SHOREBIRD SURVEYS AT PORT STEPHENS, NEW SOUTH WALES, 2004–2011 AND COMPARISONS WITH RESULTS FROM PREVIOUS SURVEYS

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Twenty-one shorebird species have been recorded in regular surveys at Port Stephens over 2004–2011, with mean counts of 1564 birds present in summer and 650 birds in winter. When compared with survey results from 20-30 years previously, Port Stephens was shown to be an internationally important site for Eastern Curlew *Numenius madagascariensis* for at least three decades. However, there has been at least a 32% decline in the numbers of Eastern Curlew over that time. The numbers of most small and medium sized shorebirds have also declined substantially. Sandpiper numbers collectively are 88% lower than were recorded in the 1980's. The Sharp-tailed Sandpiper *Calidris acuminata* is now rare and the Curlew Sandpiper *Calidris ferruginea* has not been recorded in eight years of summer surveys. There have also been large percentage decreases in the counts of species such as Red-necked Stint *Calidris ruficollis*, Lesser Sand Plover *Charadrius mongolus*, Pacific Golden Plover *Pluvialis fulva*, Double-banded Plover *Charadrius bicinctus* and Red-capped Plover *Charadrius ruficapillus*, which previously were all present in moderate numbers. Many other small and medium sized shorebirds that used to occur in Port Stephens in small numbers have not been recorded at all during the 2004-2011 surveys. A few shorebird species have increased in numbers, in particular Australian Pied Oystercatcher *Haematopus longirostris*, Sooty Oystercatcher *Haematopus fuliginosus*, Bar-tailed Godwit *Limosa lapponica* and Whimbrel *Numenius phaeopus*. The 2004-2011 surveys have established that Port Stephens is an internationally important site for Australian Pied Oystercatcher.

INTRODUCTION

Although Bamford *et al.* (2008) recognised Port Stephens as a site of international importance for Eastern Curlew *Numenius madagascariensis*, the value of Port Stephens (Figure 1) for shorebirds in New South Wales is sometimes over-looked. Port Stephens, situated approximately 200 km north of Sydney, is a popular tourist and recreational area and the south-eastern section in particular has undergone substantial development while the north-eastern part has also seen considerable growth in holiday and retirement housing. However, there are many areas of Port Stephens which remain relatively undisturbed and have suitable habitat for shorebirds. The Port Stephens environs include two reserves – Gir-um-bit National Park (32° 42', 151° 58', formerly known as Worimi Nature Reserve) and Corrie Island Nature Reserve (32° 40', 152° 08'). All of the Port Stephens waters, to the high tide shoreline, are part of the Port Stephens-Great Lakes Marine Park; this includes some small islands and sand banks exposed at low tide and used by waders for roosting or foraging.

During 1982-1984, as part of national shorebirds surveys conducted by the Australasian Wader Studies Group (AWSG), summer and winter surveys were carried out at the known land-accessible roost sites in Port Stephens. Some of the now-known roost sites (for example, Corrie Island NR, and oyster beds located off Swan Bay) are not readily accessible by land and were not surveyed. The three AWSG summer surveys revealed 707 to 1700+ birds, and the winter surveys 339 to 450 birds (Stuart 2005). The variability in the

