ANNUAL ANALYSIS OF THE STATUS OF SHOREBIRDS

IN THE PORT OF BRISBANE PTY LTD LANDS 2012/2013

Includes an analysis of historical trend in counts and

comparison with regional populations

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Table of Contents

EXECUTIVE SUMMARY

For over two decades, high numbers of migratory waders have been documented using Port of Brisbane (POB) lands as high tide roosting habitat at the mouth of the Brisbane River. The waders have responded to changing configurations of suitable roosting habitat as the engineering process of bunding, infilling, settlement and capping of subsections of the site have progressed.

POB has detailed reports on bird usage of the site throughout the 1990s. Since 2003 the Queensland Wader Study Group have undertaken regular monthly counts of birds on the reclamation area, nearby clay pan, and at the purpose built roosting site. This report is the first of what will become regular yearly reports of the counting being undertaken by QWSG. The species that are most important at the site are identified and their numbers on Port lands is compared with their numbers across the whole of Moreton Bay. Counts for each subsection of the site for June 2012 to April 2013 are tabulated (future reports will document a full year of counts). Yearly changes since 2003 in the distribution of roosting birds across the site are also presented.

There are twelve important species at the site that include the Ruddy Turnstone, four plover species (Lesser and Greater Sand Plovers, Pacific Golden Plover and Grey Plover), three large sandpipers (Eastern Curlew, Bar-tailed Godwit and Great Knot) and four smaller species (Grey-tailed Tattler, Sharp-tailed Sandpiper, Curlew Sandpiper and Red-necked Stint).

Where practical, data are presented for each time of sampling. Alternatively, mean or maximum values are given for each of four periods of the year but with a focus on the main period of occupancy during the non-breeding season of the birds from mid November to mid March. Grouped data for all migratory wader species and all resident wader species are also presented.

As expected, numbers of migratory waders are highest during the summer months and as many as 15 species are regularly recorded at any one time. Numbers of resident waders are marginally higher during the winter months. Over the last decade migratory waders numbers have remained at about the same level and the site generally remains the most important single roosting area for waders in the whole of Moreton Bay. The data suggest that the relative importance of the reclamation area for five species of wader in Moreton Bay may have increased slightly since 2003. Two other species tend to exhibit the opposite trend.

Subsections of the Port lands have been used to document changes in the distribution of waders across the site over time. There is a clear indication of the way in which birds alter their choice of roosting area as reclamation proceeds. They move to where fresh dredge spoil is being deposited and then move on as deposition stops and the spoil is allowed to dry and form a crust. For the areas that are currently in use by waders, more detailed spatial records are presented. For individual species it should be possible to relate the choice of habitat to the nature and condition of the substrate but this is beyond the scope of this report.

For the site as a whole since 2003, the pattern of yearly changes in numbers varies between species but without any significant change. These patterns are described and continued sampling will help to establish whether there are cyclical patterns or distinct increasing or decreasing trends in numbers. Grey Plover and Pacific Golden Plover numbers need closer scrutiny. Critically low count values for each of the twelve species are tabulated. A decline in the numbers of birds of any species below the critical value during a November – March survey can serve as a trigger to illicit further investigation and/or responses in management of the site.

1. BACKGROUND

The Port of Brisbane Pty Ltd (POB) reclamation area holds large migratory wader populations. These birds are attracted to the large area of feeding and roosting habitat provided by the pumping of dredge spoil. Members of the Queensland Wader Study Group (QWSG) have been counting the POB reclamation area and nearby claypan since 1991. These counts have been undertaken monthly since 2003 when POB and QWSG commenced a formal arrangement. These data provide a long time series of counts with which to examine the relative importance of the area for waders. At the same time, QWSG members have also counted between 50 and 65 other high tide roosts monthly in Moreton Bay.

The Port of Brisbane Pty Ltd approached the Queensland Wader Study Group to undertake an annual assessment of the status of migratory waders within their lands in November, 2012. The first of these annual assessments will summarise data collected to April 2013 and include:

1. Bird numbers by species and site (individually and overall) at the Port for the last year presented as a table of raw numbers and suitable graph/s.
2. Comparison of wader numbers by species at the Port with a suitable background site or sites. Identify any species where there has been a significant difference between the Port and the background sites.
3. Graphical presentation of annual changes in wader numbers by species for each subgroup of sites and within the most recently preferred sites (subgroup D).
4. Graphical presentation of long term trends for wader numbers at the Port by species.

For all of the above POB only want a report on the most important species at the port (i.e. high numbers at the Port or highly threatened with relatively significant numbers at the Port).

2. IMPORTANT MIGRATORY WADER SPECIES AT THE PORT OF BRISBANE

To identify important migratory wader species within the POB reclamation area (including the claypan), we examined all the counts of migratory waders from the POB and found the maximum count of each species. The POB reclamation area held internationally-significant numbers of seven species of migratory wader (> 1% of their flyway population). In addition, the POB held > 0.5% of the flyway population of another four species of migratory wader. A further species, Grey Plover was regularly present (> 90% of counts) in > 0.1% of the flyway population. This species was also included as a species of interest as the POB is the most important site for the species in the region. This makes a total of 12 species of migratory wader (Table 1) that will be examined in greater detail. Most species only occurred within the reclamation area, but the maximum counts of Eastern Curlew and Great Knot also included birds on the claypan. For the collation of maximum counts of these two species, the claypan contributed < 10% of the total count.

Table 1. The maximum count of migratory species of wader present in internationally and nationally-significant numbers (> 0.5% flyway population) within the POB reclamation area (including the claypan) during the non-breeding season (15 November – 15 March). Grey Plover has been included as the POB is the most important site for this species in the region. * Counts that included both the reclamation area and the claypan. N = the number of counts.

Species	Maximum count (% flyway popn)	Proportion of POB counts (%) (N)
Grey-tailed Tattler	1288 (2.6)	85 (67)
Red-necked Stint	6803 (2.1)	100 (79)
Lesser Sand Plover	2413 (1.7)	94 (74)
Curlew Sandpiper	2712 (1.5)	97 (77)
Sharp-tailed Sandpiper	1990 (1.2)	72 (57)
Eastern Curlew	473 (1.2)*	57 (45)
Pacific Golden Plover	1090 (1.1)	78 (62)
Great Knot	2600 (0.7)*	90 (71)
Greater Sand Plover	669 (0.6)	86 (68)
Ruddy Turnstone	207 (0.6)	85 (67)
Bar-tailed Godwit	1604 (0.5)	96(76)
Grey Plover	145 (0.1)	54 (43)

Figure 1. Wader count sites and site groupings (Areas) within the Port of Brisbane land reclamation zone. The sites are labelled with the same alphanumeric codes that are used throughout this report and in the QWSG database. The claypan roost (FICP) is in the south east of Fisherman Is but is not shown.

3. RECENT COUNTS OF MIGRATORY WADER SPECIES AT THE PORT OF BRISBANE.

The numbers of migratory wader species and total migratory birds recorded in each of the sites (subsections of the Port area, see Figure 1) including the claypan (FICP, not shown in Figure 1) on each sampling occasion between June 2012 and April 2013 are given in Table 2. Similarly, the data for resident waders are presented in Table 3. The same breakdown of counts for each of the important species (Table 1) is tabulated in Table 4. Future reports will cover a twelve-month period from the previous July to June prior to the report. It was not possible here because the data could not be prepared in a suitable format in time.

Collectively, Tables 2, 3 & 4 are representative of the last 12 months of sampling. For each subsequent yearly report data will be presented on the basis of the same set of tables. Furthermore, the sampling has been divided into four time periods as follows: "Winter" (June to August – the northern hemisphere breeding season); "South Migration" (September to mid November); "Summer" (mid November to mid March – the middle of the yearly non breeding period) and "North Migration" (mid March to May). This is because these time periods generally represent a breakdown of the activity of a migratory wader throughout the year.

The hatching of migratory waders is well coordinated because of the short period when they can breed in the far northern hemisphere. Hence, their lives begin in the "Breeding" period. However, juvenile birds that are hatched each breeding season only start to occur on Australian shorelines in September. Hence, from the perspective of the population assessment of waders in Australia, a bird's annual cycle begins in September and ends in August. Such an approach is consistent with techniques of aging waders and allows a better understanding their population dynamics. Hence, the tabulations given in the tables to follow use "wader" years not calendar years and are labelled accordingly. Hence, the "2012" label represents the period from September 2012 to August 2013.

Based upon Tables 2, 3 & 4 counts of total migratory and total resident waders and the number of species for each group are consistent with data from past years (see also Figures 6a & b). There is a wide variation in the numbers recorded at different sites, which is a reflection of both chance occurrence of the birds and the suitability of sites as roosting habitat. The latter will vary depending upon the species. More is given on differential use of sites in the next section.

As expected, numbers of migratory birds were lowest in winter when numbers of resident birds was highest. Numbers of migratory birds peak through the summer months and can be high also during the period of southward migration. The maximum number of 15 migratory species that was recorded on any single count is of itself significant. Few other sites in Moreton Bay hold as many species and none on a regular basis. The Port lands remain the most important area the Bay for migratory waders (Section 2). Since July last year there have been significant counts within the Port area of greater than 1% of the flyway population of Red-necked Stint, Curlew Sandpiper and Lesser Sand Plover. Another four species reached important numbers during the periods of migration. These were the Grey-tailed Tattler, Sharp-tailed Sandpiper, Eastern Curlew and Ruddy Turnstone. Other species were not recorded in the high numbers that they have occurred in past years (see Table 1), however there is a high degree of year to year variability in peak numbers as shown in Figure 8.

Whereas the data presented in this section has full details of where and when counts were made for approximately the last 12 months, subsequent sections present summary information over longer time frames and across the whole, or parts of the Port area. This section will be repeated in subsequent yearly reports but the latter sections will not necessarily be included or may take a different form.

