ANALYSIS OF THE STATUS OF WADERS IN THE PORT OF BRISBANE PTY LTD LAND BETWEEN JULY 2015 AND JUNE 2016

Includes an analysis of historical trend in counts and comparison with Moreton Bay populations

David A Milton

Queensland Wader Study Group

October 2016

Table of Contents

Section Page

EXECUTIVE SUMMARY

2016 Update

The monthly total counts of migratory waders in the POB land were similar in 2014 – 2015 to those made in previous years. The counts of resident species were higher than during recent years. The most important reclamation ponds were PBR3, PBC3, PFPE and the new site PBS4. Counts of Sharp-tailed Sandpiper, Greater Sand Plover and Pacific Golden Plover have increased from the low count in 2013 – 2014. The summer average counts of five of the 12 most abundant migratory wader species were below the updated low count thresholds for each species (Curlew Sandpiper, Eastern Curlew, Grey Plover, Sharp-tailed Sandpiper and Red-necked Stint). Ten species had individual monthly counts below their threshold during mid-summer (Table 6). The reasons that counts were below these low count triggers varied between species. For seven of the 10 species, QWSG counts in Moreton Bay suggest that the species has redistributed away from the POB reclamation area. For the other three species (Curlew Sandpiper, Grey Plover and Ruddy Turnstone), the number of birds counted in Moreton Bay by QWSG was also well below the long term mean.

Two wader banding catches were made in the POB Pty Ltd reclamation area in 2015 – 2016. These events caught 148 waders of eight species. All waders were fitted with individually-labelled lime green leg flags to allow resighting of individual birds. Forty-four waders of five species were resighted during the remainder of 2015 – 2016. Overseas sightings were made in three countries on northward migration: Korea and Taiwan (Great Knot) or Japan (Bar-tailed Godwit, Great Knot and Pacific Golden Plover). QWSG member Robert Bush participated in a 7 week expedition to northern Kamchatka Peninsula that covered the southward migration period. The expedition monitored birds along the coast and around estuaries near their base camp that was a short distance south of the main Great Knot breeding grounds. He saw three Great Knot on southward migration in July 2016 that had been banded in the POB reclamation area on 30 January, 2016.

Overall summary

For over two decades, high numbers of migratory waders have used Port of Brisbane (POB) land as high tide roosting habitat. 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. This is the fourth annual report on the status of waders in the POB land. This report updates the previous report (October 2015) and highlights any changes that have occurred during the year.

POB Pty Ltd has detailed reports on bird usage of the reclamation area throughout the 1990s. Since 2003, the Queensland Wader Study Group have undertaken regular monthly counts of birds in the reclamation area, the nearby claypan and at the purpose-built artificial high tide roost. This report is the fourth annual report resulting from counts undertaken by QWSG. The species that are most important within the POB reclamation area are identified and their numbers on POB land are compared with their numbers across the whole of Moreton Bay. Counts for each pond that is in the process of reclamation during July 2015 to May

2016 are tabulated. No survey was made in June 2016 due to inclement weather. Annual changes since 2003 in the distribution of roosting birds across the reclamation area are also presented.

There are twelve important species within the POB reclamation area 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 sandpipers (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 18 species were recorded at any one time during the summer. Numbers of resident waders were substantially higher during the winter months in 2015 – 2016. Over the last decade, the numbers of most species of migratory wader have remained stable and the reclamation area remains the most important single roosting area for waders in the whole of Moreton Bay (and south-east Queensland). The data suggest that the relative importance of the reclamation area for three species of wader (Great Knot, Greater Sand Plover and Ruddy Turnstone) may have increased slightly since 2003. The proportion of Moreton Bay counts of Red-necked Stint roosting within the POB reclamation area has decreased during the same period.

Subsections of the POB land have been used to show changes in the distribution of waders across the reclamation area 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 material is being deposited and then move on as deposition stops and the material 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 POB land as a whole since 2003, the pattern of annual change in counts varies between species but without any significant trend in overall abundance of waders. These patterns are described and continued sampling will help to establish whether there are cyclical patterns or distinct increasing or decreasing trends in counts. Grey Plover counts may need closer scrutiny and 2015/2016 had the lowest mean summer count since QWSG began surveying in 2003. Low count thresholds for each of the twelve species that have substantial populations in the POB land are tabulated. A decline in the numbers of birds of any species below the threshold during a November – March survey can serve as a trigger to illicit further investigation and/or management responses at the site.

BACKGROUND

The Port of Brisbane Pty Ltd (POB) reclamation area attracts large populations of migratory waders at high tide. These birds are attracted to the large area of feeding and roosting habitat provided by the pumping of dredge material. 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 under a management plan required by the federal government's EPBC Act. The management plan was developed as part of the approval for the development of the port reclamation expansion. These data provide a long time series of wader and waterbird counts with which to examine the relative importance of the reclamation area for waders. At the same time, QWSG members have also made monthly counts at between 50 and 65 other high tide roosts 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 fourth of these annual assessments will summarise data collected to June 2016 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).

5. Summary of the recoveries of waders caught and banded on the Port of Brisbane reclamation site.

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 order of decreasing importance these are Grey-tailed Tattler, Red-necked Stint, Lesser Sand Plover, Curlew Sandpiper, Sharp-tailed Sandpiper, Eastern Curlew and Pacific Golden Plover. In addition, the POB held > 0.5% of the flyway population of another four species of migratory wader (Great Knot, Greater Sand Plover, Ruddy Turnstone and Bar-tailed Godwit). A further species, Grey Plover was regularly present (> 50% 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 POB land (including the claypan) during the non-breeding season (15 November – 15 March) since 2003. Grey Plover has been included as the POB is the most important site for this species in the region. N = the number of monthly surveys since January 2003 that include each species.

Species	Maximum count (% flyway population)	Proportion of POB counts (%) (N)
Grey-tailed Tattler	1288 (2.6)	89 (93)
Red-necked Stint	6803 (2.1)	100 (105)
Lesser Sand Plover	2413 (1.7)	93 (98)
Curlew Sandpiper	2712 (1.5)	98 (103)
Sharp-tailed Sandpiper	1990 (1.2)	78 (82)
Eastern Curlew	473 (1.2)*	68 (71)
Pacific Golden Plover	1090 (1.1)	82 (86)
Great Knot	2600 (0.7)*	90 (95)
Greater Sand Plover	669 (0.6)	86 (90)
Ruddy Turnstone	207 (0.6)	87 (91)
Bar-tailed Godwit	1604 (0.5)	96 (101)
Grey Plover	145 (0.1)	55 (58)

* Counts that included both the reclamation area and the claypan.

Figure 1. Wader count sites and site groupings (Areas) within the POB land reclamation area. The ponds 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.

RECENT COUNTS OF MIGRATORY WADER SPECIES AT THE PORT OF BRISBANE

The numbers of migratory wader species and total migratory and resident 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 July 2015 and June 2016 are presented (Tables 2 and 3). The same breakdown of counts for each of the important species (Table 1) is tabulated in Table 4. Two new subsections were added to the sites counted by QWSG during 2013/2014 (Fig. 1).

Collectively, Tables 2 – 4 are representative of the last 12 months of high tide counts at the POB. Data has been presented on the basis of the same set of tables in each annual report. 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 Australia 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 ageing 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 "2015" label represents the period from September 2015 to June 2016.

Based upon Tables 2 – 4, counts of total migratory and total resident waders and the number of species for each group are consistent with data from previous years (see also Fig. 5). 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 changing 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 the 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 18 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 POB land remains the most important area for migratory waders in Moreton Bay (Section 2). Since July 2015, there have been significant counts within the POB reclamation area of greater than 1% of the flyway population of Grey-tailed Tattler, Curlew Sandpiper, Red-necked Stint and Lesser Sand Plover. Another three species reached nationally-important numbers (>0.5% flyway population) during the periods of migration. These were the Bar-tailed Godwit, Sharp-tailed Sandpiper and Pacific Golden Plover. 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 (Figure 6).

Table 2. Counts of all migratory wader species (a) total birds and (b) number of species recorded in each pond in the POB reclamation area between July 2015 and May 2016. 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). NC = no count due to inclement weather.

(a) Total counts

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	75		65	1	433	991	118	207	691	368	927	NC	3876
PBAR		13	123	629	447	179	793	355	121	80		NC	2740
PBC2	9	4	–	3	2	–	–	–	31	–	24	NC	1947
PBC3	1	3	–	–	23	2	1709	4840	8622	2066	26	NC	8103
PBR3	91	319	4314	6222	4418	3219	6152	2687	2606	16	15	NC	17055
PBS1	–	–	–	–	199	20	11	36	164	–	–	NC	11
PBS2	2	–	–	–	–	–	–	–	–	–	–	NC	1168
PBS3	16	41	523	73	673	42	161	124	886	52	12	NC	13141
PBS4	492	621	1097	952	881	61	12	28	5	–	2	NC	5912
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	1
PFPE	252	114	41	43	131	1291	105	211	470	1638	52	NC	7760
Total	1049	2182	6765	9866	8987	9478	5658	6043	6130	2186	3370	NC	61714

(b) Number of species

Site Code	Breeding		South migration		Non breeding					North migration		Breeding
	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16
FICP	1	–	4	1	5	8	4	6	7	8	5	NC
PBAR	–	1	7	10	7	8	7	10	7	6		NC
PBC2	–	–	–	–	–	1	–	–	4	6	1	NC
PBC3	1	5	5	3	8	3	2	4	9	5	3	NC
PBR3	2	1	12	14	11	10	9	8	13	2	1	NC
PBS1	–	–	–	1	–	–	–	–	1	2	–	NC
PBS2	–	–	5	2	–	1	–	–	–	2	3	NC
PBS3	2	6	4	4	5	5	5	10	6	2	9	NC
PBS4	3	1	5	10	5	8	5	7	2	4	9	NC
PLDE	–	–	–	–	–	–	1	–	–	–	–	NC
PFPE	1	3	10	9	3	9	11	7	7	1	7	NC
Total no. spp.	9	10	17	17	15	15	14	17	18	16	15	NC

Table 3. Counts of all resident wader species (a) total birds and (b) number of species recorded in each pond between July 2015 and June 2016. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non-breeding) and migration (south and north migrations). NC = no count due to inclement weather.

(a)	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	36	9	16	1	4	4	4	3	90	77	76	NC	320
PBAR	173	96	28	25	36	53	47	77	36	24	57	NC	652
PBC2	2	–	–	–	–	2	–	–	32	13	36	NC	85
PBC3	687	96	45	36	434	34	6	2	116	447	7	NC	1910
PBR3	28	831	15	4	10	19	5	4	8	3	2	NC	929
PBS1	–	6	7	1	2	–	–	–	20	17	16	NC	69
PBS2	5	4	43	1	6	9	–	–	–	6	16	NC	90
PBS3	63	121	545	32	164	339	94	119	96	2	419	NC	1994
PBS4	41	4	9	23	9	4	98	131		9	95	NC	423
PLDE	2	–	–	–	–	–	1	2	–	–	–	NC	5
PFPE	3	4	4	–	–	9	–	4	–	9	6	NC	39
Total	1040	1171	712	123	665	473	255	342	398	607	730	NC	6516

(b)	Breeding		South migration		Non breeding					North migration		Breeding
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16
FICP	3	2	2	1	3	2	1	2	3	3	2	NC
PBAR	2	4	2	3	4	4	4	5	3	2	3	NC
PBC2	1	–	–	–	–	1	–	–	1	2	1	NC
PBC3	3	3	2	2	4	3	2	1	2	3	2	NC
PBR3	1	2	1	2	3	2	1	1	1	1	1	NC
PBS1	–	1	1	1	1	–	–	–	1	1	1	NC
PBS2	1	2	3	1	1	1	–	–	–	1	1	NC
PBS3	3	3	2	2	4	3	2	2	3	1	3	NC
PBS4	3	1	3	3	3	3	2	1	–	–	3	NC
PLDE	–	–	–	–	–	–	1	1	–	–	–	NC
PFPE	2	1	2	1	–	1	–	2	–	2	2	NC
Total no. spp.	3	4	3	3	4	4	4	5	3	4	4	NC

Table 4. Counts of the 12 most abundant migratory wader species recorded in each pond of the POB reclamation area between July 2015 and May 2016. Refer to Table 2 and Figure 1 for details. Seasons are winter (breeding), summer (non-breeding) and migration (south and north migrations). NC = no count due to inclement weather.