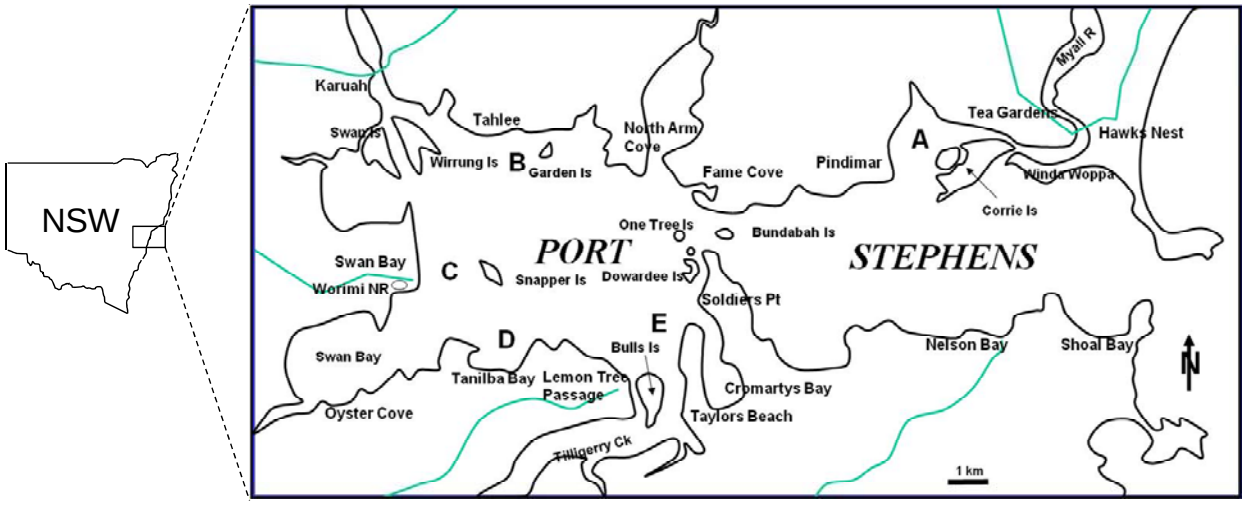

Figure 1. Port Stephens, New South Wales.

counts especially for the summer surveys was probably due to the incompleteness of coverage of all potential Port Stephens habitat; in particular, fewer sites were visited in 1983-84 compared to 1982 (Stuart 2004).

Lane (1987) analysed the AWSG data and other available records and rated Port Stephens as a top 20 site in Australia for four species – Pacific Golden Plover *Pluvialis fulva*, Lesser Sand Plover *Charadrius mongolus*, Whimbrel *Numenius phaeopus* and Eastern Curlew. That is, for those four species, the peak count was amongst the 20 largest peak counts for the species across all sites for which data were available in 1987.

Smith (1991) extended the AWSG data with later records of *ad hoc* observations by visitors to Port Stephens. He ranked Port Stephens as a Priority 2 site for shorebirds in NSW based on the high counts of Whimbrel, Eastern Curlew and Pacific Golden Plover, all of which were present there at greater than 1% of their then-estimated Australian population (Smith 1991). Smith's criteria for evaluating the sites was different from that now used whereby the population in the Flyway is taken into account, not simply the Australian population (Bamford *et al.* 2008).

Between 1985 and 2003, our knowledge about shorebirds in Port Stephens came solely from opportunistic observations (as published, for example, in the annual bird reports for the Hunter Region and for NSW). Those reports suggested that Port Stephens had remained an important shorebird site in NSW; however, the absence of any ongoing systematic surveying made it difficult to support such a conclusion. The aim of this study is to provide a revised estimate of the Port Stephens shorebird population and to document major trends in key shorebird species.

METHODS

In February 2004, annual boat-based summer surveys of Port Stephens commenced. Similar winter surveys commenced from July 2008. The surveys involved volunteers from Hunter Bird Observers Club (HBOC) and are organised jointly with NSW National Parks and Wildlife Service. The general methodology for the surveys has been described previously (Stuart 2005); in essence, five teams in boats simultaneously survey sub-areas of Port Stephens at high tide, recording the numbers of all shorebirds and any other waterbirds seen. In recent years, a supplementary shallow-drafted support vessel has been used to allow sufficiently close approach to the area around Winda Woppa Point (Figure 1) where small shorebirds sometimes roost in the dunes. The south-eastern section of the Port Stephens coastline is heavily disturbed (from leisure and tourism activities and the associated infrastructure) and is not surveyed.

RESULTS & DISCUSSION

Twenty-one shorebird species have been recorded in Port Stephens in the boat-based surveys from 2004 (21 species in the summer surveys, average total of 1564 birds; 11 species in the winter surveys, average total of 650 birds). The results are summarised in Table 1. With the exception of the March 2005 survey, the summer counts have been reasonably consistent and they align with the best result from the AWSG surveys, when around 1700 birds were recorded (in 1982). The three winter counts have produced much greater totals (nearly double) than were achieved in the AWSG surveys in the 1980s. This change in winter numbers reflects an increase in the numbers of four species and a marked decline in the numbers of almost all other species.

Four species – the Australian Pied Oystercatcher *Haematopus longirostris*, Bar-tailed Godwit *Limosa lapponica*, Eastern Curlew, and Whimbrel – have been recorded in counts of >100 birds in most summer surveys.

Table 1. Details of annual shorebird counts in Port Stephens, 2004-2011.