Table 2. Counts of all migratory wader species (total birds and number of species) recorded in each subsection of the Port since July 2012. The subsection represented by each of the site codes are shown in Figure 1 with the exception of FICP (Fisherman Island Clay Pan), which is the expansive undisturbed clay pan in to the south west of Fisherman Island. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

migratory waders - total birds

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP	123	92					448	214	190	1067
PBAR			4		780	938	80	6		1808
PBC1	170	3	2	45	1		112	16	49	398
PBC2	48				3682	616	390	2941	260	7937
PBC3	215	27	14	3	1879	41	1196	136	161	3672
PBR3	63	139	602	1652	2252	3241	1478	889	1046	11362
PBS1		402	763	5078	636	2810	624	2118	9	12440
PBS2		1	15	598	272	9	325	3	36	1259
PBS3			19		4	12	840	390	1303	2568
PFPE	23	64	885	1102	377	434	278	297	242	3702
PFPE	2			4		2				8
Total	644	728	2304	8482	9883	8103	5771	7010	3296	46221

migratory waders - number of species

	Breeding		South migration			Non breeding		North Migration	
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13
FICP	2	1					11	6	5
PBAR			2		7	7	5	1	
PBC1	3	1	1	1	1		3	3	2
PBC2	1				6	5	3	6	4
PBC3	3	2	2	2	4	3	1	3	2
PBR3	3	9	9	11	12	10	7	5	8
PBS1		6	5	8	6	9	7	6	3
PBS2		1	1	3	3	1	3	2	2
PBS3			2		1	2	3	2	5
PFPE	1	3	7	5	5	3	3	4	5
PFPE	1			1		1			
Number of spp.	6	13	15	14	15	15	15	14	13

Table 3. Counts of all resident wader species (total birds and number of species) recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

resident waders - total birds

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP		93						86	249	428
PBAR		34	157		94	122	15	39	4	465
PBC1	42	9	11	1	3		29	29	5	129
PBC2	10	17	1		8	27	2	51	31	147
PBC3	9	85	9	86	11	16	2	2	12	232
PBR3	338	235	319	15	26	6	11	22	331	1303
PBS1	19	12	10	6			4	51	7	109
PBS2	1	5	2	5	7		1	2	38	61
PBS3		12	1	1		51		4	57	126
PFPE	30	37	48	49	17	62	1	11	3	258
PFPE	5					2			1	8
Total	454	539	558	163	166	286	65	297	738	3266

resident waders - number of species

	Breeding		South migration			Non breeding		North Migration	
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13
FICP		1						3	2
PBAR		1	1		5	2	2	2	1
PBC1	2	2	1	1	1		1	1	2
PBC2	2	1	1		1	1	1	1	1
PBC3	2	3	3	2	3	3	1	1	2
PBR3	4	4	5	2	3	1	2	1	4
PBS1	2	1	1	1			1	1	1
PBS2	1	2	1	2	1		1	1	2
PBS3		1	1	1		3		1	3
PFPE	2	3	2	3	1	1	1	1	1
PFPE	2					2			1
Number of spp.	5	5	4	4	5	4	4	4	6

Table 4a. Counts of Grey-tailed Tattler and Red-necked Stint recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Grey-tailed Tattler

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							91			91
PBAR										
PBC1										
PBC2										
PBC3				2						2
PBR3										
PBS1										
PBS2										
PBS3										
PFPE		33	810	980	285	413	194	267	142	3124
PFPE										
Total		33	810	982	285	413	285	267	142	3217

Red-necked Stint

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP	82						4		4	90
PBAR					150	3	1			154
PBC1	158	3	2	45	1		76	5	45	335
PBC2	48				1370	291	387	2673	163	4932
PBC3	183	2	10	1	378	38	1196	15	155	1978
PBR3	20	11		95	401	942	319	500	919	3207
PBS1		372	352	706	125	315	185	929	6	2990
PBS2				596	99	9	318	2	29	1053
PBS3			15			4	837	309	1030	2195
PFPE			1	11	23				38	73
PFPE	2									2
Total	493	388	380	1454	2547	1602	3323	4433	2389	17009

Table 4b. Counts of Sharp-tailed Sandpiper and Curlew Sandpiper recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Sharp-tailed Sandpiper

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							3	2	2	7
PBAR			3		92	17	23			135
PBC1	10									10
PBC2					313	90		63	6	472
PBC3	2				379	1		2		384
PBR3		1	23	4	3	83	287	10	86	497
PBS1		1	127	177	39	261	161	538	1	1305
PBS2		1			1		1			3
PBS3			4		4	8	1	81	248	346
PFPE										
PFPE				4		2				6
Total	12	3	157	185	831	462	476	696	343	3165

Curlew Sandpiper

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							31	8		39
PBAR					46					46
PBC1	2						14			16
PBC2					992	161	1	25		1179
PBC3	30	25			1121	2			6	1184
PBR3		65	49	47	10	256	408	45	13	893
PBS1		2	148	2378	2	278	223	241	2	3274
PBS2				1			6		7	14
PBS3							2		11	13
PFPE			42	11				7		60
PFPE										
Total	32	92	239	2437	2171	697	685	326	39	6718

Table 4c. Counts of Great Knot and Bar-tailed Godwit recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Great Knot

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							39		6	45
PBAR						8				8
PBC1										
PBC2										
PBC3										
PBR3		3	222	398	586	507				1716
PBS1										
PBS2										
PBS3										
PFPE										
PFPE										
Total		3	222	398	586	515	39		6	1769

Bar-tailed Godwit

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							206	102	169	477
PBAR					394	704	46			1144
PBC1										
PBC2										
PBC3										
PBR3	26	21	84	546	1184	576			7	2444
PBS1						2				2
PBS2										
PBS3										
PFPE	23	4	5		52	1		5		90
PFPE										
Total	49	25	89	546	1630	1283	252	107	176	4157

Table 4d. Counts of Eastern Curlew and Ruddy Turnstone recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Eastern Curlew

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP	41	92					52	16		201
PBAR					2	2				4
PBC1										
PBC2										
PBC3										
PBR3			118	106	29	53				306
PBS1				1		204				205
PBS2				1	172					173
PBS3										
PFPE										
PFPE										
Total	41	92	118	108	203	259	52	16		889

Ruddy Turnstone

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP										
PBAR										
PBC1										
PBC2										
PBC3										
PBR3					1					1
PBS1				1			8			9
PBS2										
PBS3										
PFPE		27	25	98	16	20	83	18	10	297
PFPE										
Total		27	25	99	17	20	91	18	10	307

Table 4e. Counts of Lesser Sand Plover and Greater Sand Plover recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Lesser Sand Plover

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP										
PBAR										
PBC1							22	8	4	34
PBC2					883	62		161	40	1146
PBC3										
PBR3	17	20	25	346	3	707	448	332	6	1904
PBS1		1	60	1424	218	1087	19	229		3038
PBS2			15							15
PBS3									10	10
PFPE										
PFPE										
Total	17	21	100	1770	1104	1856	489	730	60	6147

Greater Sand Plover

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP										
PBAR										
PBC1								3		3
PBC2					120	12		18		150
PBC3										
PBR3			1	6	5	83	8		1	104
PBS1		23	76	251	80	241	2	177		850
PBS2										
PBS3									4	4
PFPE									27	27
PFPE										
Total		23	77	257	205	336	10	198	32	1138

Table 4f. Counts of Grey Plover and Pacific Golden Plover recorded in each subsection of the Port since July 2012. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non breeding) and migration (south and north migrations).

Grey Plover

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							1			1
PBAR										
PBC1										
PBC2							2			2
PBC3			4							4
PBR3				21	22	33	2		3	81
PBS1										
PBS2								1		1
PBS3										
PFPE							1			1
PFPE										
Total			4	21	22	33	6	1	3	90

Pacific Golden Plover

	Breeding		South migration			Non breeding		North Migration		
Site Code	22-Jul-12	19-Aug-12	16-Sep-12	10-Oct-12	04-Nov-12	02-Dec-12	24-Feb-13	24-Mar-13	28-Apr-13	Total
FICP							14			14
PBAR							8	6		14
PBC1										
PBC2					4			1		5
PBC3								119		119
PBR3		6	45	30	3			2	11	97
PBS1				140	172	418	26			756
PBS2										
PBS3										
PFPE					1				25	26
PFPE										
Total		6	45	170	180	418	48	128	36	1031

4. COMPARISON OF WADER NUMBERS BETWEEN THE POB AND ELSEWHERE

This section presents a comparison of migratory wader numbers between the POB reclamation area (including the claypan) and elsewhere in Moreton Bay. In order to make a valid comparison, an index of the relative importance of the POB was needed. There are no similar single high tide roosts with which to compare to the POB reclamation area. Thus, we decided to compare the monthly counts at the POB with the counts made in the same months in Moreton Bay as a whole. The highest counts at all high tide roosts including POB were summed for each month. This provided a monthly estimate of the size of the Moreton Bay population of each of the 12 species of migratory wader being examined. The ratio of the POB count to the Moreton Bay count provided an index of the relative importance (IRI) of the POB reclamation area to Moreton Bay waders (Eq. 1).

$$IRI = \frac{Port\ of\ Brisbane\ count}{Moreton\ Bay\ count} \qquad (1)$$

This ratio can vary between zero and one, with a value of 1 meaning all birds of that species that month were counted within the POB reclamation area. Temporal changes in the ratio would be expected to reflect local changes in the relative importance of the POB reclamation area to Moreton Bay wader populations. The temporal trend in the IRI was examined with linear regression. A statistically-significant increase in the IRI was interpreted to mean that the POB reclamation area had increased in importance. Similarly, a significant negative relationship implies a decline in the importance of the POB. In an initial analysis, the counts from the POB reclamation area appeared to show unexplained differences in site use by some species when the pre and post January 2003 data were compared. For brevity, we decided to restrict the analysis of the temporal trend in the IRI to post January 2003 counts.

