Coorong Wader Census, February 2012. Australian Wader Studies Group report February 2012.

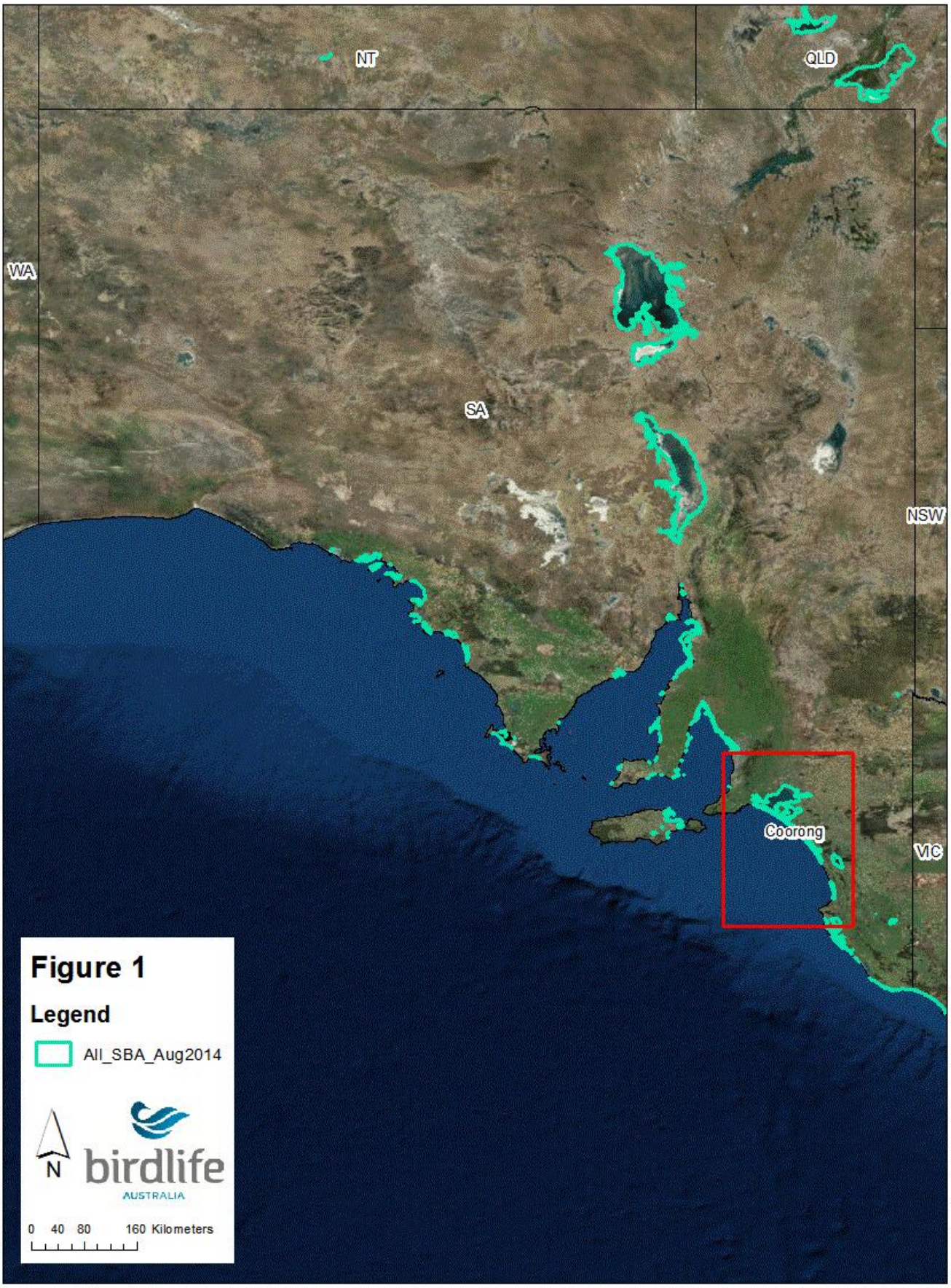
Wainwright, P. and Christie, M. (2008) Wader Surveys at The Coorong and South East Coastal Lakes, South Australia, February 2008. *The Stilt,* **54***,* pp 31-41.