	Summer surveys										Winter surveys					
	'04	**'05**	**'06**	**'07**	**'08**	**'09**	**'10**	**'11**	**Mean**	**SD**	**'08**	**'09**	**'10**	**'11**	**Mean**	**SD**
Beach Stone-curlew			1											2		
Australian Pied Oystercatcher	112	30	77	108	107	134	144	166	110	42	154	122	148	142	141	14
Sooty Oystercatcher	18	5	9	11	10	13	19	19	13	5	14	9	24	15	15	6
Pacific Golden Plover			38			28	7	23	12	15						
Grey Plover			1													
Red-capped Plover			26	41	10	37	20		17	17		3	3	5	2.8	2.1
Double-banded Plover			15				1		2	5				35	9	17
Lesser Sand Plover	5	4		3	2	1			2	2						
Masked Lapwing	33	15	11	50	46	29	24	54	33	16	23	16	51	22	28	16
Black-tailed Godwit	51			1		6			7	18						
Bar-tailed Godwit	888	268	515	809	886	641	876	511	674	229	354	340	424	227	336	82
Whimbrel	218	248	424	215	261	40	271	240	239	104	10	24	27	36	24	11
Eastern Curlew	649	80	303	329	320	551	376	342	369	171	52	223	14	36	81	96
Terek Sandpiper	6		4	6	5		2	1	3	3	11			1	3	5
Common Sandpiper	1		1		1		1		1	1						
Grey-tailed Tattler	44	9	32	100	37	18	22	51	39	28	1	1	7	23	8	10
Common Greenshank		8	15	13	5	13		2	7	6						
Ruddy Turnstone	8	20	9	5	5	2	5		7	6						
Red Knot							1									
Red-necked Stint	20	2	6	59	0	41	43	22	24	22						
Sharp-tailed Sandpiper			40						5	14						
Total number of birds	2053	689	1527	1750	1695	1554	1812	1431			619	738	701	544		
Number of species	13	11	18	14	13	14	15	15			8	8	6	11		
Seasonal mean									1564	403					650	86

For all other species, the counts have been much smaller and several species have not been recorded every year. Individual species accounts are provided below.

Australian Pied Oystercatcher *Haematopus longirostris*

Port Stephens has emerged as the stronghold for Australian Pied Oystercatcher in NSW. In 10 of the 12 surveys, >100 birds have been present (Table 1) and the low count of just 30 birds in March 2005 was from a survey that produced anomalous results for almost all species. The average numbers are 110 birds in summer and 142 birds in winter. These represent 1-1.5% of the estimated 11,000 Australian population and >40% of the previously estimated NSW population (Watkins 1993, Owner & Rowheder 2003) although the present NSW population is probably larger than those earlier estimates (Stuart 2010).

These results were unexpected. Although Lane (1987) and Smith (1991) noted that there had been peak counts of 60-63 birds in the 1980s, the species was only recorded once in the AWSG surveys – four birds at Taylors Beach in July 1982. Opportunistic records from the intervening period are scant and there are only two known records of 10 or more birds – 18 birds were recorded at Corrie Island in August 2001 and 10 birds at Oyster Cove in 1998 (Stuart 2004). The AWSG surveys did not include Corrie Island and Winda Woppa Point, two important roost sites recently identified for Australian Pied Oystercatcher. Several other of the now known roost sites are not fully accessible from land and probably were not surveyed comprehensively in the 1980s. High numbers of Australian Pied Oystercatcher might always have been present in Port Stephens but this cannot be confirmed. Alternatively, high numbers might be a recent phenomenon. Their numbers are known to be increasing at other sites, for example in Sydney (P. Straw *pers. comm.*) and this might be indicative of a broader trend.

There is only one known breeding record from Port Stephens, at Orobillah Island about 10 years ago (G. Little *pers. comm.*), and there are very few suitable locations for pairs to establish breeding territories (M. Newman *pers. comm.*). Thus, it may be that most of the birds that are recorded in Port Stephens are from breeding sites elsewhere and that they only spend some of their life cycle in Port Stephens. Given that the species is classified as Endangered in NSW under the Threatened Species Conservation Act 1995 (NSW Scientific Committee 2010), it seems important to gain better understandings about this.

Bar-tailed Godwit *Limosa lapponica*

Eight hundred to nine hundred birds have been recorded several times in the summer surveys since 2004, and with >500 birds present most years (Table 1). These counts represent >0.5% of the sub-species *baueri* population that visits Australia (Bamford *et al.* 2008). As there were >600 birds present in the 1982 AWSG survey (Table 2), it seems probable that Port Stephens has supported good numbers of Bar-tailed Godwit for at least three decades.

The winter surveys have yielded an average of 336 birds – much greater counts than the ~150 birds that were recorded in the 1980's (Smith 1991) and rather higher than the corresponding winter counts in the Hunter Estuary (for example see Table 3). Thus, Port Stephens has emerged as the most important site in NSW nowadays for over-wintering Bar-tailed Godwits.