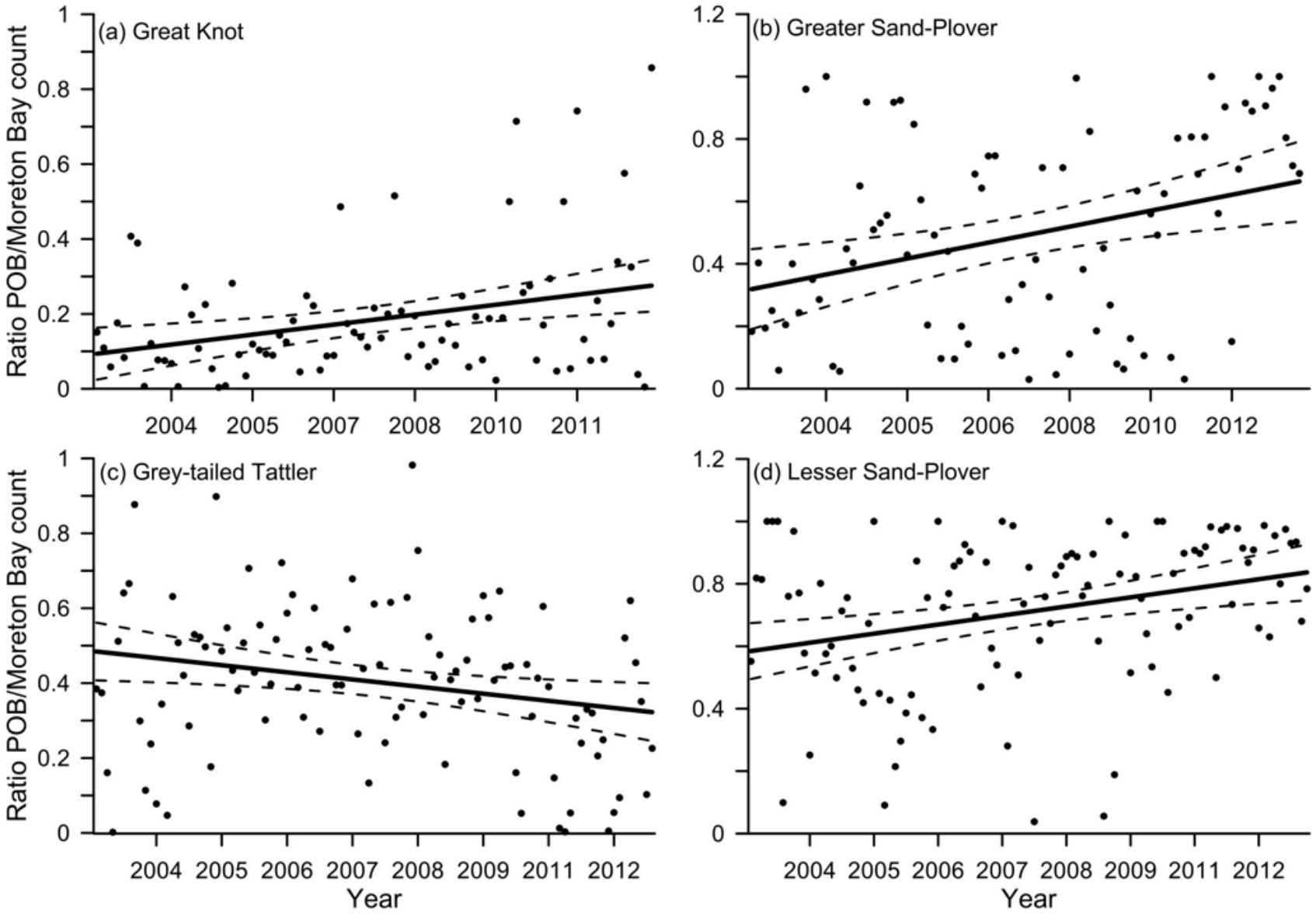
Temporal trend in IRI for the POB reclamation area

There was a statistically significant trend in the IRI for seven of the 12 species of wader examined (Figure 2). Five species, Bar-tailed Godwit, Curlew Sandpiper, Eastern Curlew, Grey Plover and Red-necked Stint showed no temporal trend in the IRI. For Eastern Curlew, the POB reclamation area supported a mean of 18% of the estimated Moreton Bay population. Whereas, for the other species, the mean percentage of the Moreton Bay count present in the POB reclamation area was between 56 and 65%.

The fit of the significant trends in the IRI were all quite weak, with the best correlation being Ruddy Turnstone ($r^2 = 0.34$; $P<0.001$). The correlations for the six other species were all less than $r^2 = 0.1$ but were still highly significant ($P<0.01$). Five of the seven species of wader with a significant temporal trend in the IRI had an increasing trend. This implies that these species are leaving other high tide roosts to use the POB reclamation area. The POB reclamation area regularly held the entire Moreton Bay count for three of the seven species – Lesser Sand-Plover, Ruddy Turnstone and Sharp-tailed Sandpiper since 2003. This reflects the quantity of preferred roosting habitat available within the POB reclamation area for these species. Each species prefers different habitats but there is an excess of these preferred habitats available within the POB reclamation area. The availability of habitat and low disturbance rates add to the attractiveness of the POB.

It is not completely clear why the POB reclamation area has become less important to Grey-tailed Tattler and Pacific Golden Plover (Figure 2). Grey-tailed Tattler prefer to roost almost exclusively on the outer wall at the POB. Over the same time period, nearby roosts such as Manly and Lytton have maintained their importance as alternative roosts. Recently, the QWSG have found a new roost for Grey-tailed Tattler on Goat Is in southern Moreton Bay. The addition of these birds to the Moreton Bay count may have contributed to the reduced IRI for the POB. However, this will not be the entire explanation as the Goat Is counts are only made each three months.

Pacific Golden Plover prefer dry, open roosting habitats and these habitats have become less widespread in the POB reclamation area in the last few years. Ponds have been left in a drying muddy state or with varying amounts of water. These habitats are less attractive to Pacific Golden Plover than those available at other roosts in Moreton Bay. There have been increasing numbers of Pacific Golden Plover at roost south of the POB, such as Manly and Wellington Point claypan. The entire population of Pacific Golden Plover in Moreton Bay is quite small (800 - 1,000 birds) and so changes in roosting preference by a small number of birds will affect the ratio.


(a) Great Knot
(b) Greater Sand-Plover
(c) Grey-tailed Tattler
(d) Lesser Sand-Plover
Ratio POB/Moreton Bay count
Year
0
0.2
0.4
0.6
0.8
1
1.2
2004
2005
2006
2007
2008
2009
2010
2011
2012

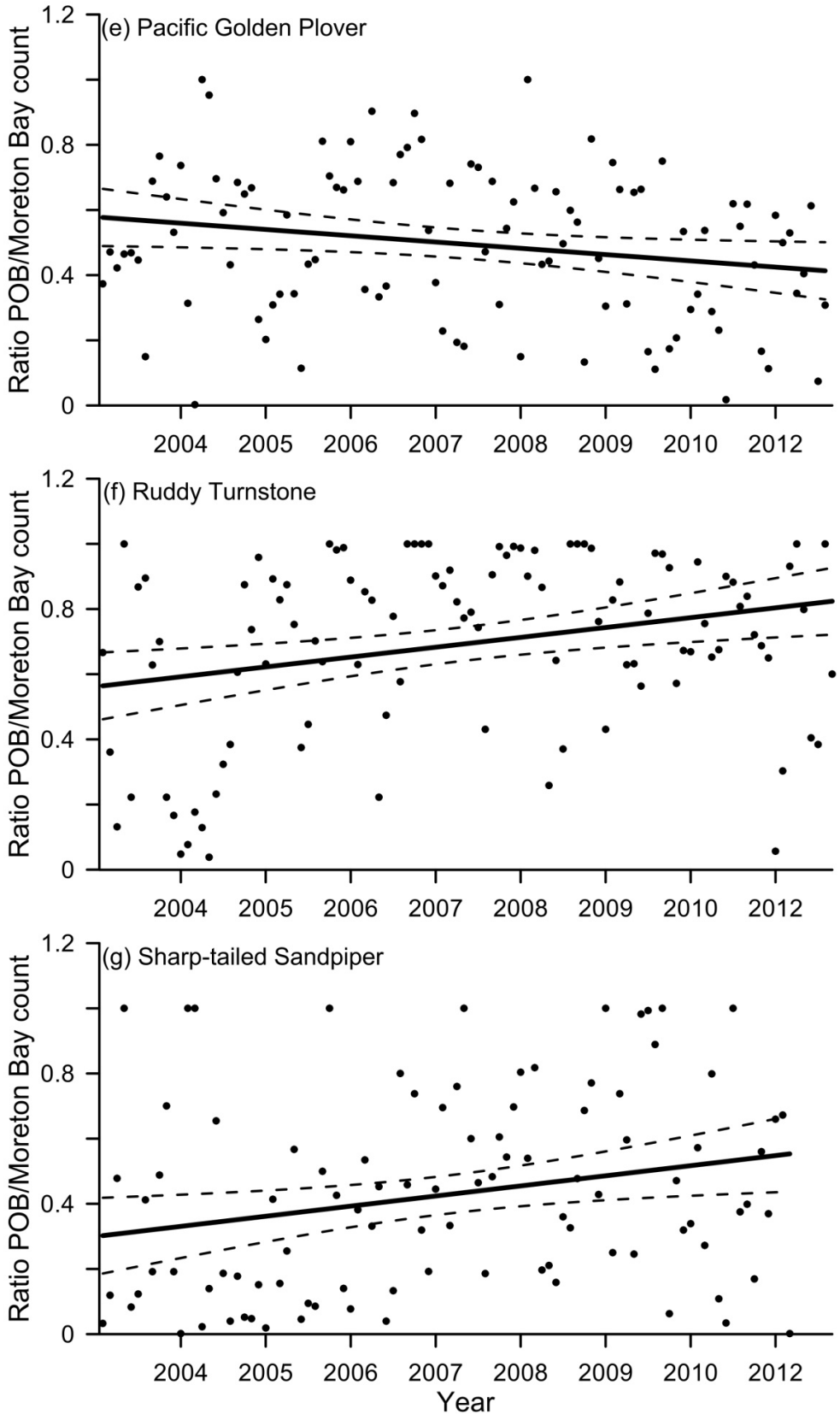


Figure 2. The species of migratory wader that showed a significant temporal trend in the IRI. The best fit mean and 95% confidence limits (dotted lines) are shown. Only counts made since the start of the comprehensive program by QWSG in January 2003 were analysed.