Grey-tailed Tattler

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	–	–	–	–	4	–	NC	4
PBAR	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBR3	–	–	–	–	223	146	–	–	21	–	–	NC	390
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	–	–	–	–	–	–	–	–	–	9	NC	9
PBS4	204	640	1009	843	174	62	583	1175	383	–	65	NC	5138
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	134	3	3	–	202	43	408	–	543	–	218	NC	1354
Total	336	643	1012	843	599	251	991	1175	947	4	283	NC	6882

Red-necked Stint

Site Code	Breeding		South migration		Non breeding					North migration		Breeding	Total
	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	
FICP	–	–	–	–	332	56	6	47	45	258	158	NC	902
PBAR	–	–	–	26	–	11	16	48	104	70	–	NC	275
PBC2	–	–	–	–	–	–	–	1	368	781	55	NC	1206
PBC3	–	–	21	465	602	1799	14		516	–	82	NC	3499
PBR3	511	–	268	996	645	32	192	107	749	20	15	NC	3535
PBS1	–	–	–	2	–	–	–	–	–	7	–	NC	9
PBS2	–	–	340	11	66	–	–	–	–	1	13	NC	431
PBS3	–	442	626	660	1815	656	902	686	166	7	1564	NC	7524
PBS4	–	–	10	188	12	3	28	5	–	25	124	NC	395
PLDE	–	–	–	–	–	–	1	–	–	–	–	NC	1
PFPE	–	2	662	161	–	1487	3	2	14	–	11	NC	2342
Total	511	444	1927	2509	3472	4045	1162	896	1962	1169	2022	NC	20119

Sharp-tailed Sandpiper

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	22	–	85	31	–	11	3	3	–	NC	155
PBAR	–	–	18	83	10	75	33	22	4	1	–	NC	246
PBC2	–	–	–	–	–	–	–	–	3	–	–	NC	3
PBC3	–	–	–	11	188	86	24	24	5	4	–	NC	342
PBR3	–	–	2	867	–	42	52	13	124	–	–	NC	1100
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	422	1	–	–	–	–	–	–	–	NC	423
PBS3	1	154	136	168	278	260	93	12	6	–	19	NC	1127
PBS4	–	–	–	10	4	6	2	–	–	1	–	NC	23
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	6	2	–	4		1	2	–	–	NC	15
Total	1	154	606	1142	565	504	204	83	147	9	19	NC	3434

Curlew Sandpiper

Site Code	Breeding		South migration		Non breeding					North migration		Breeding	Total
	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	
FICP	–	–	–	–	–	11	–	–	–	1	–	NC	12
PBAR	–	–	22	6	–	17	3	6	2	1	–	NC	57
PBC2	–	–	–	–	–	–	–	–	40	10	–	NC	50
PBC3	–	76	308	136	1427	116	–	–	6	110	2	NC	2181
PBR3	–	–	102	1540	4	250	39	29	273	–	–	NC	2237
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	290	–	–	–	–	–	–	–	–	NC	290
PBS3	–	287	273	245	160	438	171	777	6	–	4	NC	2361
PBS4	22	–	–	8	2	11	–	2	–	–	3	NC	48
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	1	1	54	–	6	14	–	–	–	–	NC	76
Total	22	364	996	1989	1593	849	227	814	327	122	9	NC	7312

Great Knot

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	14	–	–	70	6	1	NC	91
PBAR	–	–	38	33	8	36	–	24	–	–	–	NC	139
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	105	14	–	–	–	–	7	84	–	–	NC	210
PBR3	–	33	110	250	347	582	313		102	–	–	NC	1737
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	32	–	–	–	–	–	–	–	–	–	NC	32
PBS4	–	–	–	–	–	–	–	–	–	–	–	NC	0
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	–	–	–	–	107	150	–	–	–	NC	257
Total	0	170	162	283	355	632	420	181	256	6	1	NC	2466

Bar-tailed Godwit

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	638	–	28	470	54	229	NC	1419
PBAR	–	–	195	366	362	70	690	212	–	1	–	NC	1896
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	72	220	575	–	179	–	–	–	91	21	–	NC	1158
PBR3	–	–	362	1007	646	616	297	–	316	–	–	NC	3244
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	65	–	–	–	–	–	73	–	–	–	NC	138
PBS4	–	–	–	14	2	2	2	–	–	–	7	NC	27
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	9	96	–	30	266	386	–	–	3	NC	790
Total	72	285	1141	1483	1189	1356	1255	699	877	76	239	NC	8672

Eastern Curlew

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	75	–	16	1	2	121	101	79	52	–	201	NC	648
PBAR	–	–	2	2	2	1	1	2	1	1	–	NC	12
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	69	37		25	–	–	–	–	27	1	NC	159
PBR3	–	–	26	106	–	–	–	–	–	–	–	NC	132
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS4	–	–	–	–	–	–	–	–	–	5	–	NC	5
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	–	–	–	–	–	–	–	–	–	NC	0
Total	75	69	81	109	29	122	102	81	53	33	202	NC	956

Pacific Golden Plover

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	12	18	10	11	–	4	–	NC	55
PBAR	–	–	1	2	7	3	2	3	5	5	–	NC	28
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	–	–	–	22	–	–	–	–	–	14	NC	36
PBR3	–	–	86	14	484	–	425	298	214	–	–	NC	1521
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	–	–	–	–	–	–	33	–	10	2	NC	45
PBS4	–	–	–	–	–	–	3	1	–	–	28	NC	33
PLDE	–	–	–	–	–	–	–		–	–	–	NC	0
PFPE	–	–	96	264	–	123	135	216	–	–	4	NC	838
Total	0	0	183	281	525	144	575	562	219	19	48	NC	2556

Ruddy Turnstone

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	2	15	48	37	–	–	–	–	–	–	NC	102
PBR3	–	–	12	1	–	–	3	9	44	–	–	NC	69
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	–	–	–	–	5		18			46	NC	69
PBS4	–	–	24	30	–	2	–	85	15	–	54	NC	210
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	–	–	–	10	122	15	36	9	4	NC	196
Total	0	2	51	79	37	17	125	127	95	9	104	NC	646

Lesser Sand Plover

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC2	–	–	–	–	–	–	–	–	39	575	–	NC	614
PBC3	–	–	–	75	–	–	–	–	313	–	–	NC	388
PBR3	–	–	134	85	177	395	72	279	622	–	–	NC	1764
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	4	NC	4
PBS3	–	–	–	8	153	53	398	889	11	–	65	NC	1578
PBS4	–	–	–	3	–	–	–	–	–	4	–	NC	8
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	42	263	–	960	2	–	18	–	22	NC	1307
Total	0	0	177	##	330	1409	472	1168	###	##	91	NC	5663

Greater Sand Plover

Site Code	Breeding		South migration		Non breeding					North migration		Breeding	Total
	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	
FICP	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	–	–	–	–	–	–	2	73	–	–	NC	75
PBR3	–	–	2		209	5		19	48	–	–	NC	283
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS3	–	–	–	–	1	–	46	105	–	–	8	NC	160
PBS4	–	–	–	–	–	–	–	–	–	20	–	NC	27
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	38	28	–	–	21	–	1	–	–	NC	88
Total	0	0	40	28	210	5	67	133	122	20	8	NC	633

Grey Plover

	Breeding		South migration		Non breeding					North migration		Breeding	
Site Code	05-Jul-15	30-Aug-15	27-Sep-15	18-Oct-15	15-Nov-15	13-Dec-15	17-Jan-16	14-Feb-16	13-Mar-16	10-Apr-16	08-May-16	05-Jun-16	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBC3	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBR3	–	–	24	11	–	–	4	18	5	–	–	NC	62
PBS1	–	–	–	–	–	–	–	–	–	–	–	NC	0
PBS2	–	–	–	–	–	–	–	–	–	1	–	NC	1
PBS3	–	–	–	–	–	–	–	31	–	–	–	NC	31
PBS4	3	–	–	–	–	1	–	3	–	–	–	NC	7
PLDE	–	–	–	–	–	–	–	–	–	–	–	NC	0
PFPE	–	–	–	–	–	–	2	–	–	–	–	NC	2
Total	3	0	24	11	0	1	6	52	5	1	0	NC	103

COMPARISON OF WADER NUMBERS BETWEEN THE POB AND MORETON BAY

This section presents a comparison of migratory wader numbers between the POB lands (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 that is comparable with the POB land. Thus, I 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 land to Moreton Bay wader populations (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 land. Temporal changes in the ratio would be expected to reflect local changes in the relative importance of the POB land 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 reduction 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 consistency, we decided to restrict the analysis of the temporal trend in the IRI to post January 2003 counts when the POB has been counted in a similar way.

TEMPORAL TREND IN IRI FOR THE POB RECLAMATION AREA

The relative importance of the POB lands for waders varied widely between months, both within a year and between years. There was a weak statistically significant trend in the IRI for four of the 12 species of wader examined ($r^2 < 0.21$; Figure 3). Most species, Bar-tailed Godwit, Curlew Sandpiper, Eastern Curlew, Grey-tailed Tattler, Grey Plover, Lesser Sand Plover, Pacific Golden Plover and Sharp-tailed Sandpiper showed no significant temporal trend in the IRI.

The POB land is the most important high tide roost in Moreton Bay for most species of migratory wader counted. The mean percentage of the Moreton Bay count of species present in the POB land this year varied between 21% (Bar-tailed Godwit) up to 90% for Grey Plover. Eastern Curlew is an exception as the POB land only supported a mean of 11% of the estimated Moreton Bay population in 2015 – 2016.

The fit of the significant trends in the IRI were all quite weak, with the best correlation being Greater Sand Plover ($r^2 = 0.21$; $P<0.001$). The correlations for the three other species were all less than $r^2 = 0.2$ but were still highly significant ($P<0.001$). Three of the four species of wader had a significant increasing temporal

trend in the IRI (Fig. 3). This implies that these species are increasingly preferring to use the POB land. Since 2003, the POB land regularly held the entire Moreton Bay count for two of the four species – Greater Sand-Plover and Ruddy Turnstone. This reflects the quantity of preferred roosting habitat available within the POB land for these species. Each species prefers different habitats but there is an excess of these preferred habitats available within the POB land. The availability of habitat and low disturbance rates add to the attractiveness of the POB reclamation area.

Previous analyses (2014 and 2015) have detected significant trends in the IRI of several other species. The lack of significant trends following the addition of data from another 11 surveys made between June 2015 and May 2016 suggests that the relationships were weak and could be best interpreted as random variation for most species. There are multiple factors influencing the roost choices of individual birds and these will vary monthly. It would be difficult to measure these factors on an appropriate scale to inform this analysis. Despite this, during 2015 – 2016, the POB is still the most important roost in Moreton Bay for nine species (Curlew Sandpiper, Great Knot, Greater Sand Plover, Grey-tailed Tattler, Grey Plover, Pacific Golden Plover, Red-necked Stint, Ruddy Turnstone and Sharp-tailed Sandpiper).

ANNUAL CHANGES IN WADER NUMBERS BETWEEN SITES WITHIN THE POB

This section firstly examines annual changes in total migratory wader numbers since 2003 (Fig. 4) for the various areas, or site groupings within the POB. The areas are selections of neighbouring ponds as areas A to D (Fig. 1). 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) and since 2012, all other available ponds form area D. The claypan roost (FICP) is not included in the data presented in this section.

Similar graphs to Figure 4 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 POB reclamation area. Earlier than 2008, area C was being supplanted by area B, which are both now superseded by area D.