Eastern Curlew *Numenius madagascariensis*

The first summer boat-based survey produced the second-highest known count for Eastern Curlew in Port Stephens, after the count of 960 birds in 1982 (Smith 1991). The 649 birds recorded in 2004 (Table 1) were 1.7% of the Flyway population and Port Stephens very clearly is an internationally important location for Eastern Curlew. The post-2004 summer counts have mostly been 350±25 birds, but with a much larger count (551 birds; 1.45% of the Flyway population) in February 2009 and a very low count (80 birds) in March 2005.

Although only modest numbers have been present in three of the four winter surveys, there were 223 birds present in July 2009. The 1983 and 1984 AWSG surveys also recorded 105 and 152 over-wintering birds, respectively. These results suggest that Port Stephens has been an important NSW site for over-wintering Eastern Curlews for at least three decades.

Whimbrel *Numenius phaeopus*

Two hundred and twenty birds on average have been present in the summer surveys, with the peak count 424 birds in February 2006 (Table 1). However, the very low count of just 40 birds in February 2009 suggests that in some years the conditions in Port Stephens are less favourable for Whimbrel. Only small numbers of birds over-winter (Table 1).

Sooty Oystercatcher *Haematopus fuliginosus*

Small numbers occur regularly, with a peak count of 24 birds in July 2010. Although some young birds are usually present, there are no known breeding records. As for the Australian Pied Oystercatcher, there seem to be very few suitable locations for pairs to establish breeding territories (M. Newman *pers. comm.*) and it may be that the birds in Port Stephens are from breeding sites elsewhere and that

Table 2. Comparison of 1982 and 2004-11 summer surveys

Species	1982	2004-11 mean (SD)
Australian Pied Oystercatcher	0	110 (42)
Sooty Oystercatcher	0	13 (5)
Black-winged Stilt	4	0
Red-capped Plover	70+	17 (17)
Lesser Sand Plover	0	2 (2)
Masked Lapwing	16	33 (16)
Black-tailed Godwit	0	7 (18)
Bar-tailed Godwit	600+	674 (229)
Whimbrel	27	239 (104)
Eastern Curlew	800+	369 (171)
Terek Sandpiper	0	3 (3)
Common Sandpiper	0	1 (1)
Grey-tailed Tattler	21	39 (28)
Ruddy Turnstone	0	7 (6)
Red-necked Stint	150+	24 (22)
Sharp-tailed Sandpiper	42	5 (14)
Curlew Sandpiper	30	0

Table 3. Comparisons of mean counts at Port Stephens and the Hunter Estuary during February and July, for the main species occuring in Port Stephens.

Species	Feb 2004-11		July 2008-11	
	Port St	Hunter	Port St	Hunter
Australian Pied Oystercatcher	110	8	142	11
Sooty Oystercatcher	13	5	15	7
Pacific Golden Plover	12	163	0	0
Bar-tailed Godwit	674	977	336	228
Whimbrel	240	31	24	10
Eastern Curlew	369	397	81	53
Grey-tailed Tattler	39	13	8	0

they only spend some of their life cycle in Port Stephens.

Grey-tailed Tattler *Tringa brevipes*

Although the peak count from the surveys is 100 birds in February 2007, the numbers have varied considerably (mean of 39 birds, standard deviation 28; see Table 1). Due to the roosting preference for mangrove areas, the counts may be under-estimates. For example, in December 2004, the western side of Pindimar Bay was surveyed by foot and 75+ birds were recorded in that limited area – a higher number than the counts for all of Port Stephens in February 2004 and March 2005.

Pacific Golden Plover *Pluvialis fulva*

Birds have only been recorded in half of the summer surveys (and no winter surveys). However, birds have now been present each summer over 2009-2011 and perhaps a modest recovery is underway. The peak count of 38 birds in February 2006 is a 50% decline in the previous peak count (Table 4). Although Lane (1987) rated Port Stephens in the top 20 of sites in Australia for Pacific Golden Plover, his conclusion can no longer be considered valid.

Other shorebirds

A feature of the 2004-2011 surveys is the general absence or low counts of small and medium sized shorebirds. Red-necked Stint *Calidris ruficollis*, Common Greenshank *Tringa nebularia*, Lesser Sand Plover and Red-capped Plovers *Charadrius ruficapillus* have been present most summers but in low to modest numbers (Table 1). All other species have only been recorded intermittently. These results are discussed in more detail in a later section, where the counts are compared with those from the 1980's.