5. ANNUAL CHANGES IN WADER NUMBERS BETWEEN SITES WITHIN THE POB

This section firstly examines annual changes in total migratory wader numbers since 2003 (Figure 3) for the various areas, or site groupings within the POB. The areas are selections of neighbouring sites and are depicted in Figure 1 as areas A to D. The data are based only on records during the summer period for each year and the years are "wader" years as explained in Section 1. Area A is the purpose built roost site (PBAR) regularly used by birds but never in very large numbers. The claypan roost (FICP) is not included in the data presented in this section.

Similar graphs to Figure 3 for individual species are not displayed. However, they indicated that, with just a few exceptions, since 2008 or earlier, species have primarily been using area D for roosting, presumably because other areas are in more advanced stages of reclamation. This progressive replacement of suitable roosting habitat as reclamation continues has long been a feature of the Port lands. Earlier than 2008, area C was being supplanted by area B, which are both now superseded by area D.

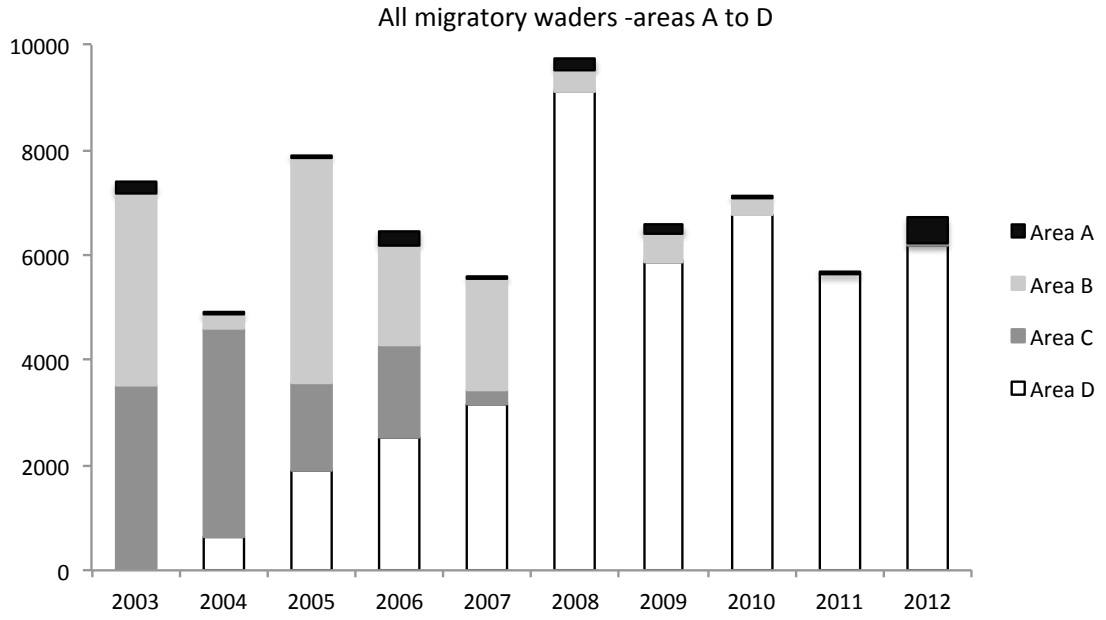


Figure 3. Average counts for the summer period of all migratory waders in four subsections of the Port lands for each "wader" year since 2003. Area A is the purpose built artificial roost site (PBAR) and the other areas are groupings of sites (see Figure 1).

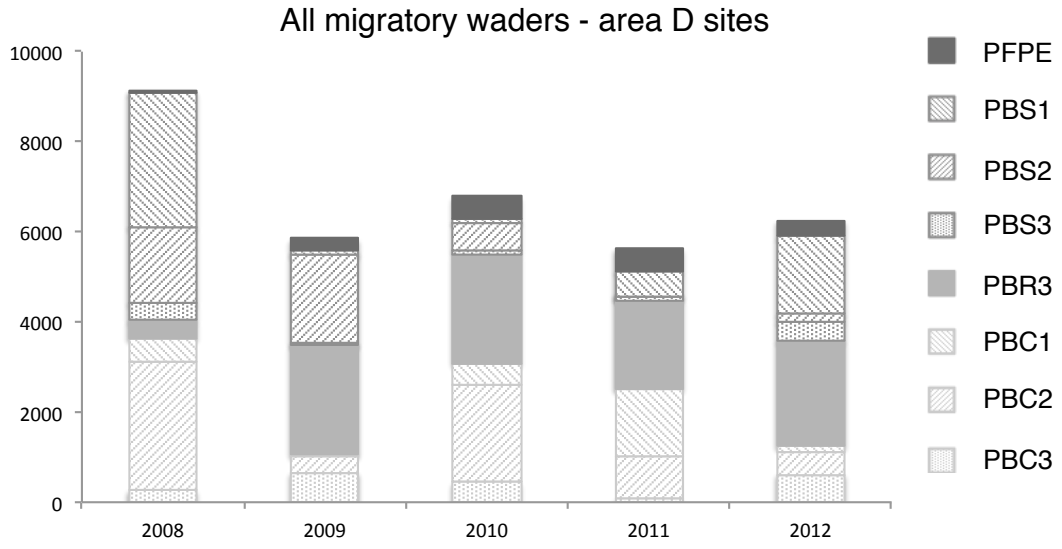
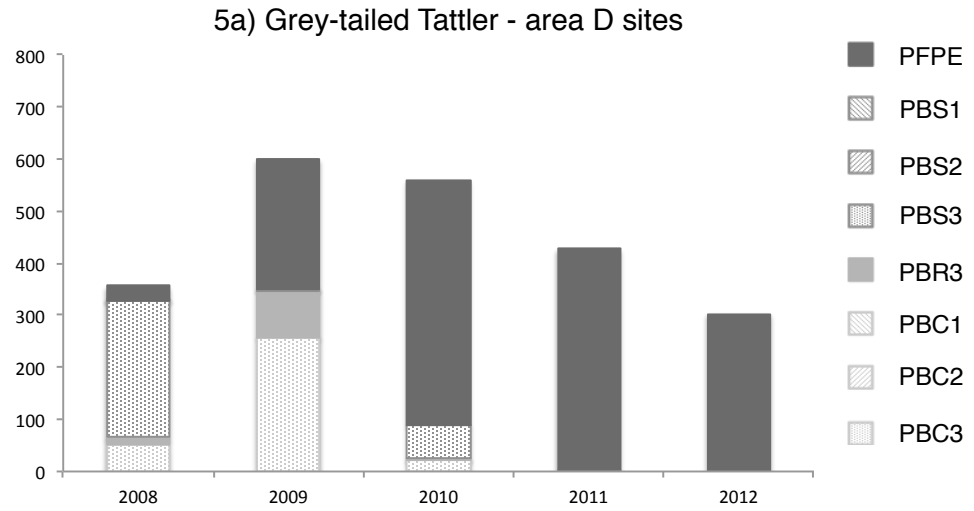
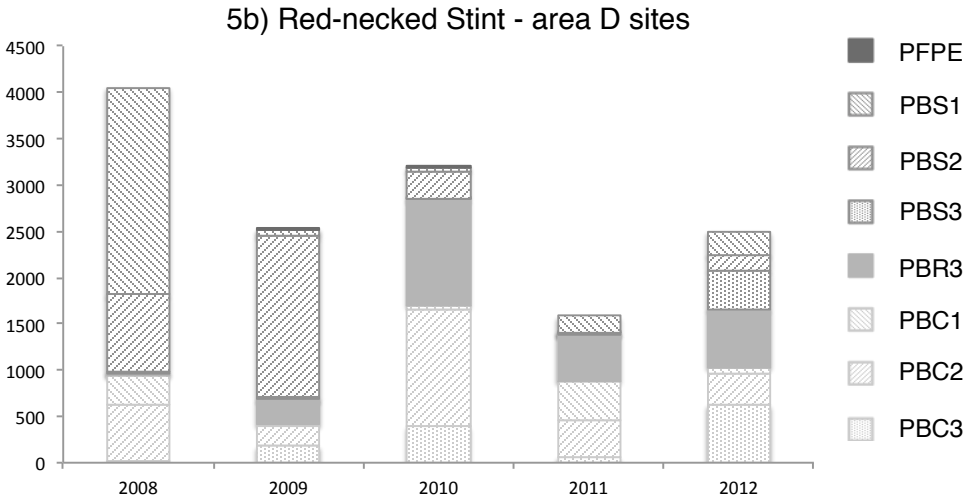


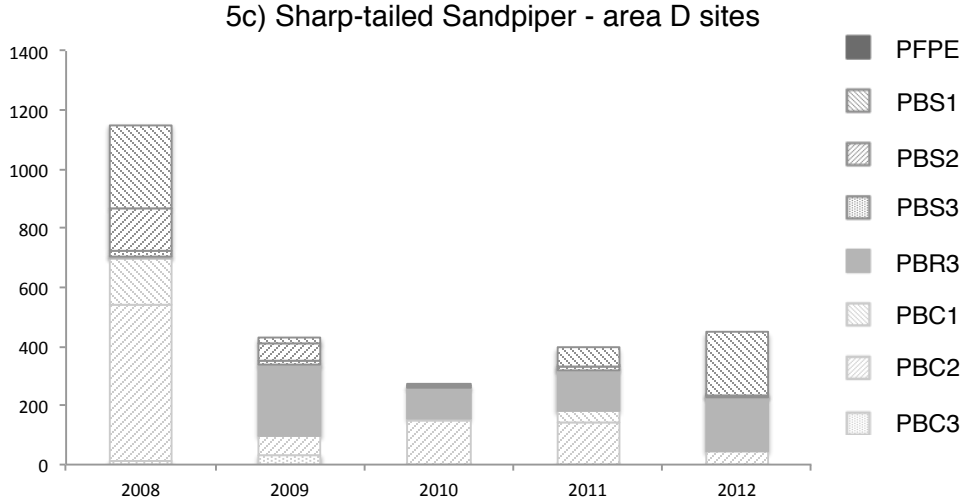
Figure 4. Average counts (summer) of all migratory waders in area D sites (see Figure 1).