The main focus of this section is on the use by birds of individual sites within area D since 2008. Figure 5 shows data for all migratory waders combined. PBR3 was used by fewer birds in 2015/2016 compared to previous years and was not the most important pond for roosting (Fig. 5). In 2014, the new site PBS4 (see Fig. 1) was enclosed and immediately began being used by birds that have shifted from other sites (Fig. 5). This pond remains an important roosting site, whereas PBS3 increased in use in 2015/2016. The reasons for these and similar change, especially for individual species are best examined in relation to changes of the various ponds over time. PBS3 was partly filled with water from heavy rainfall during the year and this pondage increased its attractiveness to migratory waders. The distribution of summer season counts within area D for individual species illustrate the pond (and habitat) preferences of each species (Fig. 6a – l).

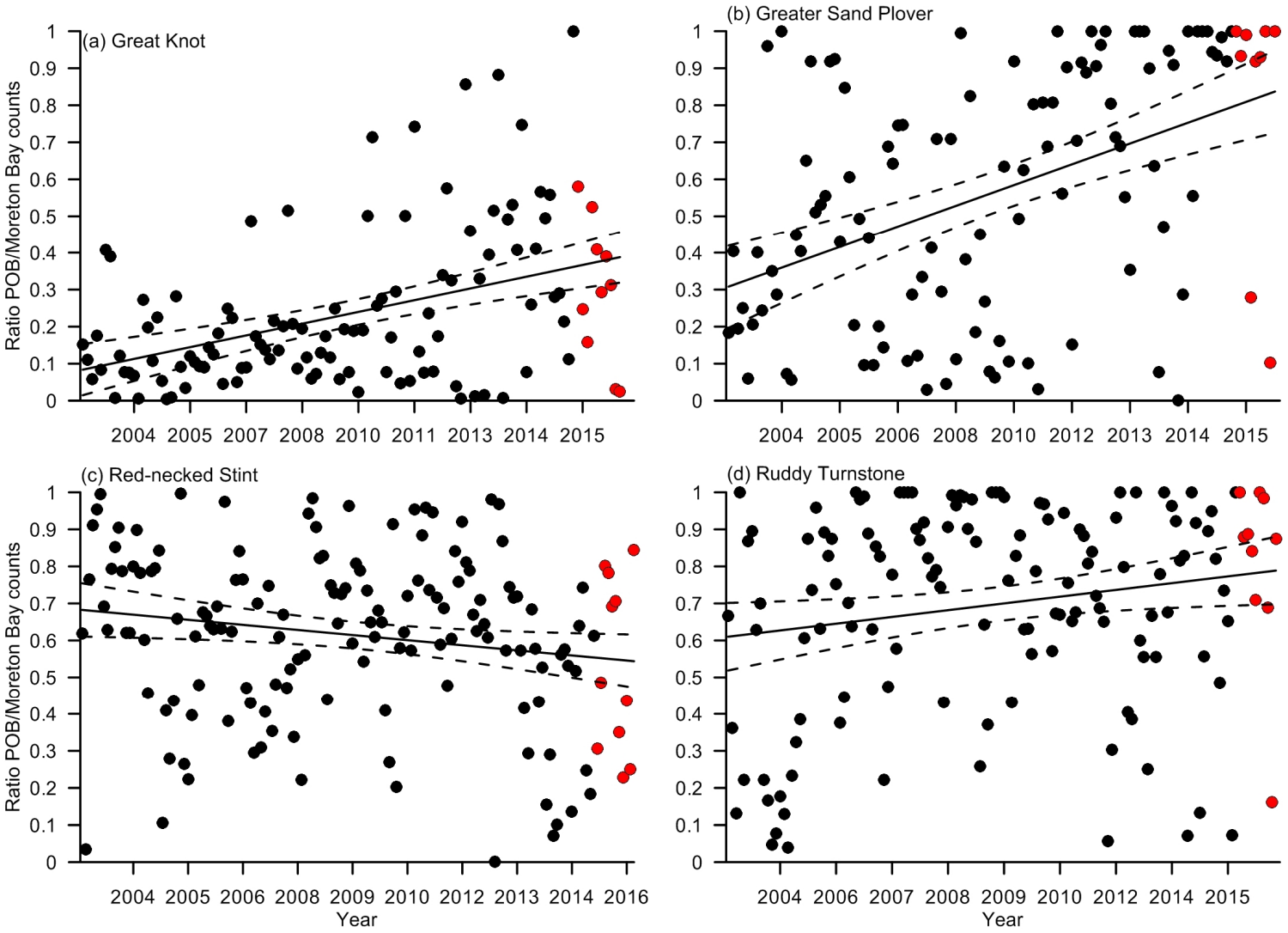


Figure 3. The species of migratory wader that showed a significant temporal trend in the IRI in 2016. The best fit mean and 95% confidence limits (dotted lines) are shown. Only counts made since the start of the comprehensive program by QWSG in January 2003 were analysed. Red points show the data for July 2015 – May 2016.

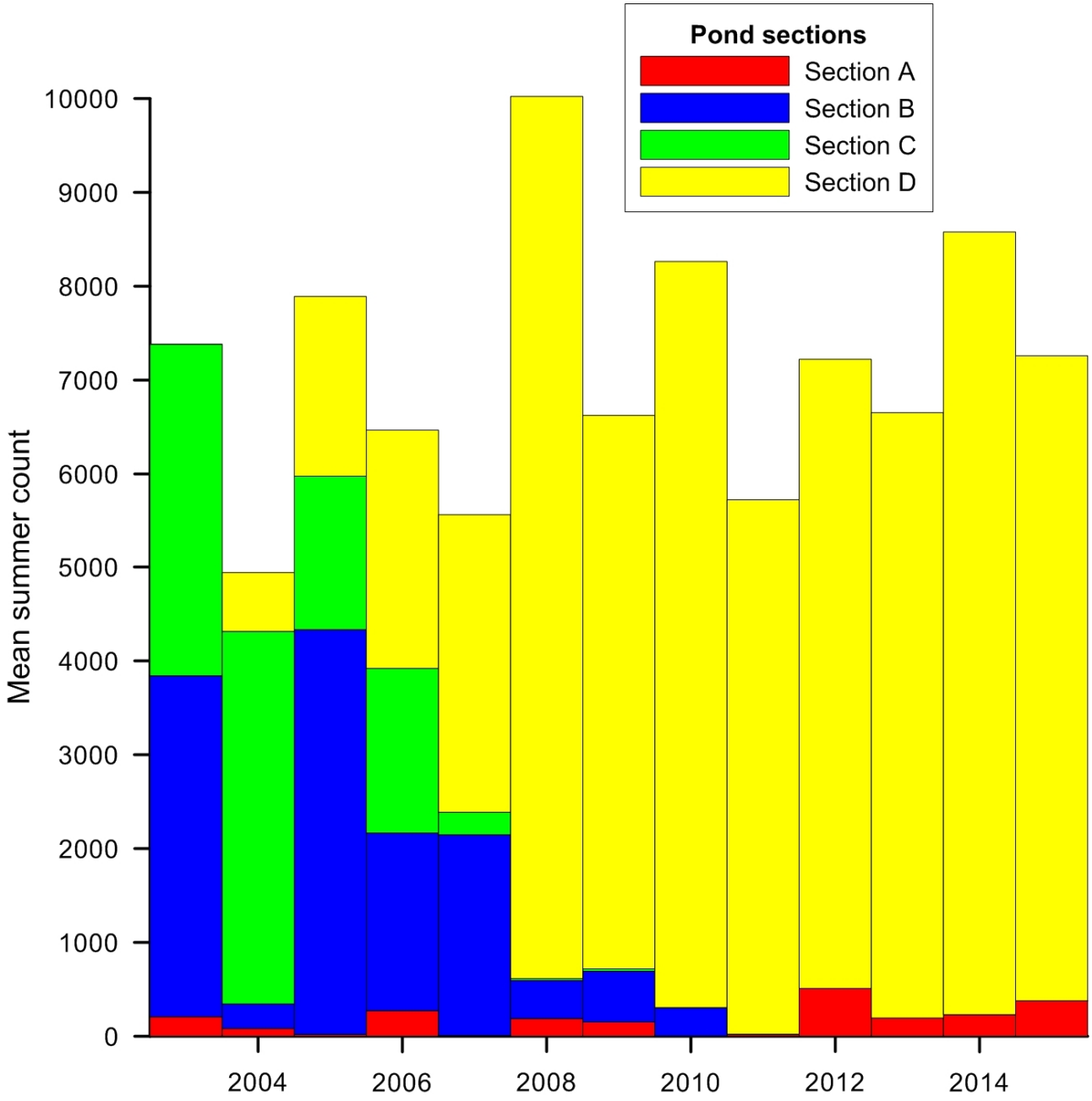


Figure 4. Average counts for the summer period of all migratory waders in four subsections of the Port lands for each "wader" summer since 2003. Area A is the purpose built artificial roost site (PBAR) and the other areas are groupings of ponds (see Fig. 1).