Limitations of surveys

The boat-based methodology used since 2004 means that all potential roost sites are surveyed, and therefore the overall counts provide a more accurate estimate of the Port Stephens shorebird population than the land-based surveys of the 1980s. However, the numbers of Whimbrel, Grey-tailed Tattler *Tringa brevipes* and Terek Sandpiper *Xenus cinereus* are potentially under-estimated by both methodologies. This is because these species are known to sometimes roost in areas which are less accessible, such as in mangroves or at rocky shorelines. For example, far greater counts of Grey-tailed Tattler were found foraging and roosting in the mangrove fringed northern shores in January 1980 than ever were recorded in any of the formal AWSG surveys (Pegler 1982).

It is not clear why the March 2005 survey yielded such low counts compared to all other summer surveys. Although there were some operational issues, about 70% of the targeted area was surveyed. Two hundred and forty-eight Whimbrel were recorded which was about average (Table 1), but all the other shorebirds which are present in good numbers most years had March 2005 counts which were only 20-40% of their average for 2004-2011. At the time of the March 2005 survey, migratory shorebirds had not departed from the Hunter Estuary which is only ~50km to the south; the counts for the Hunter Estuary for February and March 2005 were essentially unchanged (HBOC unpublished results). The Port Stephens survey took place just one day after the March Hunter Estuary survey, and therefore it seems unlikely that there had been a significant departure of migratory shorebirds from Port Stephens. All waterbird numbers, not just shorebirds, were substantially lower in the three sub-sections that were surveyed normally. It may have been the case that foraging and/or roosting conditions were unsuitable in Port Stephens in March 2005. This is partially confirmed by counts of Australian Pied Oystercatcher further north, at Forster/Tuncurry and Manning Estuary, were unusually high in that month (Stuart 2010).

Comparisons with the Hunter Estuary

Smith (1991) recognised the Hunter Estuary as the premier

Table 4. Percentage change in peak counts for some Port Stephens shorebirds. 1980's peak counts are from those reported in 1982-84 AWSG surveys and additional data presented by Lane (1987) and Smith (1991)

Species	Change since the 1980's
Australian Pied Oystercatcher	+163%
Sooty Oystercatcher	+500%
Pacific Golden Plover	-50%
Bar-tailed Godwit	+48%
Whimbrel	+63%
Eastern Curlew	-32%
Grey-tailed Tattler	-59%
Pacific Golden Plover	-50%
Ruddy Turnstone	+400%
Sandpipers	-88%
Stint, small plovers	-69%
Other medium/small waders	-74%

site in NSW for shorebirds and this undoubtedly remains the case based on the total numbers of shorebirds that are recorded there. Most summer counts for the Hunter Estuary are of many thousands of birds (HBOC unpublished results). However, it is interesting to compare the situations at the two sites for shorebirds which are common in Port Stephens. Table 3 shows the average counts for those seven species for the February surveys at both locations over 2004-2011, and for the July counts for 2008-2011. In summer, Port Stephens is far more important for Australian Pied Oystercatcher and Whimbrel than is the Hunter Estuary, and about as important for Bar-tailed Godwit and Eastern Curlew. In winter, it remains far more important for Australian Pied Oystercatcher and also hosts a considerably greater number of over-wintering Bar-tailed Godwit.

Comparisons with earlier records

Lane (1987) and Smith (1991) both summarised the available shorebird count data for Port Stephens. Their peak counts for each species are shown in Table 5, with the peak count for 2004-2011 also presented. It should be pointed out that both Lane and Smith did not take into account some of the results from the February 1982 AWSG survey. That survey recorded 600+ Bar-tailed Godwit and 150+ Red-necked Stint (Stuart 2004). Smith and Lane both cited lower peak counts for these two species for the period covered in their reviews. There has been a decline in Eastern Curlew numbers, with the 2004-2011 peak count of 649 birds in this study being much lower than the peak count of 960 birds reported by Smith (1991) (Table 5). The comparison presented in Table 5 also highlights the decline in numbers of many small and medium sized shorebirds in Port Stephens. For example, the Sharp-tailed Sandpiper *Calidris acuminata* had a peak count of just 40 birds in the 2004-2011 surveys and the Curlew Sandpiper *Calidris ferruginea* was not recorded at all in those surveys. There were also substantial decreases in the peak counts of species such as Red-necked Stint, Lesser Sand Plover, Pacific Golden Plover, Double-banded Plover *Charadrius bicinctus* and Red-capped Plover which previously all were present in moderate numbers. Many other small and medium sized shorebirds that used to occur in Port Stephens in small numbers have not been recorded at all during the 2004-2011 surveys. Only a few shorebird species have increased in numbers; most notably Australian Pied Oystercatcher, Sooty Oystercatcher, Bar-tailed Godwit and Whimbrel.