The main focus of this section is on the use by birds of individual sites within area D since 2008. Figure 4 shows data for all migratory waders combined. PRB3 has maintained its importance since 2009 (about half the birds), whereas PBS1 was important in 2008 but not again until 2012. The reasons for these and similar change, especially for individual species are best examined in relation to changes of the various ponds over time. Therefore the graphs presented here are primarily for consideration of Port personnel who have an understanding of the processes that have been the basis for the ongoing reclamation of Port lands.

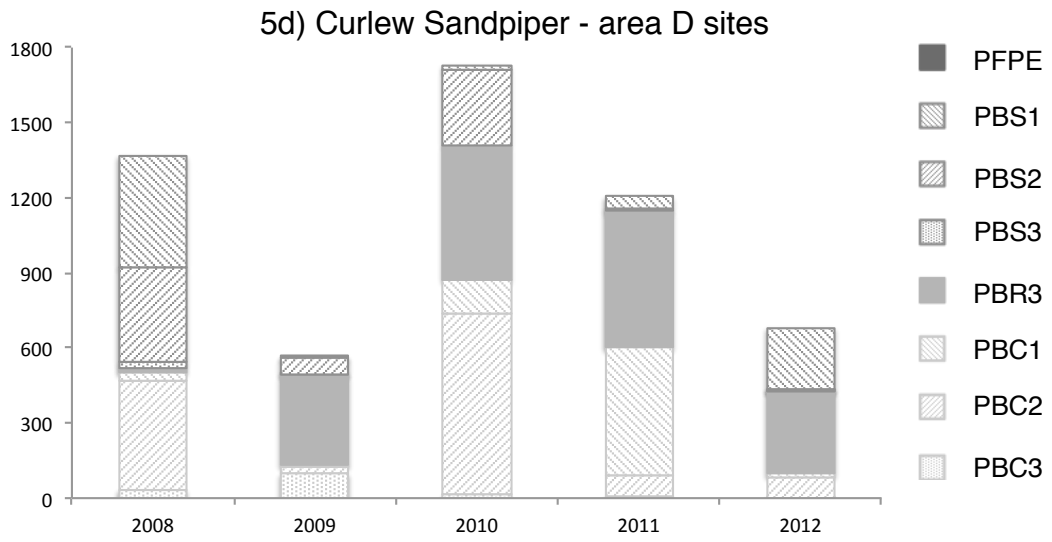
The distribution of summer season counts within area D for individual species are given in Figures 5a to l.

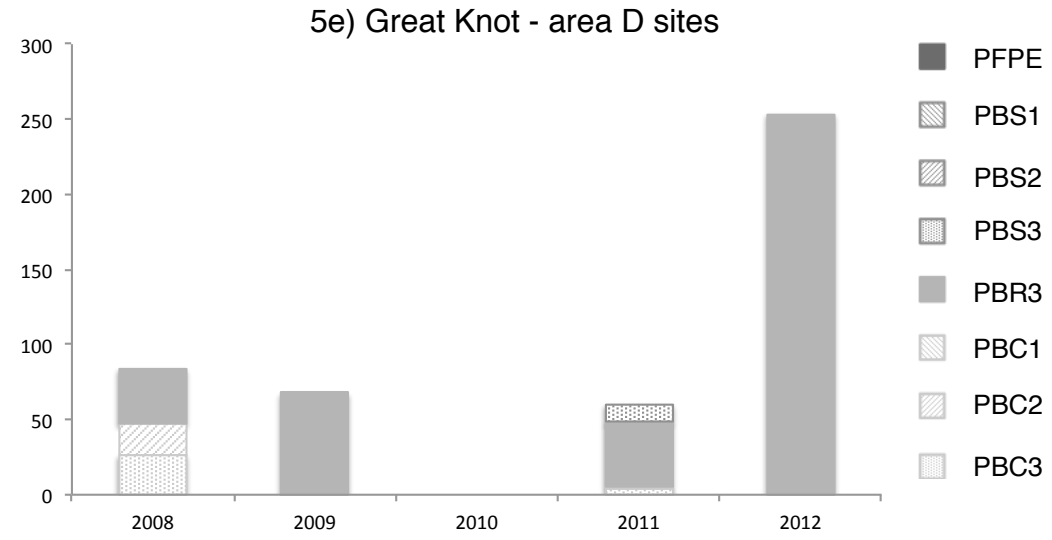


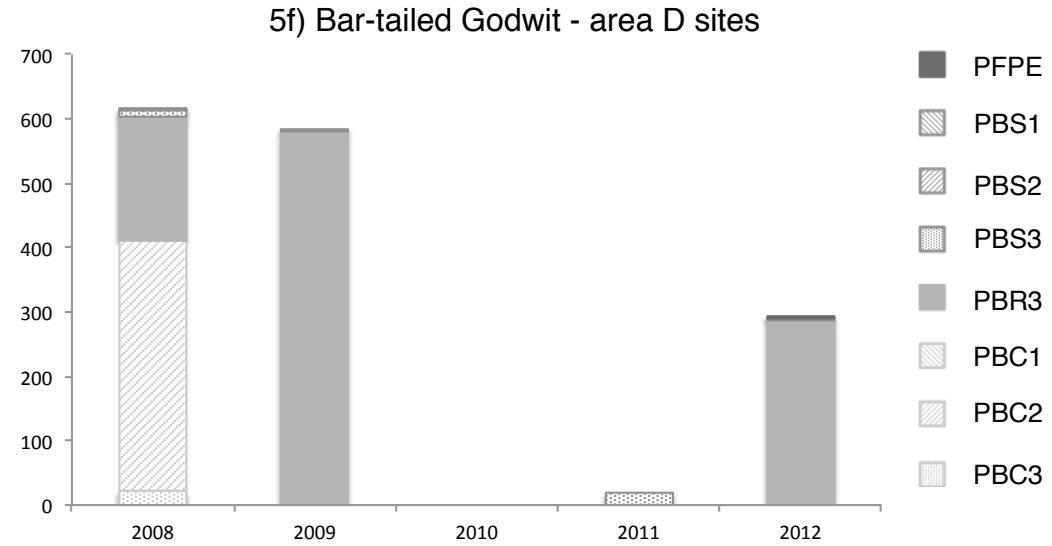




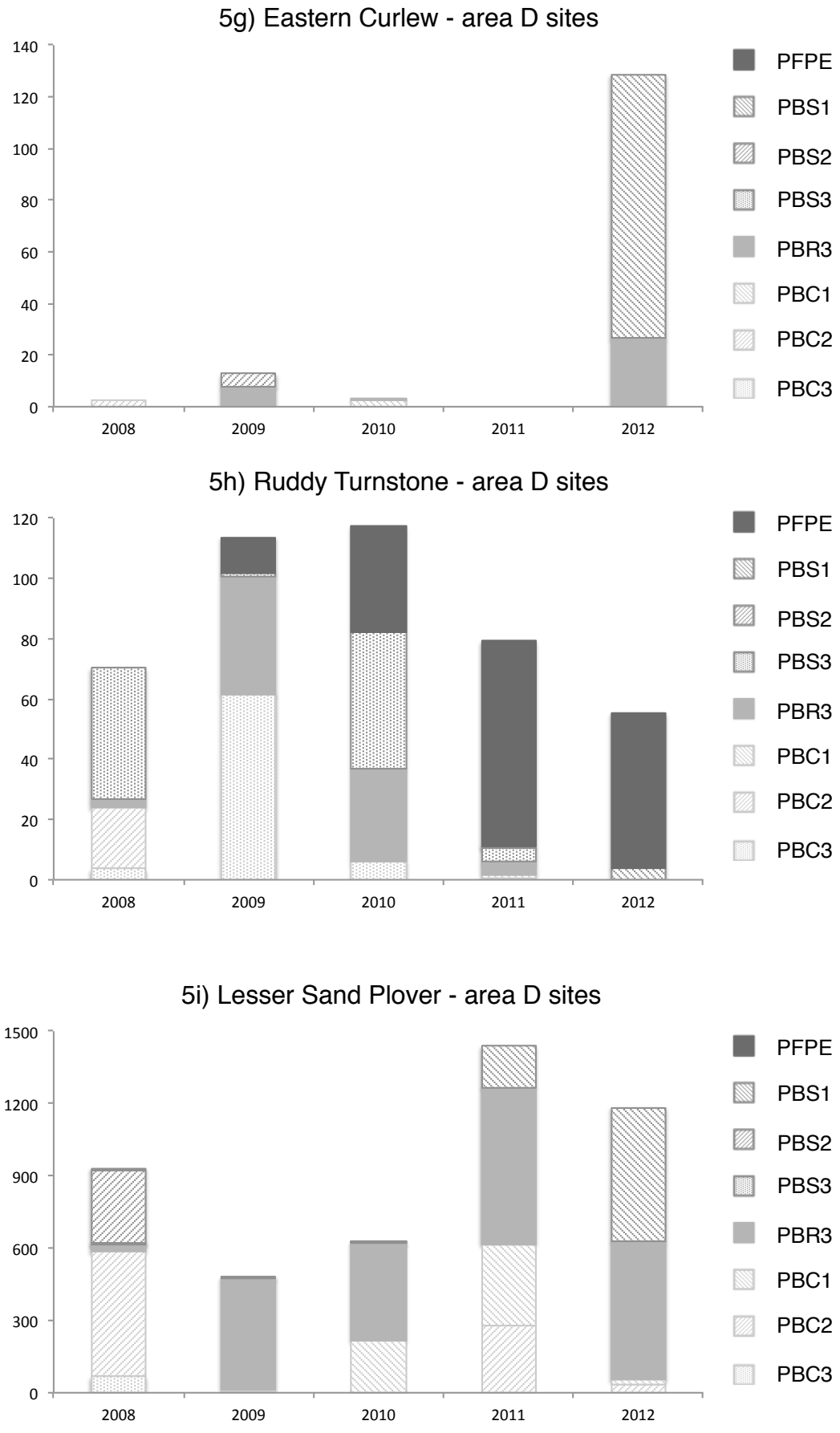
Figures 5a, b & c. Average counts (summer) of three species in area D sites (see Figure 1).



