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

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

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

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

INTRODUCTION

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

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

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

METHODS

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

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

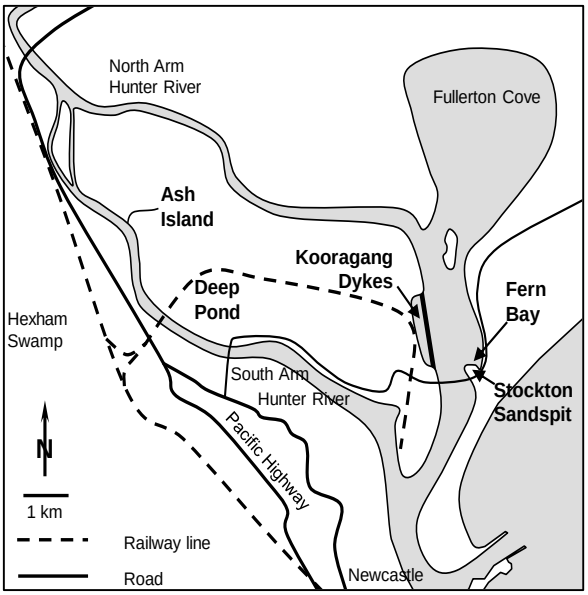

Figure 1. Main shorebird survey sites in the Hunter Estuary (reproduced from Stuart *et al.* 2013).

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

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

RESULTS

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

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

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

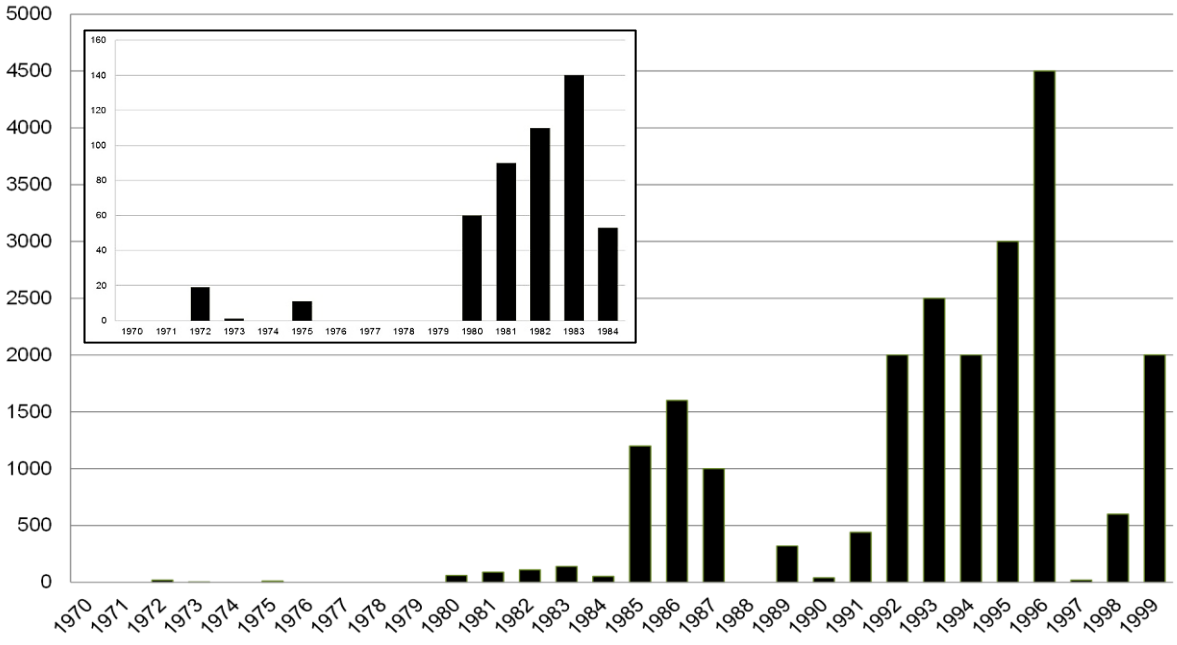

Figure 3. Red-necked Avocet opportunistic counts in the Hunter Estuary 1970-1999. Inset: 1970-1984 data in expanded view (sourced from van Gessell & Kendall 2015, the NSW annual bird report series 1972-1999 e.g. Lindsey 1981 and the Hunter Region bird report series 1993-1999 e.g. Stuart 2000).