The use of peak counts for comparisons between two sets of surveys potentially could mislead since they do not necessarily indicate the typical situation, but instead the extreme. For this reason, it is interesting to also compare the results from the 1982 AWSG survey with the averaged results from the 2004-2011 surveys (see Table 2). Since more Port Stephens sites were visited in 1982 than was the case in the 1983-84 AWSG surveys, the 1982 survey is a more relevant benchmark (but noting that the land based survey could not cover all of the now known roost sites). In Table 2, the decline in numbers of many small and medium sized shorebirds in Port Stephens is very clear: for example, Red-necked Stint, Red-capped Plover and Sharp-tailed Sandpiper are now uncommon and Curlew Sandpiper has not been recorded in any of the 2004-2011 surveys. In contrast, the numbers for Whimbrel and Australian Pied Oystercatcher are much higher. It is not clear though whether this is because of an actual increase in their local populations or because of the more effective survey methodology which is now being used.

Results presented in Figures 2 and 3 highlight the decline that has occurred in the numbers of small and medium sized shorebirds. Figure 2 compares the peak counts for large shorebirds for the two periods (the Figure uses the count data from Smith (1991), but also includes the higher 1982 AWSG peak count for Bar-tailed Godwit). The peak counts for both godwit species and Whimbrel are higher now, but there has been a 32% decrease in the peak count for Eastern Curlew. It is possible that the counts for the other species are higher because of the more comprehensive survey method; for the same reason, the decrease in Eastern Curlew numbers may be larger than the available data indicate. Figure 3 shows the corresponding situation for small and medium sized waders. To simplify the analysis, all of the sandpiper species (Terek, Sharp-tailed, Curlew, Common *Actitis hypoleucos*, Pectoral *Calidris melanotos* and Wood *Tringa glareola*) have been grouped together, as have Red-necked Stint and the small plovers (Red-capped, Double-banded, both Sand Plovers) and then all the other waders are grouped (for example, Black-fronted *Elseyornis melanops* and Red-kneed Dotterel *Erythrogonys cinctus*, Common Greenshank). The changes

Table 5. Comparisons of 2004-2011 peak counts with previously published peak counts (Lane 1987, Smith 1991).

Species	Lane	Smith	2004-11
Beach Stone-curlew	0	0	2
Australian Pied Oystercatcher	60	63	166
Sooty Oystercatcher	4	4	24
Black-winged Stilt	16	16	0
Red-necked Avocet	0	1	0
Pacific Golden Plover	70	76	38
Grey Plover	0	1	1
Red-capped Plover	60	120	41
Double-banded Plover	50	69	35
Lesser Sand Plover	40	101	5
Greater Sand Plover	0	6	0
Masked Lapwing	*	27	54
Black-tailed Godwit	0	1	51
Bar-tailed Godwit	370	370	888
Whimbrel	30	260	424
Eastern Curlew	530	960	649
Terek Sandpiper	0	2	11
Common Sandpiper	0	2	1
Grey-tailed Tattler	70	245	100
Common Greenshank	14	14	15
Marsh Sandpiper	1	1	0
Ruddy Turnstone	2	4	20
Red Knot	0	3	1
Red-necked Stint	110	116	59
Sanderling	0	1	0
Sharp-tailed Sandpiper	260	406	40
Pectoral Sandpiper	0	1	0
Wood Sandpiper	0	1	0
Curlew Sandpiper	30	30	0
Red-kneed Dotterel	15	15	0
Black-fronted Dotterel	14	14	0