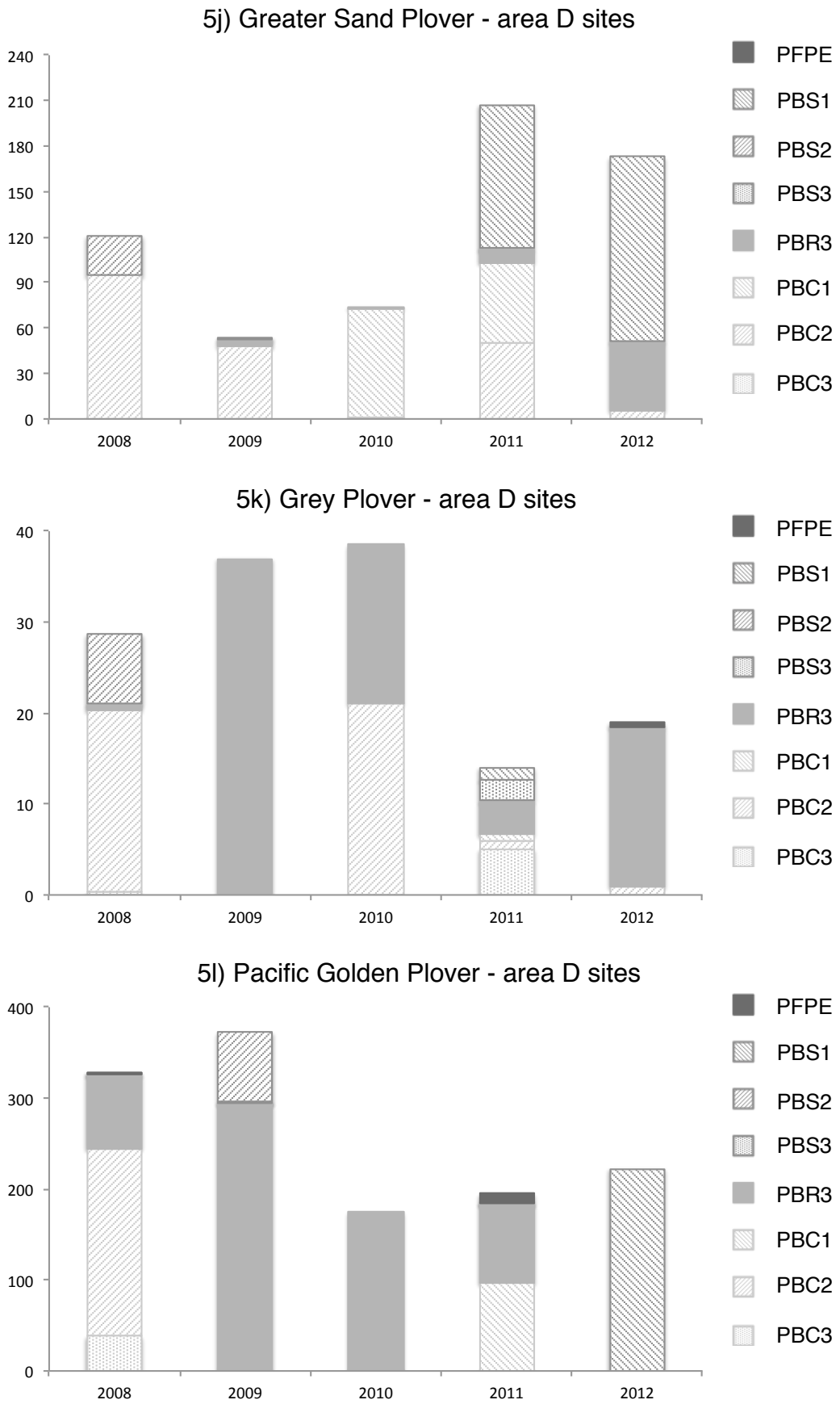




Figures 5d, e & f. Average counts (summer) of three species in area D sites (see Figure 1).



Figures 5g, h & i. Average counts (summer) of three species in area D sites (see Figure 1).

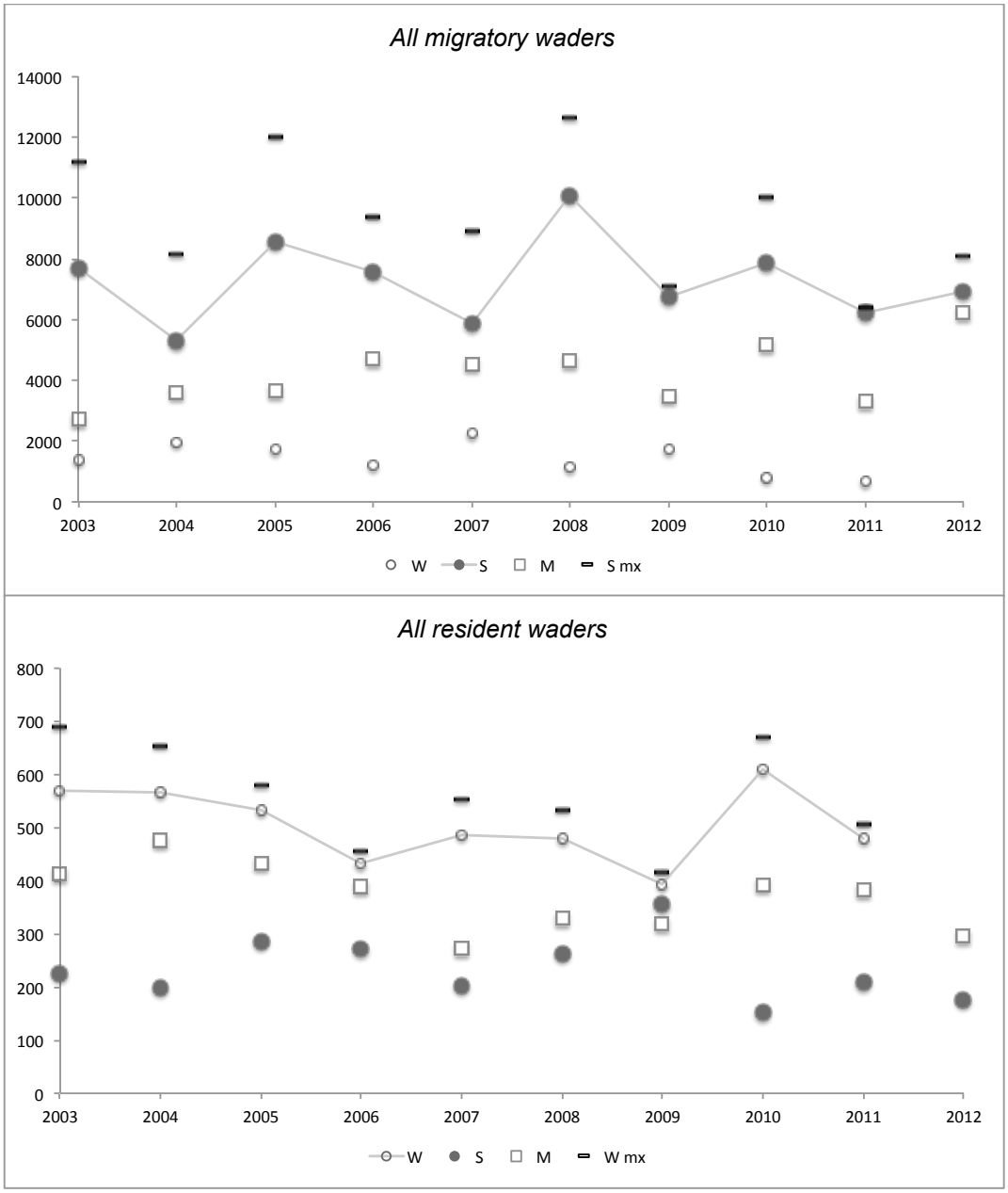


Figures 5j, k & l. Average counts (summer) of three species in area D sites (see Figure 1).