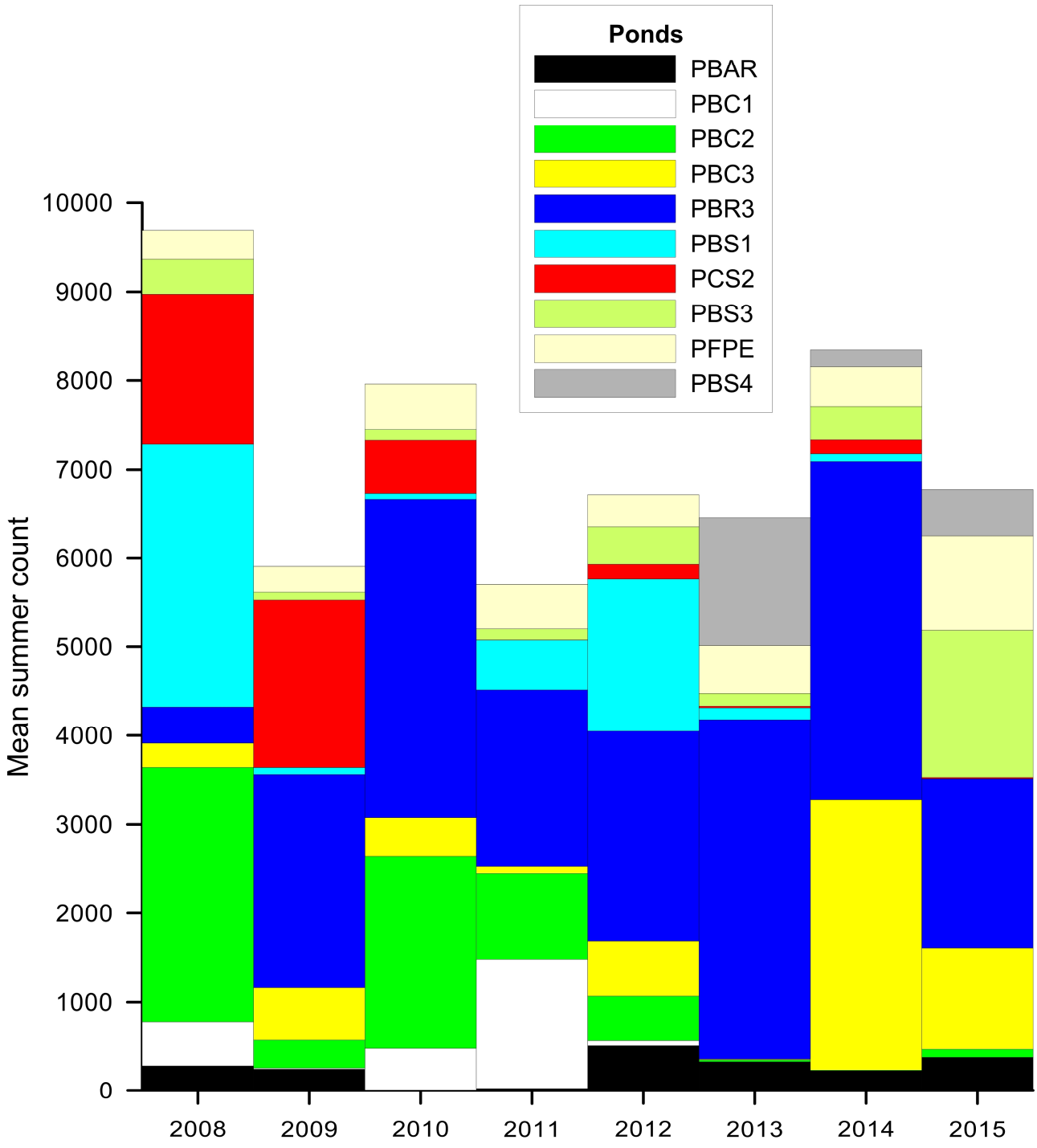
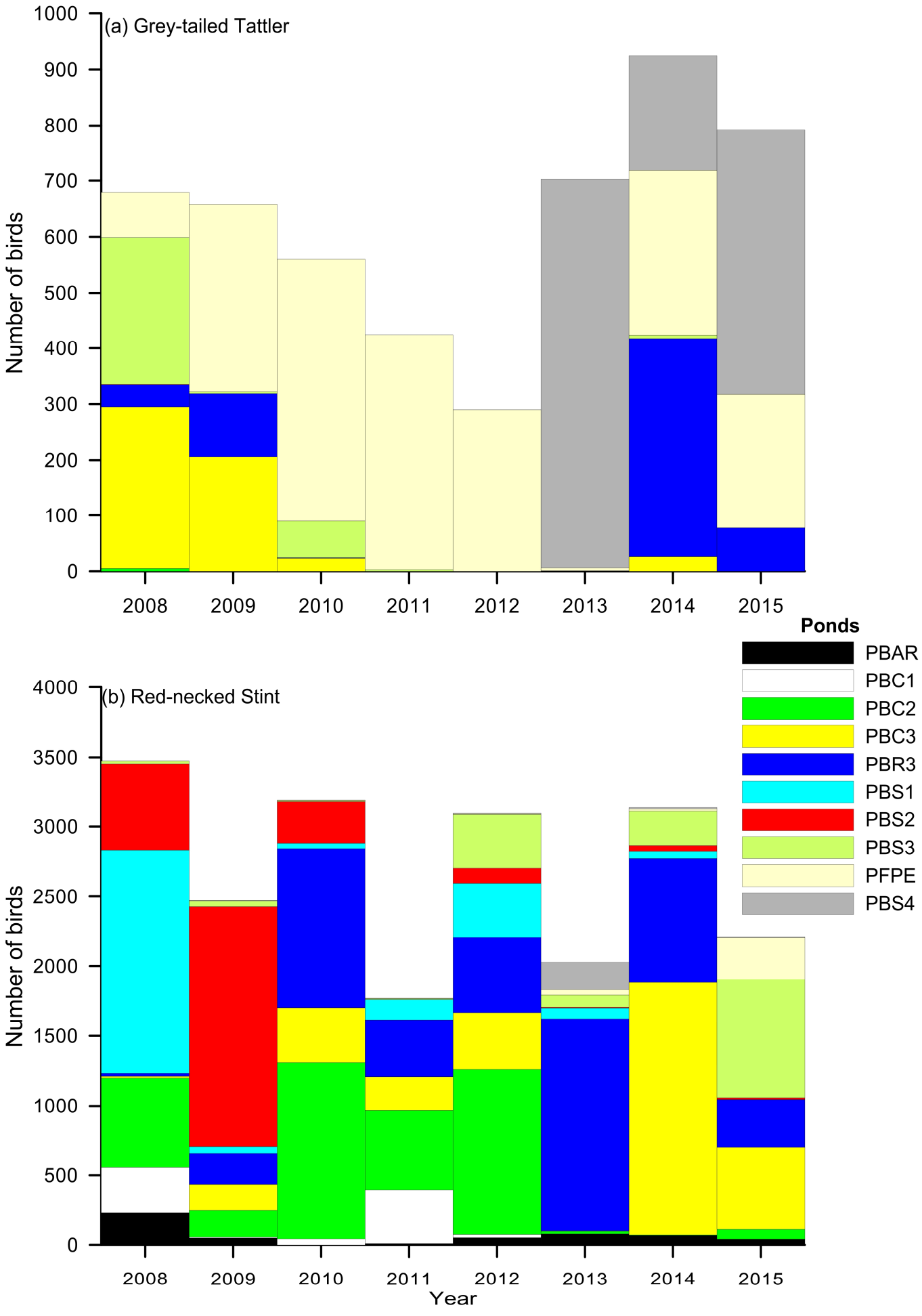
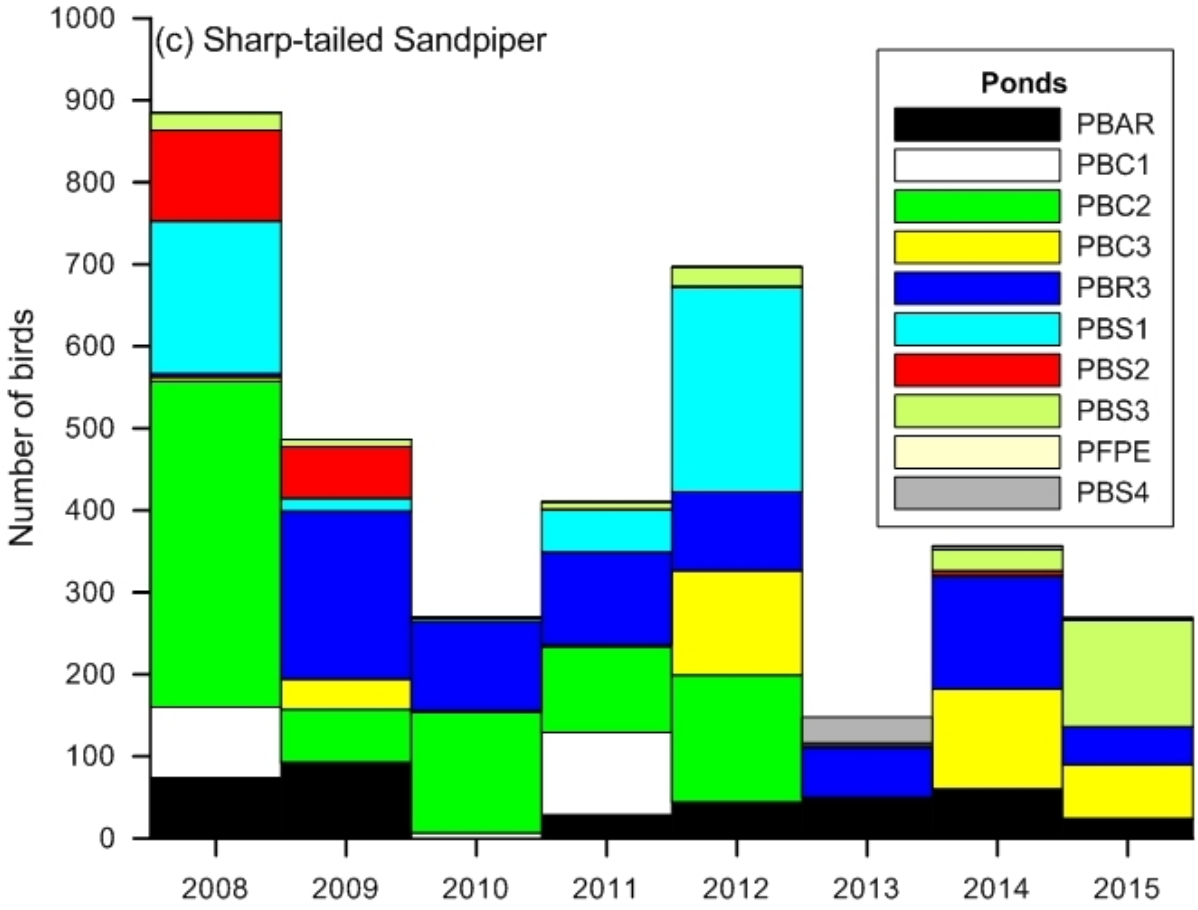
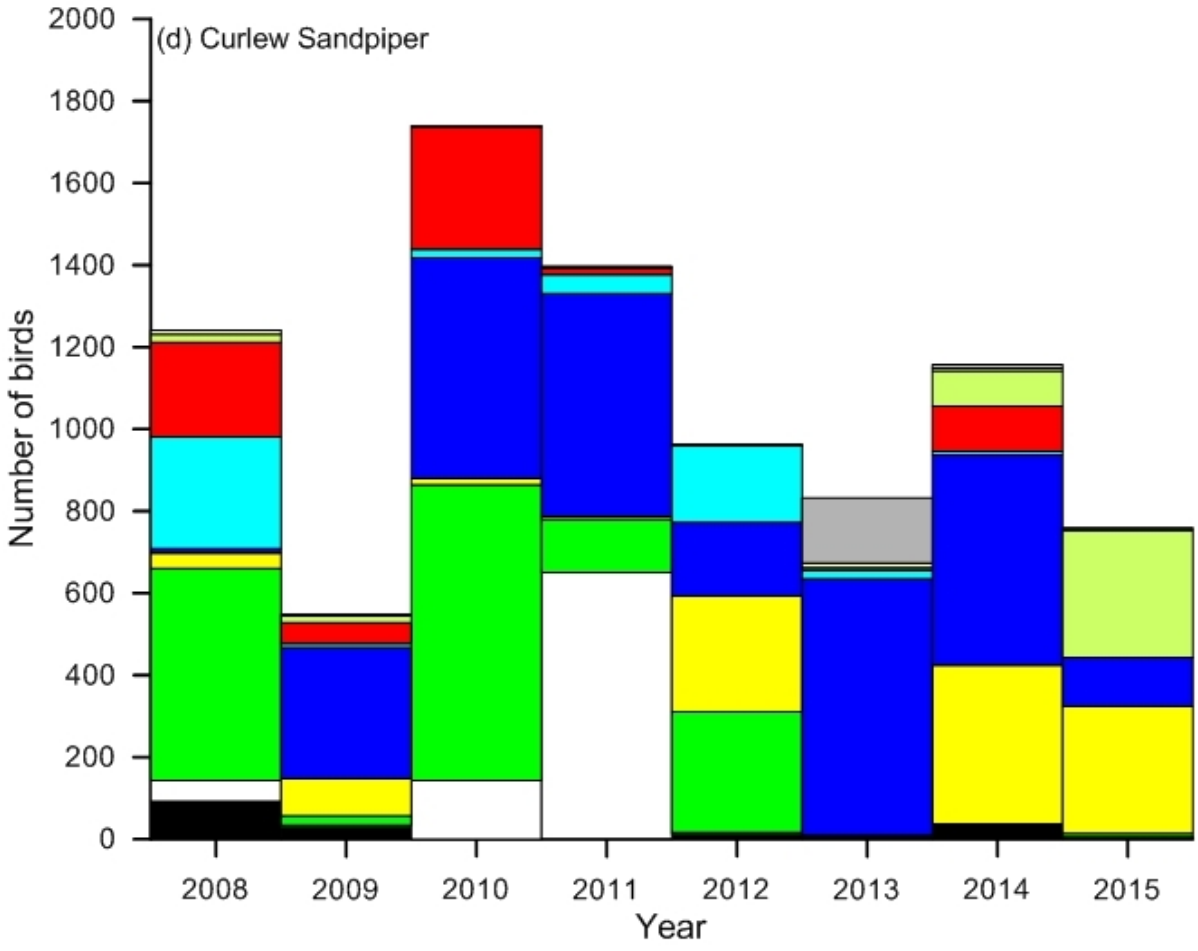
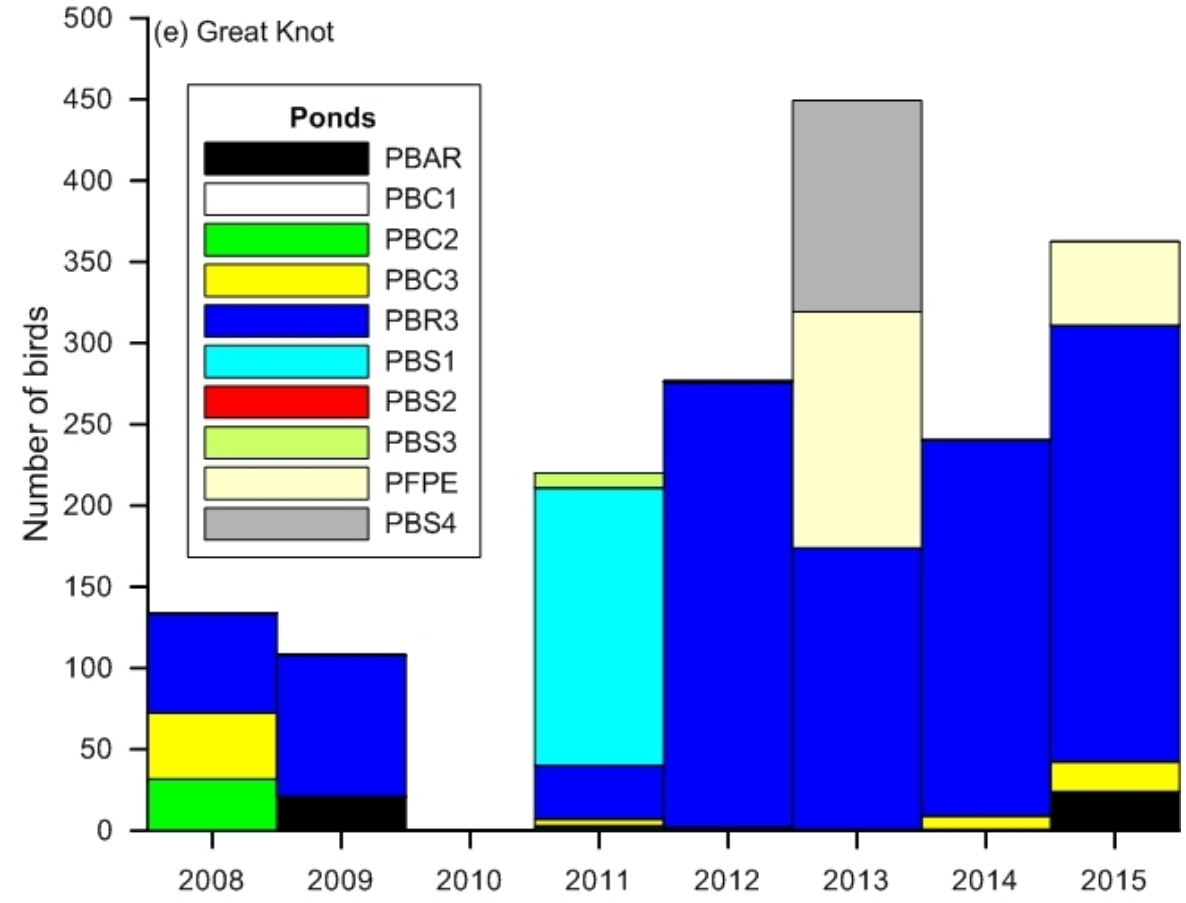