* Masked Lapwing was not reviewed by Lane

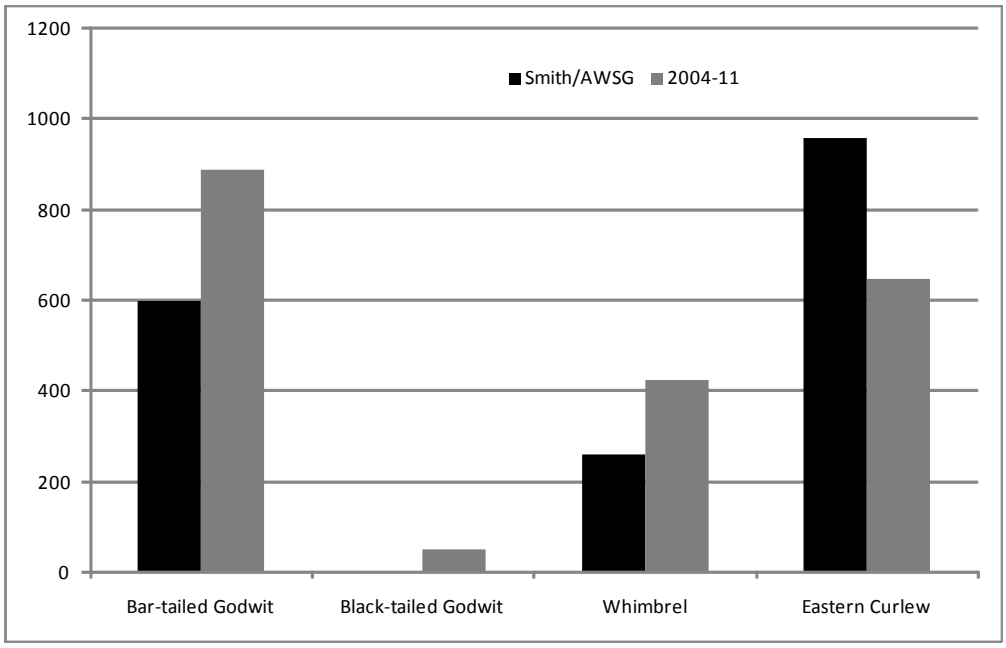

Figure 2. Comparisons of the recent and historical peak counts – large shorebirds.

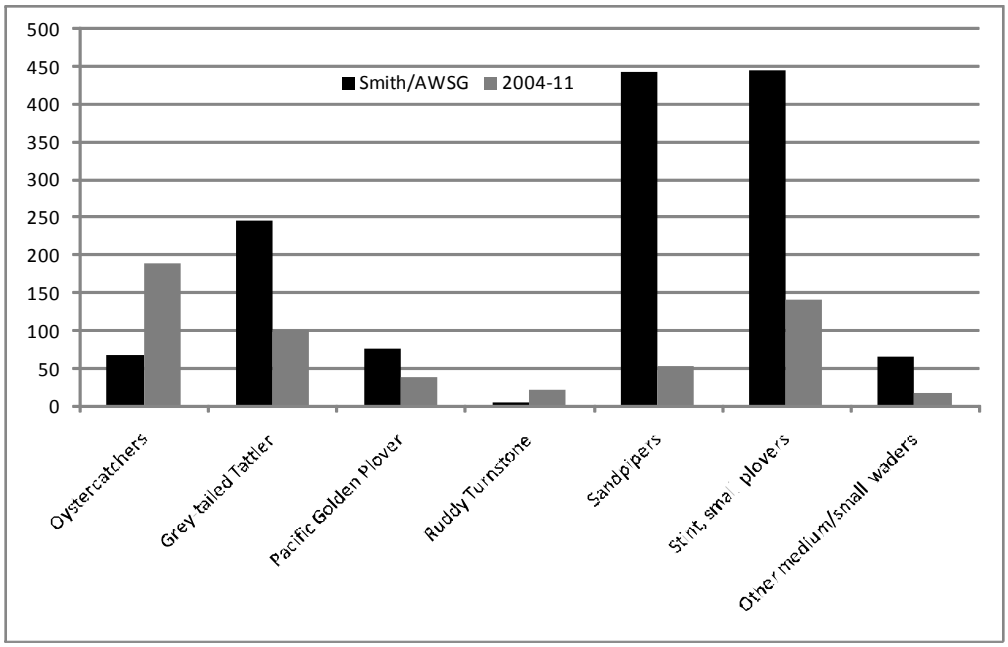

Figure 3. Comparisons of the recent and historical peak counts – medium and small shorebirds.

are also expressed as percentages in Table 4. There has been an 88% decline in the counts of sandpipers (considering all of these species combined) and approximately 70% decline in the numbers of many other small to medium sized waders. The decreases might actually be even larger than this, since the survey methodology now allows a more comprehensive coverage of all of the roost sites than was possible in the earlier surveys.

Many of these findings echo the decline in shorebird numbers identified elsewhere in Australia (Gosbell & Clemens 2006). In the case of Red-necked Stint, Gosbell and Clemens concluded that numbers in SE Australia are increasing in some areas but decreasing in other ones. Port Stephens therefore is another site where the numbers are decreasing. Conversely, the numbers of Bar-tailed Godwit are higher now in Port Stephens than were recorded in the 1980's, which is contrary to the general decline in their numbers in SE Australia (Gosbell & Clemens 2006). One can speculate that an increase in the Port Stephens Bar-tailed Godwit population is an artefact of the more effective boat-based survey method now in use and that the numbers present in the 1980's were higher than the land-based surveys had indicated. This may also explain the increases in the numbers of Australian Pied Oystercatcher, Sooty Oystercatcher and Whimbrel in the 2004-2011 surveys compared to the 1980's.