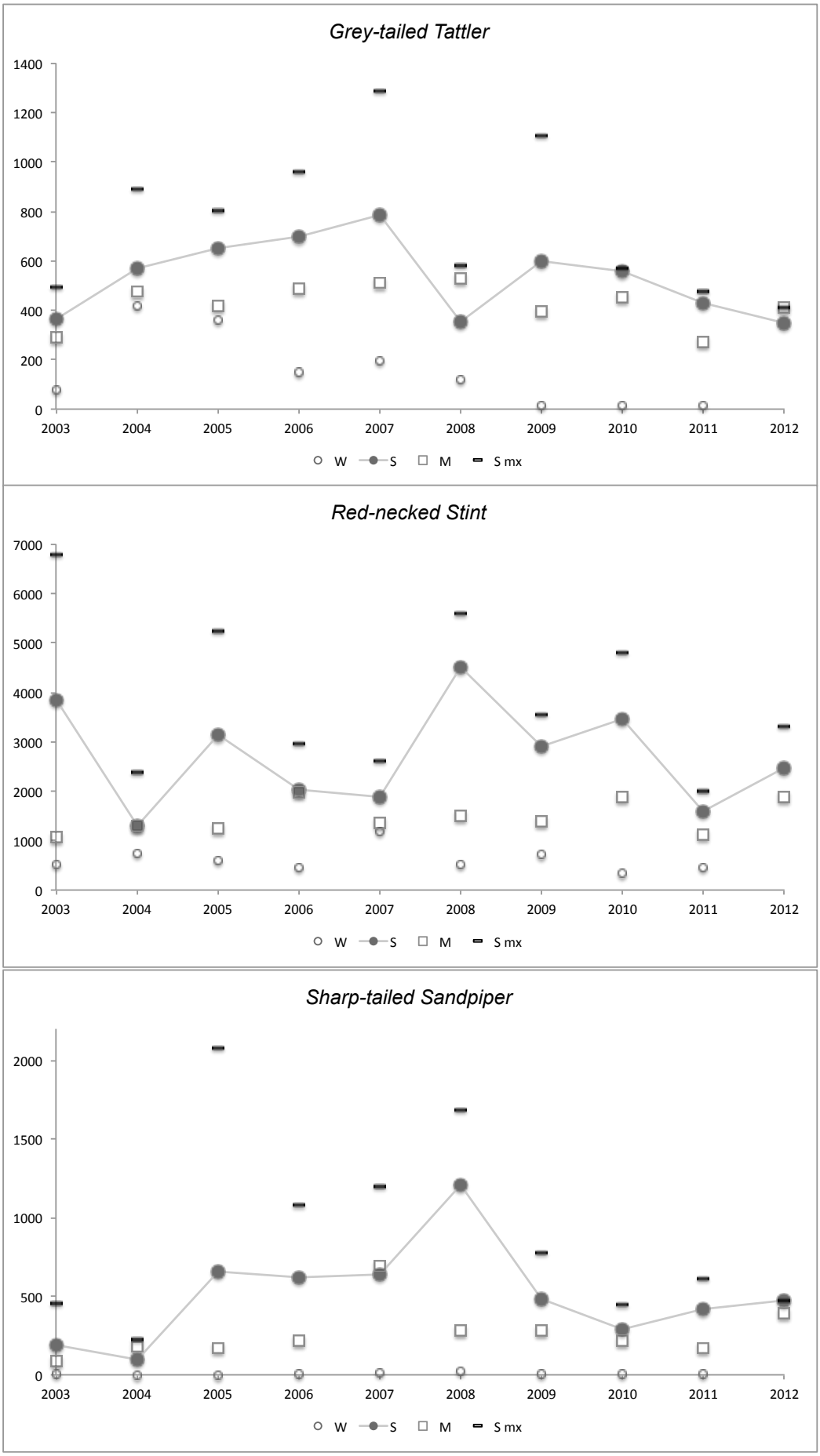
6. GRAHPICAL PRESENTATION OF LONG TERM TRENDS IN WADER NUMBERS

Data are available since 1991 but consistency in sampling procedures has been best since 2003. The data presented here are mean counts for different seasons across the Port lands, including the claypan (FICP) from 2003 until 2012. Again, seasons are defined as in Section 1 and the "wader" year is the relevant measure of time. On each graph mean values are presented as is the maximum values for the summer season. Mean values for all resident waders are also presented for each season and year but the maximums given are for the winter season (June to August), when resident waders tend to be at their peak abundances.

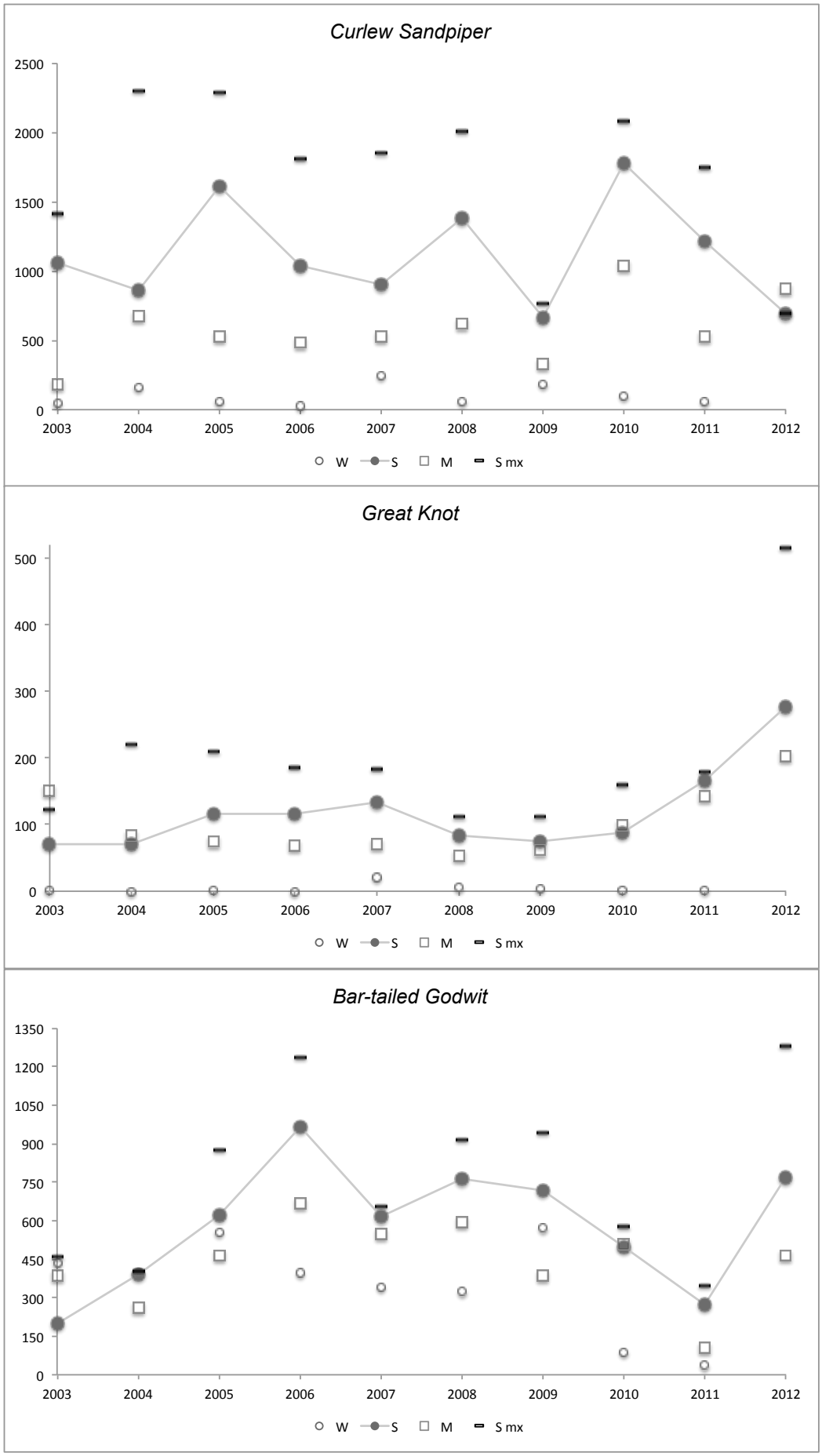
Figure 6a and b show the results for the combination of all migratory waders (a) and the combination of all resident waders (b). Figure 7a to l present the results for the twelve important species of migratory wader.



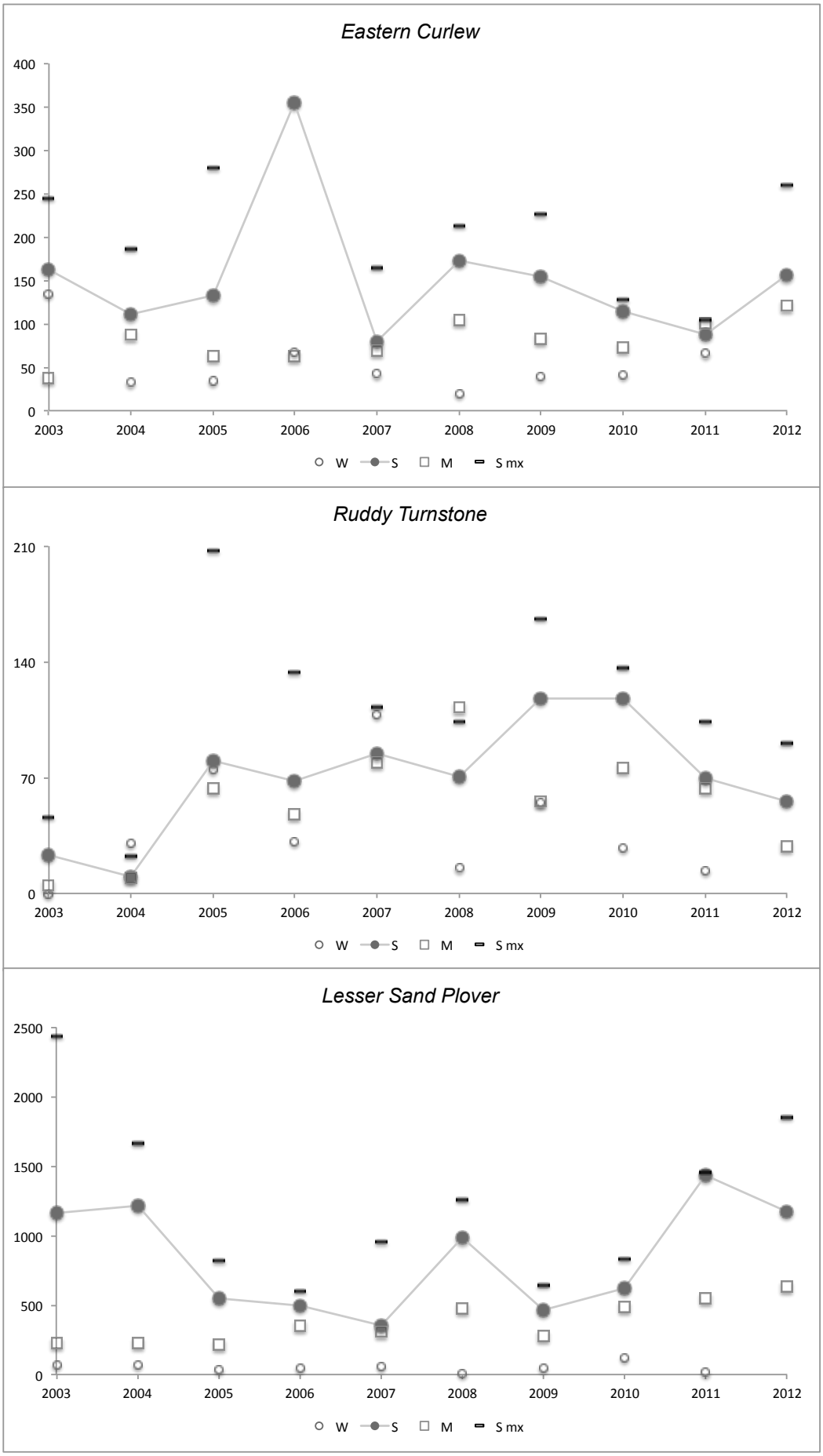
Figures 6a & b. Average counts for each season and "wader" year since 2013 for all migratory and all resident waders throughout the Port lands, including the claypan (FICP). W: winter (Jun to Aug); S: summer (mid Nov to mid March); M: migration periods (south – Sep to mid Nov and north – mid March to end of May. The "wader: year runs from the southward migration through to winter.