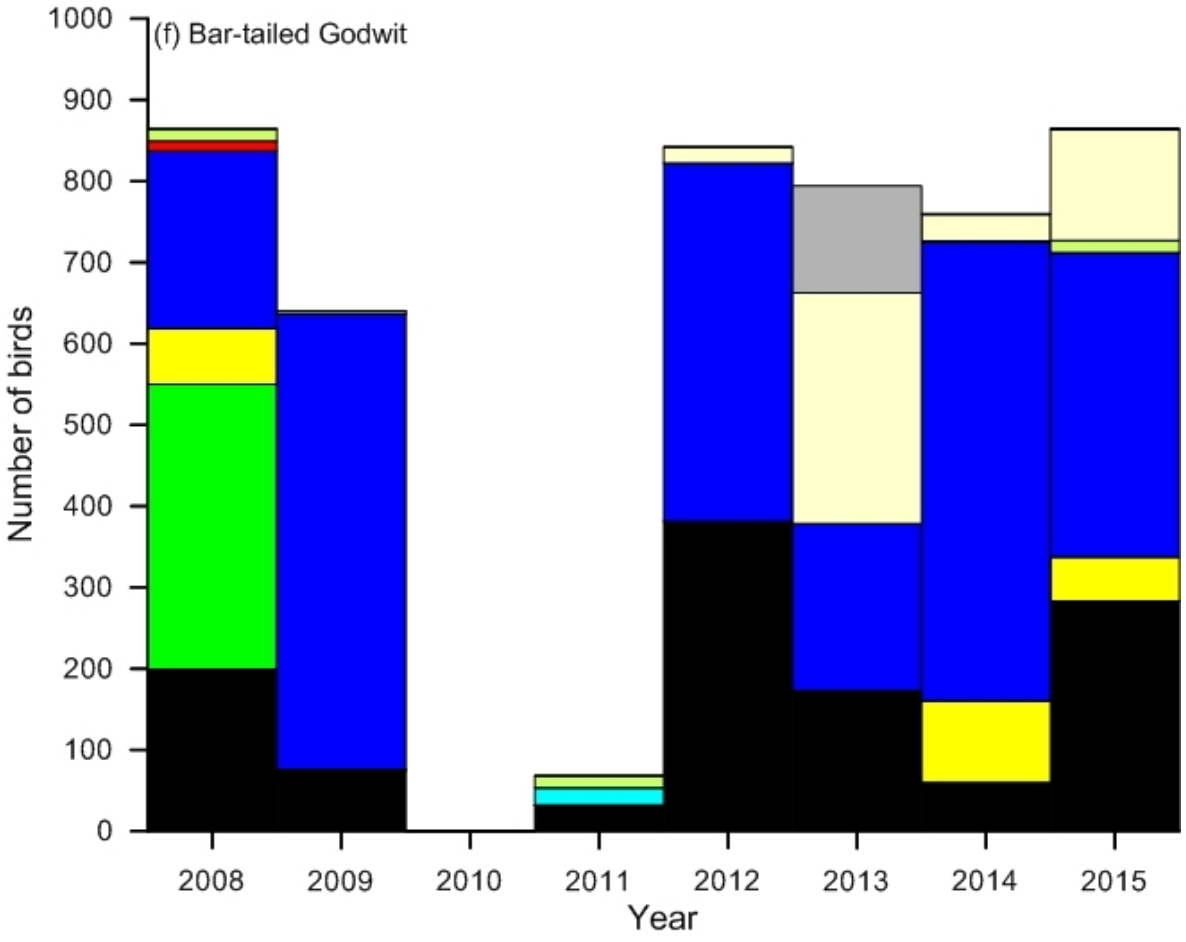
Figure 5. Average counts (summer) of all migratory waders in ponds within Area D (see Fig. 1).

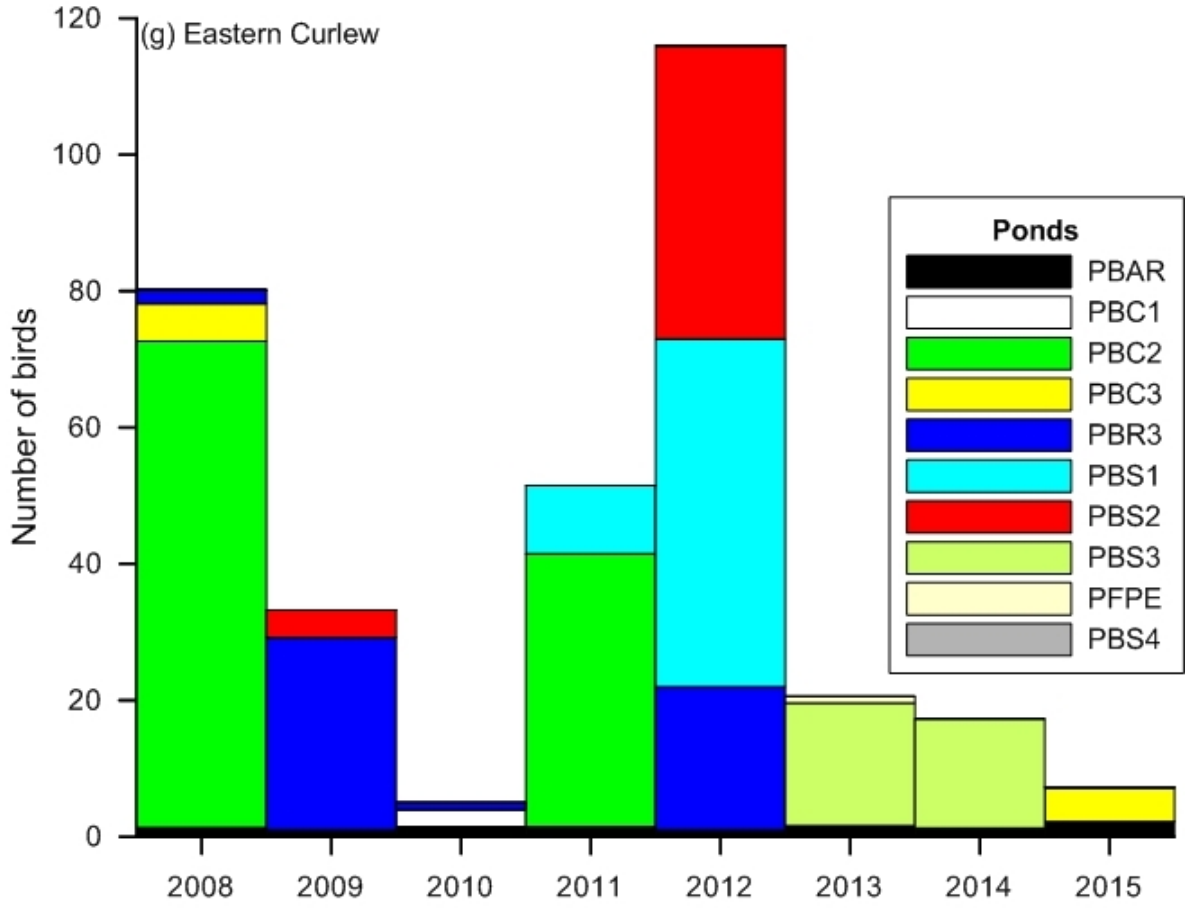

(a) Grey-tailed Tattler
Number of birds
1000
900
800
700
600
500
400
300
200
100
0
2008
2009
2010
2011
2012
2013
2014
2015
(b) Red-necked Stint
Number of birds
4000
3500
3000
2500
2000
1500
1000
500
0
2008
2009
2010
2011
2012
2013
2014
2015
Year
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4

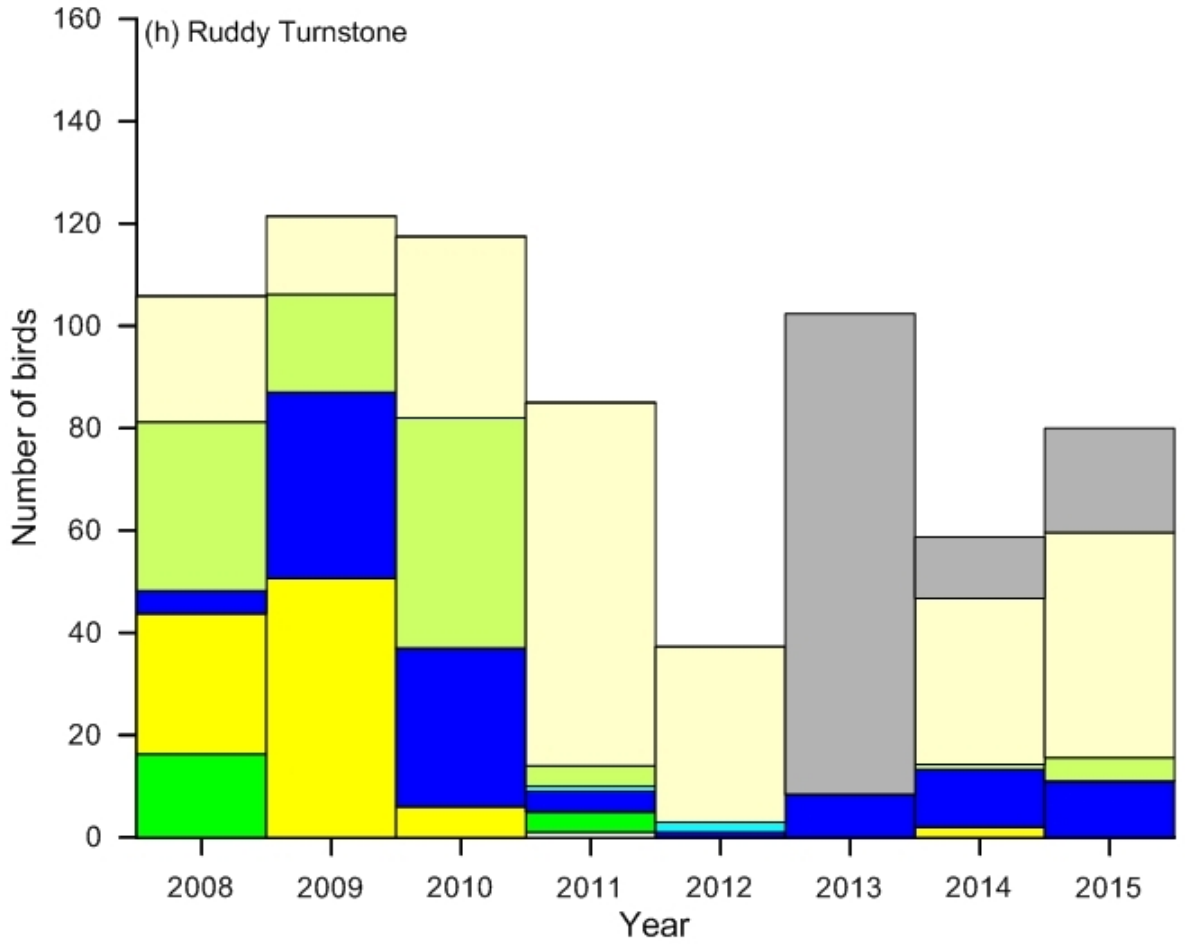

(c) Sharp-tailed Sandpiper
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
100
200
300
400
500
600
700
800
900
1000
2008
2009
2010
2011
2012
2013
2014
2015