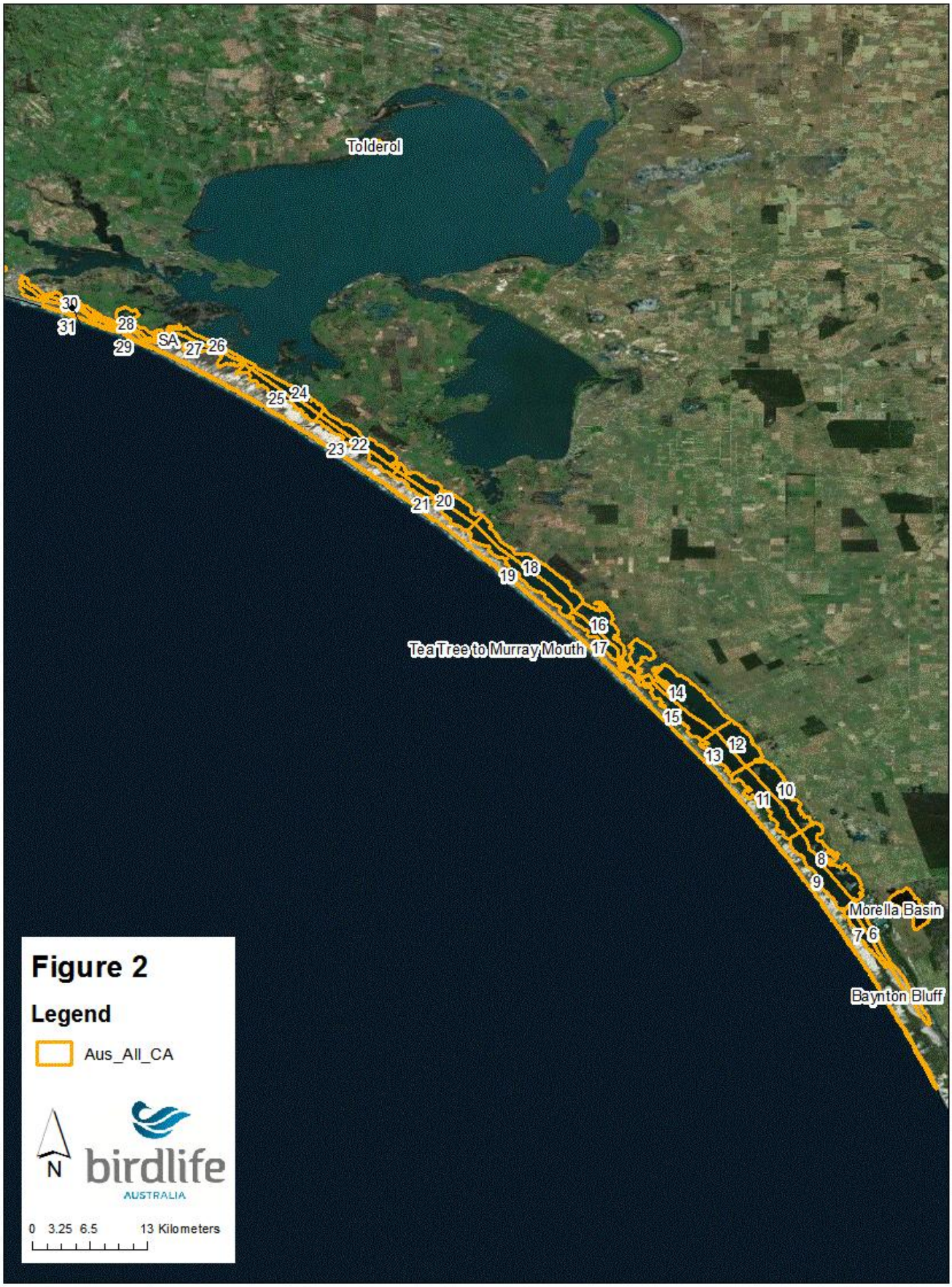
Watkins, D. A national plan for shorebird conservation in Australia. RAOU Report No. 90, 1993.

Wilson, J.R. 2000. South Australia Wader Surveys. January and February 2000. AWSG report.

Wilson, J.R. 2001. Wader Surveys in the Coorong. January and February 2001. AWSG Report.