The decline in shorebird numbers is also very clear from comparisons of winter count data from 2008-2011 and 1982-84. The comparisons of mean counts and peak counts for the two periods are presented in Table 6. The 1982-84 data are from AWSG surveys in June of each year at just two sites in Port Stephens (Taylors Beach, Swan Bay) and therefore are likely to be an under-estimate of how many shorebirds were present in the entirety of Port Stephens. The winter counts for four species increased: Australian Pied Oystercatcher, Sooty Oystercatcher, Bar-tailed Godwit and Whimbrel. At the very least, this reflects the more effective surveying that now takes place. The counts for all other species have declined, in most cases very markedly. Four small shorebirds, Red-capped Plover, Double-banded Plover, Grey-tailed Tattler and Red-necked Stint, which were present in moderate numbers in Port Stephens in the 1980's have collectively declined by 86% based on mean counts (140 birds then, 20 birds now). Shorebirds present in low numbers in winter, such as Pacific Golden Plover, Black-winged Stilt *Himantopus himantopus*, and Ruddy Turnstone *Arenaria interpres*, have not been recorded at all during 2008-2011.

Factors like loss of habitat at staging sites on migration are thought to be contributing to declines in many migratory species (Rogers *et al.* 2010). However, the decreases in non-migratory species such as Red-capped Plover suggest that local factors may also be contributing to declines. Geering *et al.* (2007) summarised the main threats to shorebirds; the only threat they identified which seems obviously to apply for Port Stephens is disturbance. Port Stephens is one of the fastest population growth centres in NSW (Australian Bureau of Statistics 2011, accessed 5/12/2011). Many more people now live in the area and it has also become a very popular holiday destination. Geering *et al.* (2007) cite human activity, habitat modification, and predation of eggs and chicks by feral and domestic animals as disturbances which impact shorebirds. All of these disturbances are presumed to have increased as a result of the population growth around Port Stephens. However, the conditions prevailing there in the 1980's are not well documented, precluding a formal analysis of the impact of disturbance in Port Stephens.

CONCLUSIONS

Port Stephens has been a site of international importance for Eastern Curlew for at least three decades and is a site of international importance for Australian Pied Oystercatcher. Up to 1.7% of the Flyway population of Eastern Curlew has been present in Port Stephens in the 2004-2011 surveys and up to 1.4% of the world population of Australian Pied Oystercatcher. For the latter, a very large proportion of the NSW population seems to be present in both summer and winter, although further study is needed to determine if they reside in Port Stephens for the whole of the year.

Eastern Curlew numbers have decreased by 32% since the 1980's based on comparisons of peak counts. The land-based surveys of the 1980's very likely under-estimated the total population present, whereas the modern survey methodology allows coverage of all the potential roost sites. Therefore, the real decline in Eastern Curlew numbers probably is much more than 32%.

There has been a substantial decline in the numbers of most small and medium sized shorebirds when compared with the data from the 1980's. Many species which occurred in low numbers in the 1980's have not been recorded at all during the 2004-2011 surveys. Species which previously were present in moderate numbers have declined, by up to 90% from direct comparisons of the data and possibly by even higher percentages given that the modern survey methodology is more effective.

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Table 6. Comparison of 1982-84 (AWSG) and 2004-11 (this study) winter surveys

Species	Mean counts		Winter peak counts	
	1982-4	2004-11	1982-4	2004-11
Australian Pied Oystercatcher	1	142	4	154
Sooty Oystercatcher	0	16	0	24
Black-winged Stilt	4	0	13	0
Pacific Golden Plover	3	0	0	0
Red-capped Plover	54	3	64	5
Double-banded Plover	42	9	69	35
Red-kneed Dotterel	5	0	15	0
Masked Lapwing	22	28	33	51
Bar-tailed Godwit	98	336	114	424
Whimbrel	13	24	25	36
Eastern Curlew	100	81	152	223
Terek Sandpiper	0	3	0	11
Grey-tailed Tattler	21	8	37	23
Common Greenshank	<1	0	1	0
Ruddy Turnstone	8	0	20	0
Red-necked Stint	23	0	33	0
Curlew Sandpiper	<1	0	1	0

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