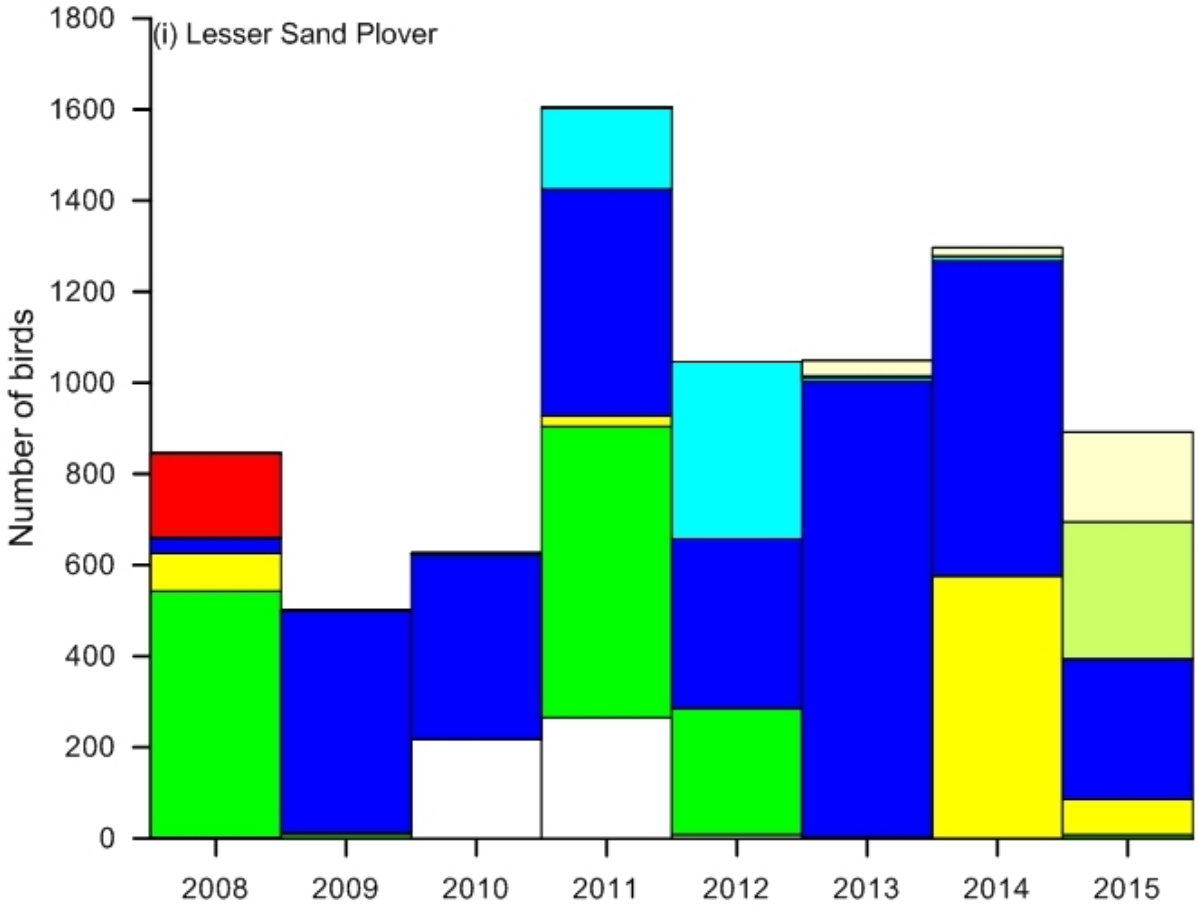

(d) Curlew Sandpiper
Number of birds
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2008
2009
2010
2011
2012
2013
2014
2015
Year

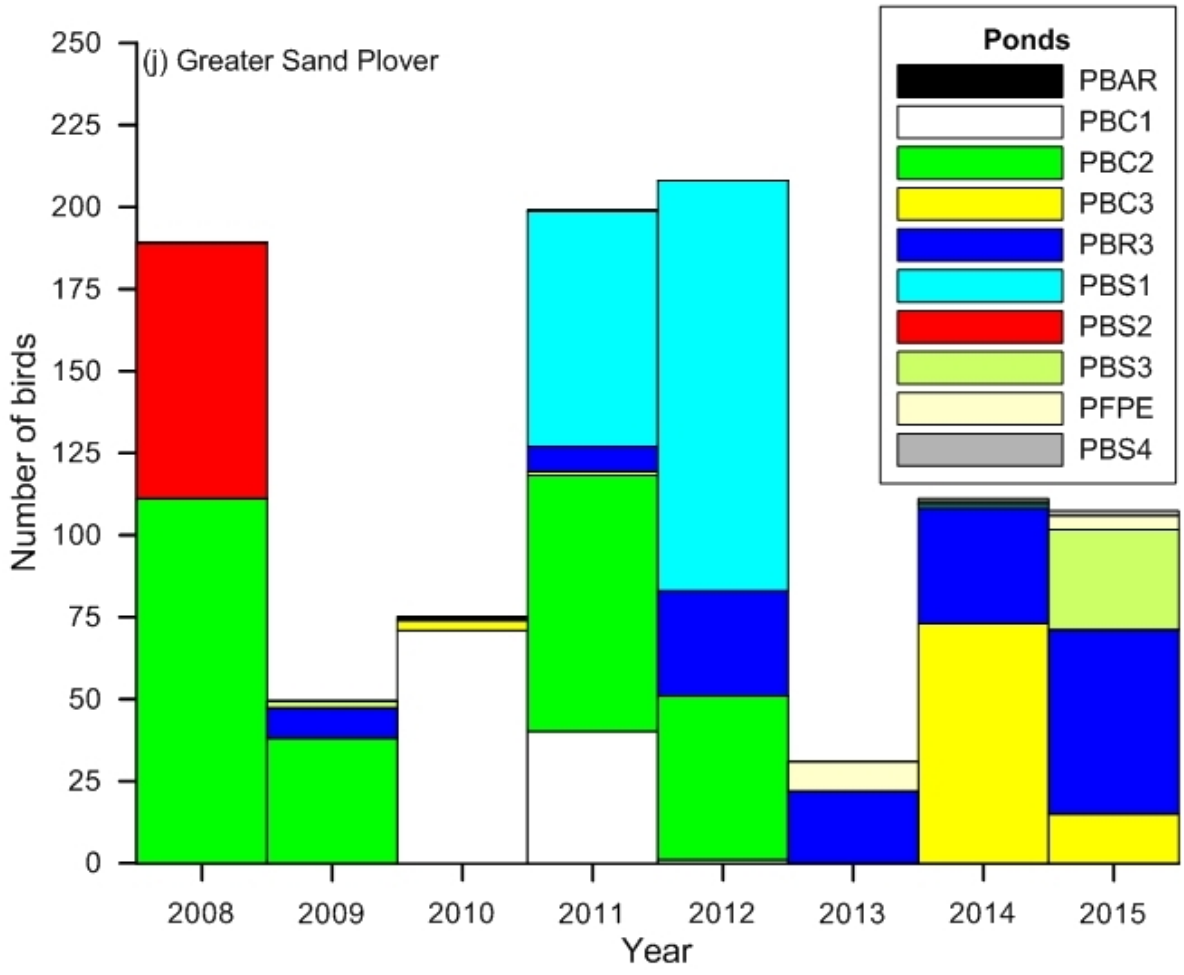

(e) Great Knot
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
50
100
150
200
250
300
350
400
450
500
2008
2009
2010
2011
2012
2013
2014
2015

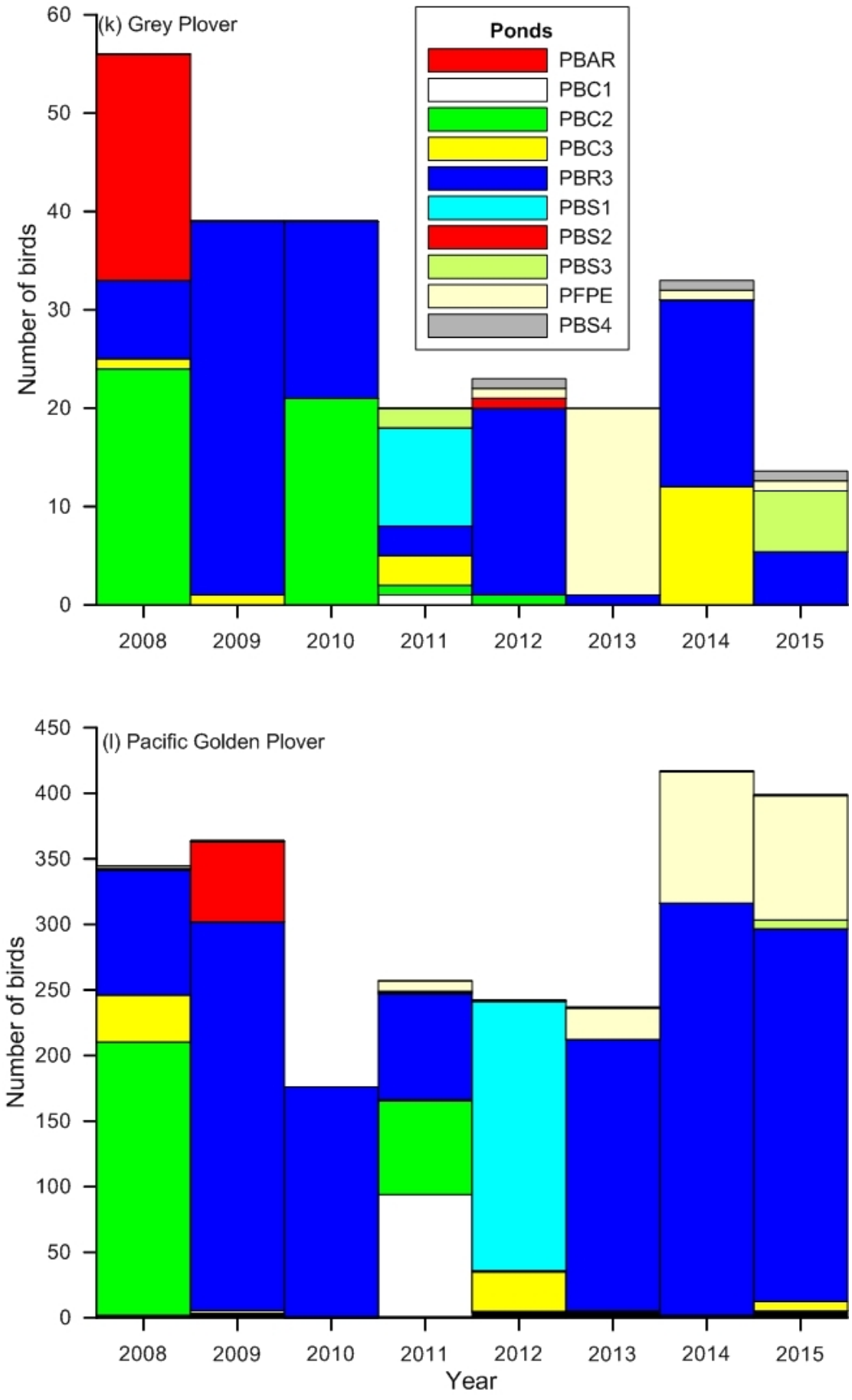

(f) Bar-tailed Godwit
Number of birds
0
100
200
300
400
500
600
700
800
900
1000
2008
2009
2010
2011
2012
2013
2014
2015
Year