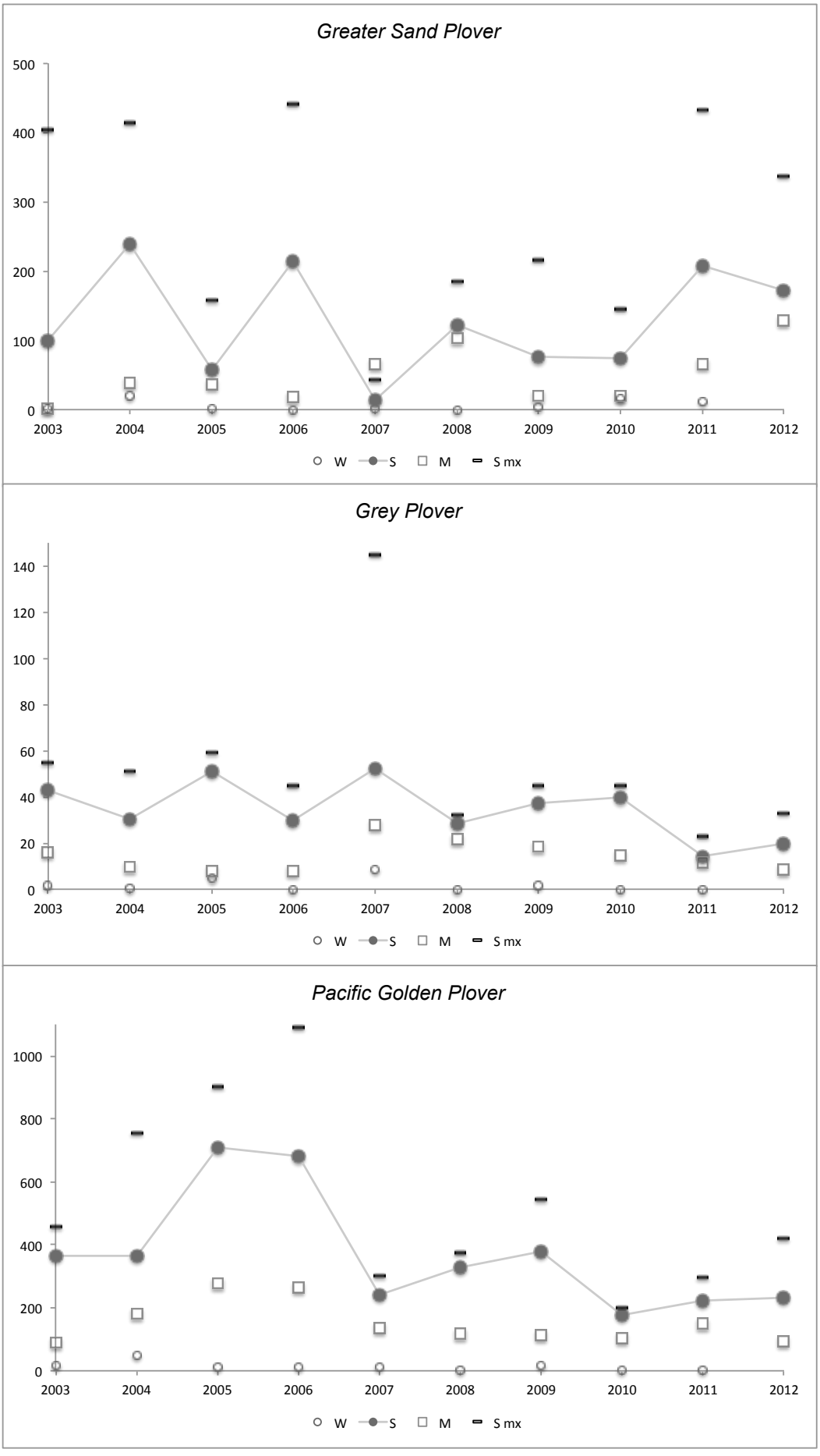
Figures 7a, b & c. Average yearly counts for the Port lands (Figure 1) of three species in different seasons (Winter, Summer & Migration) and maximum summer counts.



Figures 7d, e & f. Average yearly counts for the Port lands (Figure 1) of three species in different seasons (Winter, Summer & Migration) and maximum summer counts.



Figures 7g, h & i. Average yearly counts for the Port lands (Figure 1) of three species in different seasons (Winter, Summer & Migration) and maximum summer counts.



Figures 7j, k & l. Average yearly counts for the Port lands (Figure 1) of three species in different seasons (Winter, Summer & Migration) and maximum summer counts.

As noted earlier, average counts of total migratory waders do not appear to have changed appreciably over the last ten years (Figure 6a). However, the three highest counts of total birds occurred prior to 2009. Similarly, there is no distinct downward trend in total resident wader numbers on the Port Lands, although summer counts have been the lowest over the last three years, but only marginally so.

For individual species, there is some indication of long-term changes in numbers. However, none of these changes have been investigated statistically, other than through an examination of variances, which show considerable count-to-count variability. It is considered unlikely any year-to-year change in mean summer counts will prove to be statistically significant. It is considered that the best approach is to examine the graphs for any possible trends in the data and to watch for any critically low count as discussed in the next section.

Average numbers of Grey-tailed Tattler show a steady rise until 2007 and then a steady decline, apart from the dip in 2008 to return to about the same value 2012 as was recorded for 2003. Numbers of Red-necked Stint have fluctuated from year to year. Compared with the value for 2012, during the past ten years average summer numbers have been higher for 5 of those years and lower for four of those years. For the last four years, Sharp-tailed Sandpiper numbers have been higher than in 2003 and 2004 but lower than in the years from 2005 to 2009. The species may have a lower abundance than in the past but there is no suggestion yet of the beginning of a consistent downward trend. Curlew Sandpiper numbers have fluctuated with peaks every 2 to 3 years. Another year of sampling will indicate whether this pattern will be repeated as 2011 and 2012 were years of somewhat lower than normal counts. In contrast, Great Knot numbers over the last two years have been marginally higher than in other years since 2003. Bar-tailed Godwit numbers may be cyclical with a peak in 2005 followed by declining values but with the second highest average summer count in 2012. Again, continued monitoring will help clarify whether there is a cyclical pattern or an overall decline since 2005. Eastern Curlew counts have been fairly consistent with an unusually high count in 2006, which is probably best considered an anomaly. Similarly, Ruddy Turnstone numbers show no real change over time, other than the two lowest average values being in 2003 and 2004. The Lesser Sand Plover continues to occur on the Port lands in high numbers with recent average summer counts in 2011 and 2012 being amongst the four highest since 2003. The variability in Greater Sand Plover numbers is greater than for the Lesser Sand Plover, but also without any discernible long-term pattern. The data for Grey Plover and Pacific Golden Plover suggest otherwise and an overall downward trend is suggested by the graph of average summer counts, particularly in the case of Pacific Golden Plover (high values in 2005 and 2006). The data for both species deserve extra consideration and would be expected to show a statistically significant regression. Refer to Section 2 for comments on the presence of Pacific Golden Plover on the Port lands compared to elsewhere in Moreton Bay.

Table 5. Critical low counts (see text) and standard deviation of the untransformed summer counts since 2003 for the twelve important migratory wader species recorded on the Port lands.

Species	Critical low count	standard. dev
Grey-tailed Tattler	205	261
Red-necked Stint	927	1422
Sharp-tailed Sandpiper	54	483
Curlew Sandpiper	346	586
Great Knot	16	92
Bar-tailed Godwit	99	316
Eastern Curlew	37	115
Ruddy Turnstone	6	52
Lesser Sand Plover	114	542
Greater Sand Plover	6	147
Grey Plover	7	24
Pacific Golden Plover	110	244

7. CRITICAL COUNT VALUES OF EACH IMPORTANT SPECIES

Critical low summer values for any single count on the Port lands (including the claypan) for each of the twelve important species are listed in Table 5. These values have been calculated using natural log transformed data for each summer count since 2003 for the Port area. They represent the lower 90%

confidence limit of the sample mean of all post 2002 summer counts. That is, any single count lower than these limits will only occur by chance on average once in every ten counts. The values should be used as triggers to look more closely at the data, starting with a close examination of the patterns of variation in counts shown in Figure 8. Possible causes for a low count, such as changed site conditions, should be investigated. Similar low counts at other locations may have occurred and should also be considered.

Site management responses may be necessary to address any local issues of changed habitat conditions. A second consecutive count below these limits would be extremely unlikely and should trigger a higher level of concern with appropriate actions.

8. RECOMMENDATIONS

The analysis does not identify any clear trends in changes in the count of each wader species on POB lands since 2003. However, these data and the experience of QWSG members during the 11 years of monitoring of the site do suggest some recommendations that maybe helpful in maintaining the wader populations within the POB lands.

- The monitoring of waders and waterbirds within the POB lands continue with the same intensity and data recording detail. They should be sufficient to inform the POB Pty Ltd of substantial changes in counts of the most abundant species.
- The POB consider an analysis of patterns of habitat type use by waders based on the existing habitat types recorded on the data sheets. This analysis will better inform the proportions of each habitat required to support the existing wader populations as the POB approaches full reclamation. It will also identify those species with less flexibility in habitat choice and thus potentially enable habitat construction/maintenance prioritisation.
- Sufficient quantity of each of the roosting habitat types preferred by the 12 species that are present in nationally and internationally-important numbers be maintained. These habitats include wet margin of ponds, dry rubble/broken ground and shallow pools up to 5 cm deep and bund wall. Recent engineering works have drained and completely dried, up to 7 ponds concurrently. These ponds are no longer used by waders and the birds are only using a few ponds. More ponds need to be kept at a wetter stage of reclamation than currently occurs.
- The POB lands currently provide all, or the majority of roosting habitat in Moreton Bay for three species of migratory wader that also occur in internationally or nationally-significant numbers within the POB lands. The POB needs to better understand the use of the site by these species (Lesser Sand-Plover, Ruddy Turnstone and Sharp-tailed Sandpiper) in order to plan for the future when the redevelopment of the site is complete.