Map Figures


NT
QLD
WA
SA
NSW
Coorong
VIC
Figure 1
Legend
All_SBA_Aug2014
N
birdlife
AUSTRALIA
0 40 80 160 Kilometers


Tolderol
30
31
28
29
SA
27
26
25
24
23
22
21
20
19
18
16
17
Tea Tree to Murray Mouth
14
15
12
13
10
11
8
9
Morella Basin
7
6
Baynton Bluff
Figure 2
Legend
Aus_All_CA
N
birdlife
AUSTRALIA
0 3.25 6.5 13 Kilometers

Appendices

Appendix 1

Table 1 Total counts of waders	Watkins 1993	1981	1982	1987	2000	2001	2002	2003	2004	2005	2006	2007	2008	2010	2011	2012	2013	2015	2015 (inc. Morella Basin)
Black-tailed Godwit	150	133	185	105	210	115		21	98		5	99	2	11				30	30
Bar-tailed Godwit	25	15		3	8			20	5	58	116	21	150	58	37	11	81	36	36
Eastern Curlew	24	17	24	8	15	16	2	2	13	15	23	29	10	17	2	6		4	4
Marsh Sandpiper	30		2	30			68	1	2	1	9	3	4		1		1		
Common Greenshank	720	600	717	596	557	305	323	312	355	616	520	416	436	226	167	252	211	140	140
Terek Sandpiper							1						1					2	2
Common Sandpiper	5	13	1	1		1		2			8	2						3	3
Ruddy Turnstone			1		1						3								
Great Knot	5	3	4		1						1		1					7	7
Red Knot	100	57	67		80		30		12		1							14	14
Sanderling	930	113	929	308	512	53	10	120	165	235	173	16	131	147	99	20		5	5
Sharp-tailed Sandpiper	55700	24871	55739	22898	10697	5718	17067	6992	6535	10447	33740	3848	6222	11542	342	14222	4292	77	89
Pectoral Sandpiper			1																
Red-necked Stint	63800	54743	63794	54710	30145	18368	44544	46067	28772	29265	32114	20298	12288	10894	12191	21029	24002	14719	27109
Curlew Sandpiper	40000	39882	22614	22512	13124	4309	9177	13430	3304	7052	2388	2171	3988	1017	8	806	200	773	1766
Cox's Sandpiper				1															
Pied Oystercatcher	630	108	297	84	92	9	208	149	255	58	258	200	77	134	152	14	95	240	240
Sooty Oystercatcher	18			3	3	3	24			12	19	5	4	2		1	6	3	3
Black-winged Stilt	600	238	991	291	340	183	712	282	238	180	399	132	700	148	27	345	603	159	159
Banded Stilt	77000	13782	77149	18692	11299	15611	24552	8602	12055	29195	92522	9106	261229	140411	3817	1731	356	454	934
Red-necked Avocet	5400	1449	5401	3589	93	260	3856	4122	5687	3331	2411	165	195	575	204	1720	3544	436	437
Pacific Golden Plover	290	289	230	144	84	103	43	43	30	91	256	50	34	89	18	10	30		
Grey Plover		1			12		2	3	1	11	5		1	11	1				
Red-capped Plover	5700	4677	5152	2533	1089	1288	968	2897	817	803	1231	737	1065	812	338	1174	2710	852	995
Double-banded Plover	150			1				1										8	8
Black-fronted Plover	15		2					1											
Lesser Sand Plover							2						1						
Hooded Plover				12	3	4	12	7	8	15	23	6	21	20	13		7	10	10
Red-kneed Dotterel	10	14	17				1	3	18	9	4		2	9			119		
Oriental Plover		18																	
Banded Lapwing	150		248	130								18				108			
Ruff					1														
Masked Lapwing	800	591	978	765	233	355	337	423	284	328	540	512	348	467	333	345	392	377	377
Red-necked Phalarope				3								2							
Unidentified medium												20	20	73		4744	60		
Unidentified small				3064		1724	1912	539	103	55	1103	200	383	21	32	3990	56		
TOTAL	**252252**	**141614**	**234543**	**130483**	**68599**	**48425**	**103851**	**84039**	**58757**	**81777**	**167872**	**38056**	**287313**	**166684**	**17782**	**50533**	**36765**	**18349**	**32368**
Band Stilt+RN Avocet	82400	15231	82550	22281	11392	15871	28408	12724	17742	32526	94933	9271	261424	140986	4021	3451	3900	890	1371

TOTAL less BS+RNA	169852	126383	151993	108202	57207	32554	75443	71315	41015	49251	72939	28785	25889	25698	13761	47082	32865	17459	30997
Total Species Count		**21**	**23**	**23**	**22**	**17**	**21**	**22**	**20**	**19**	**24**	**21**	**23**	**19**	**17**	**16**	**16**	**21**	**21**