(g) Eastern Curlew
Number of birds
120
100
80
60
40
20
0
2008
2009
2010
2011
2012
2013
2014
2015
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4


(h) Ruddy Turnstone
Number of birds
160
140
120
100
80
60
40
20
0
2008
2009
2010
2011
2012
2013
2014
2015
Year


(i) Lesser Sand Plover
Number of birds
1800
1600
1400
1200
1000
800
600
400
200
0
2008
2009
2010
2011
2012
2013
2014
2015


(j) Greater Sand Plover
Number of birds
250
225
200
175
150
125
100
75
50
25
0
2008
2009
2010
2011
2012
2013
2014
2015
Year
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4



Figures 6. Average counts (summer; N = 5) of 12 species of migratory wader in area D ponds (see Figure 1).

LONG TERM TRENDS IN WADER COUNTS WITHIN POB

Overall wader counts

Wader counts have been made within the POB land since 1991. However, sampling methods have been most consistent since 2003. The data presented here are mean counts for different seasons across the POB land, including the claypan (FICP) from 2003 until 2016. 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 most abundant.

Figure 7 shows the results for the combination of (a) all migratory waders and (b) the combination of all resident waders. Figure 8a to l present the results for the twelve important species of migratory wader. As noted earlier, average counts of total migratory waders do not appear to have changed appreciably over the last 14 years (Fig. 7a). However, two of the three highest single counts of total migratory waders occurred prior to 2009. The average count in 2016 was around the mean of the last seven years. Similarly, there is no distinct trend in total resident wader numbers on the POB land, although summer and winter counts increased in 2016 to the highest seen since 2003. This increase may be related to drier conditions in inland eastern Australia where many of the birds could normally have lived.

Individual species counts

For individual species, there is some indication of long-term cyclic patterns in counts. However, none of these patterns have been investigated statistically, other than through an examination of variances (Table 5). This shows that there is 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 unexpectedly low count as discussed in the next section.

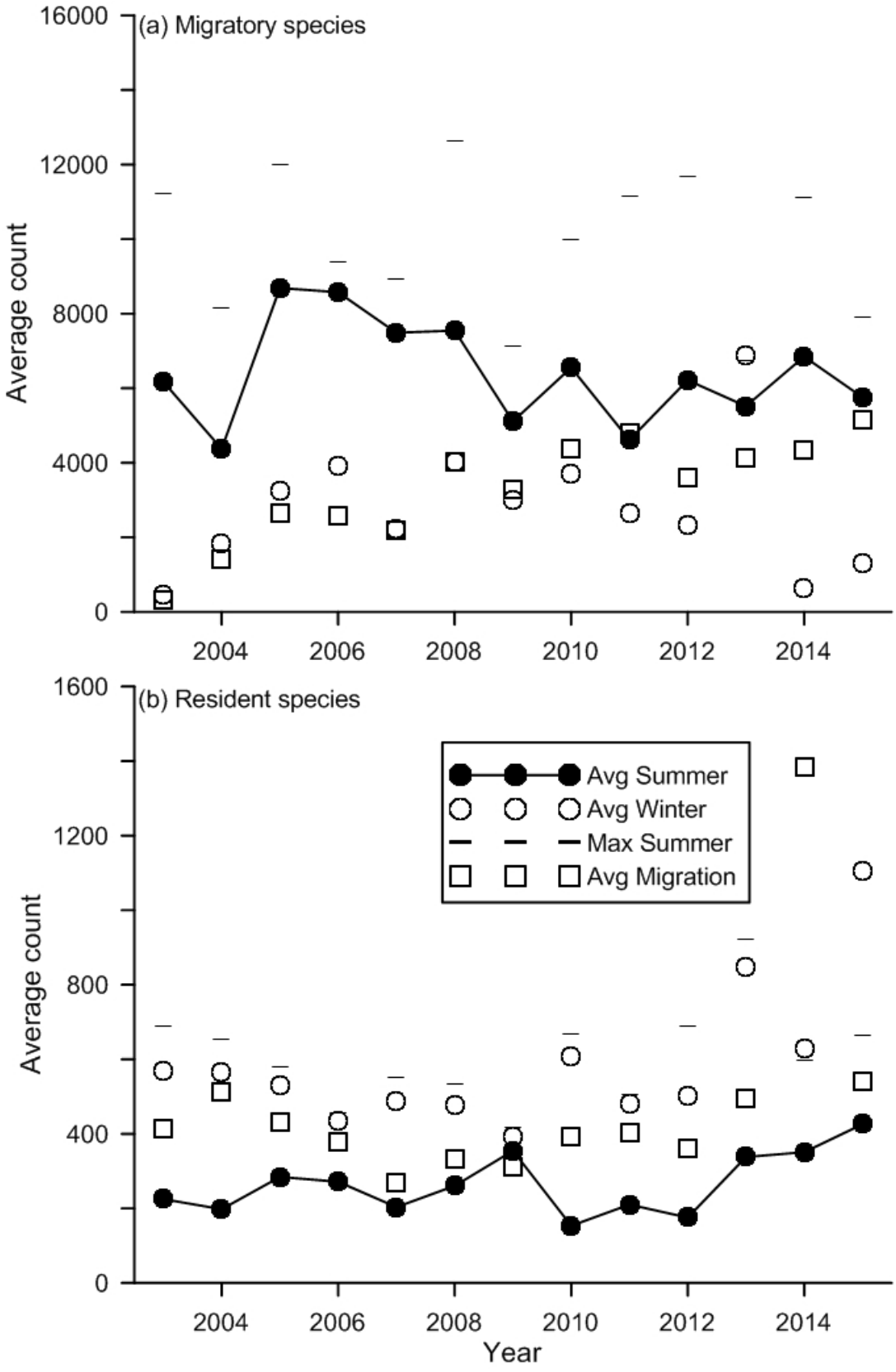
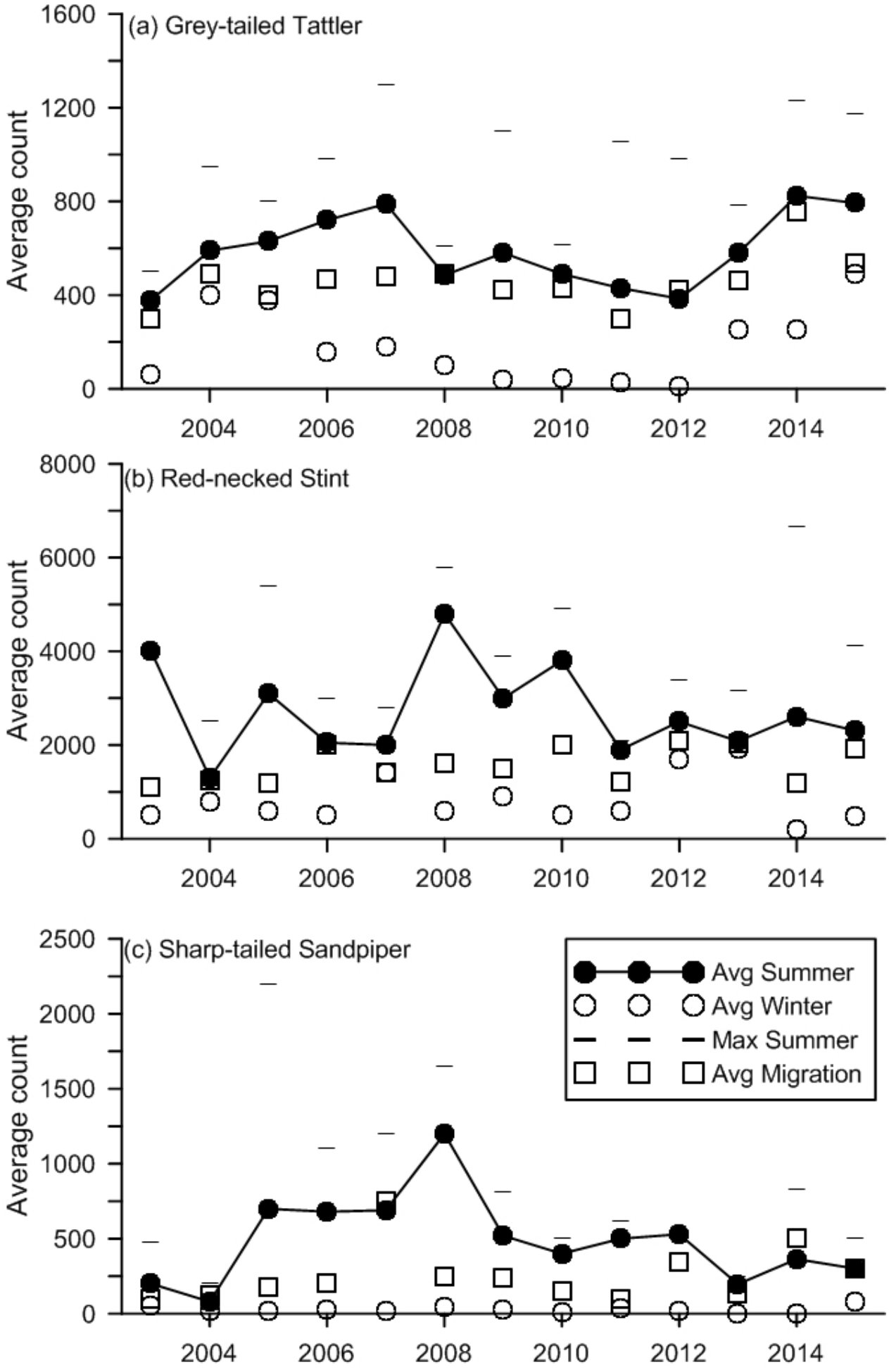
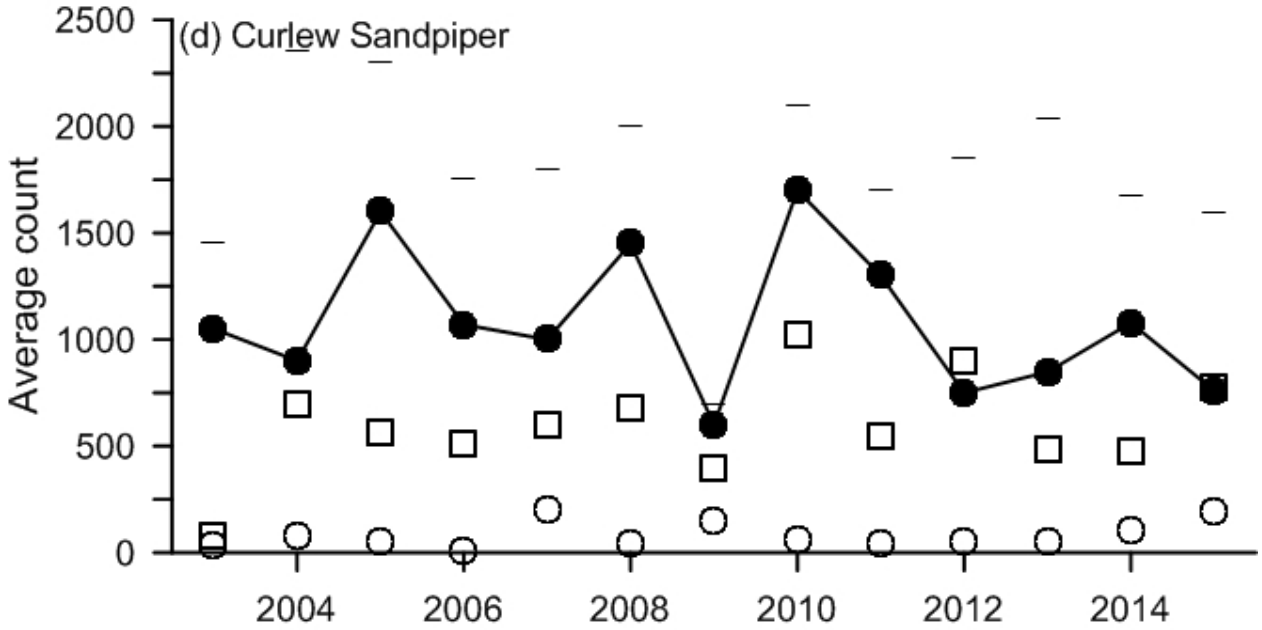
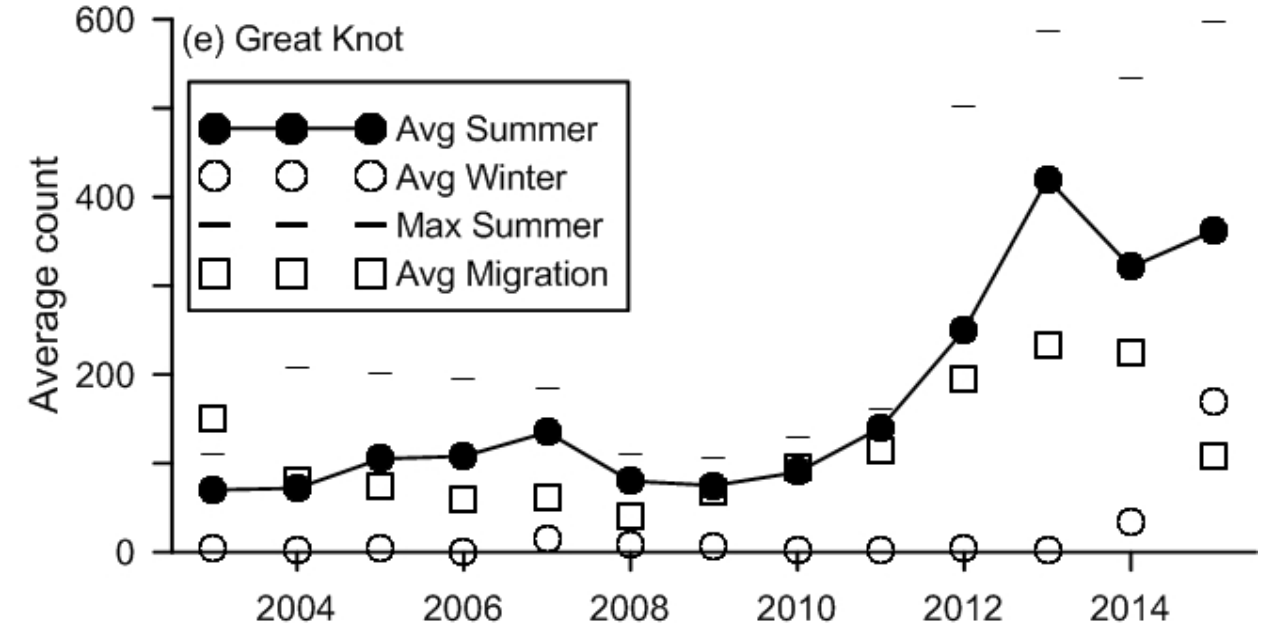
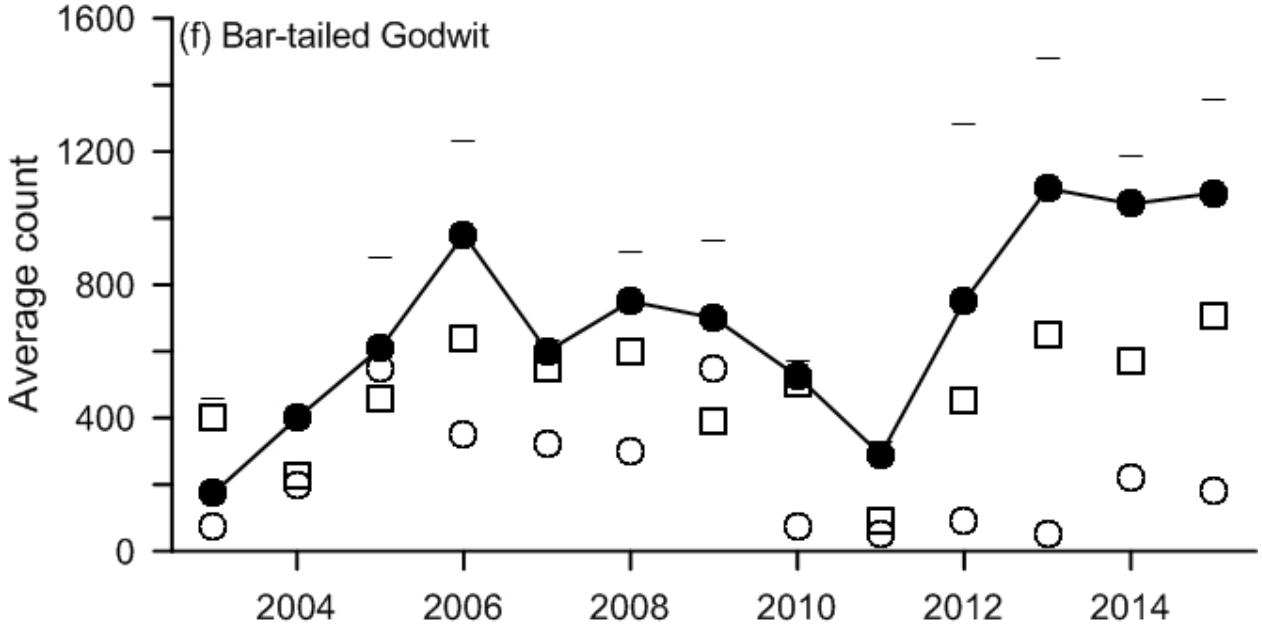