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

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

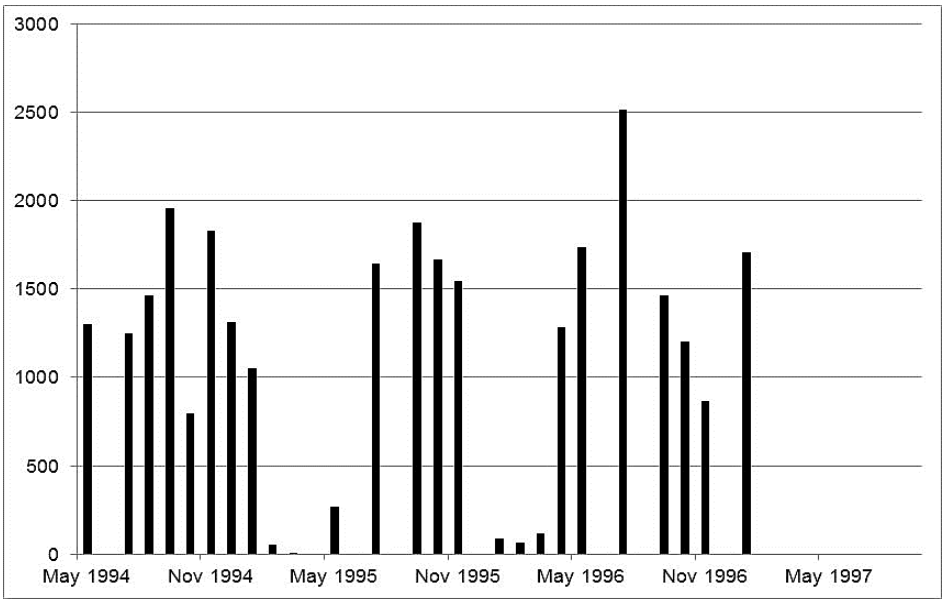

Figure 4. Red-necked Avocet numbers from systematic counts in the Hunter Estuary May 1994 to September 1997 (sourced from Kingsford *et al.* 1998).

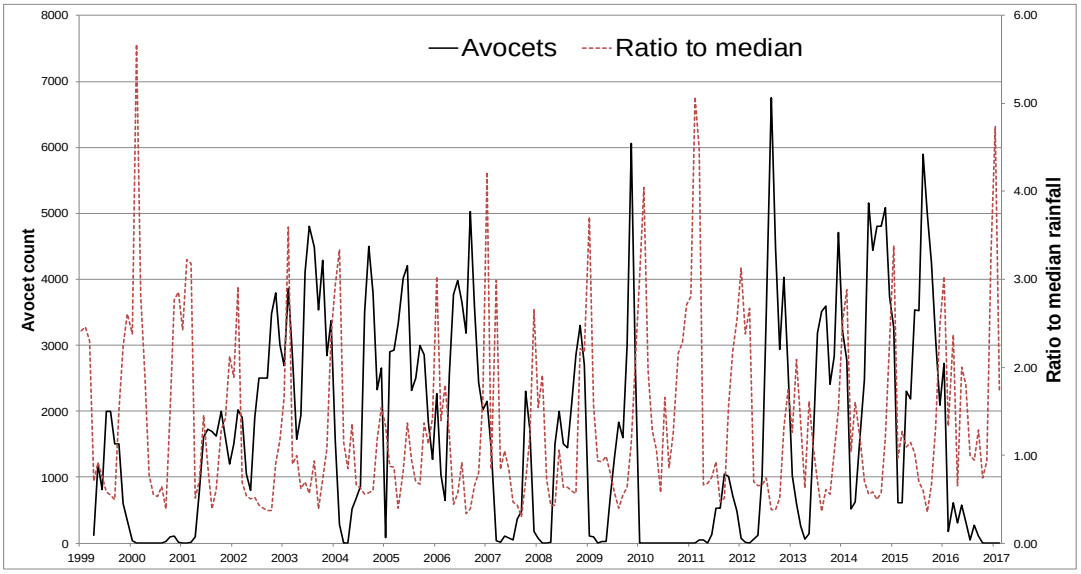

Figure 5. Red-necked Avocet numbers from monthly counts in the Hunter Estuary April 1999 to March 2017 *(sourced from Hunter Bird Observers Club)*, and monthly inland rainfall levels (sourced from CHIRPS).

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

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

DISCUSSION

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

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

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

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

minor La Niña conditions.

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

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

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

CONCLUSIONS

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

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

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