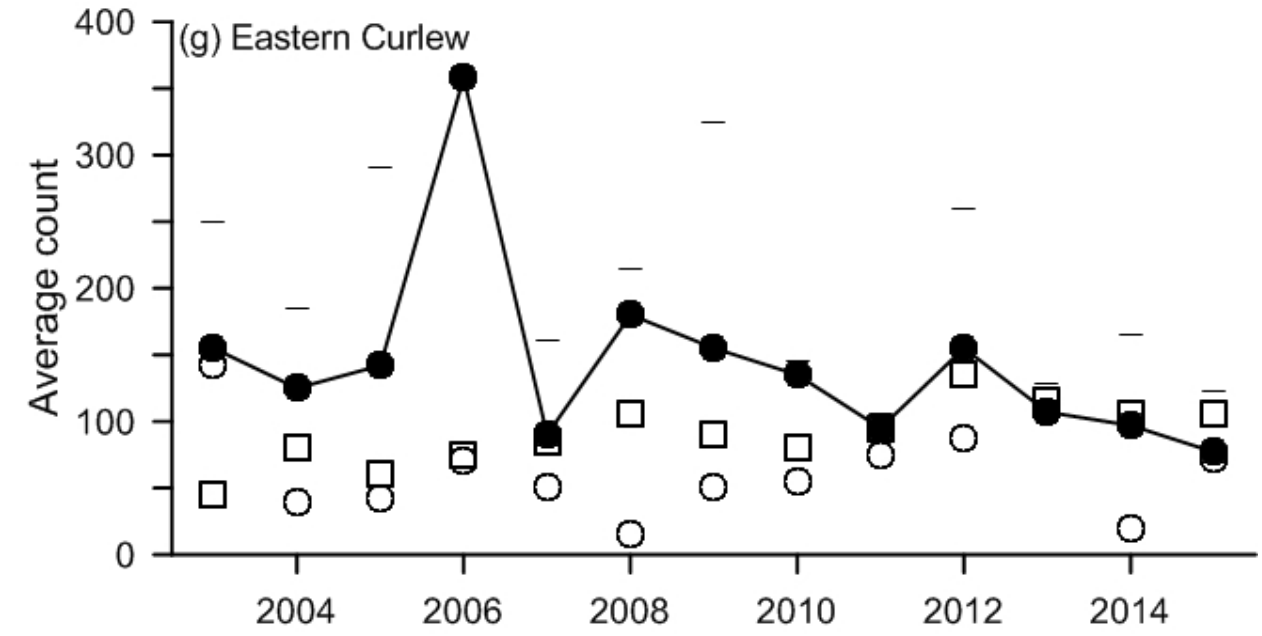
Figure 7. Average counts for each season and "wader" year since 2003 for all migratory and all resident waders throughout the POB lands, including the claypan (FICP). W: winter (June to August); S: summer (mid November to mid-March); M: migration periods (south – September to mid-November and north – mid-March to end of May). The "wader: year runs from the southward migration through to winter.

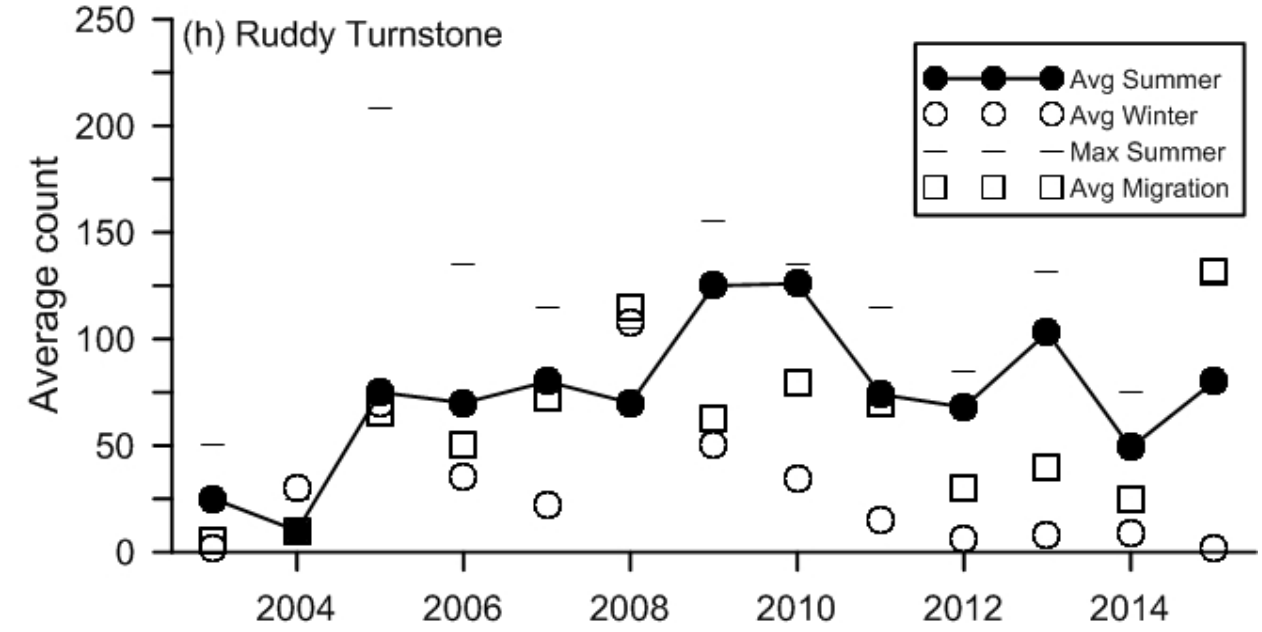

(a) Grey-tailed Tattler
Average count
1600
1200
800
400
0
2004
2006
2008
2010
2012
2014
(b) Red-necked Stint
Average count
8000
6000
4000
2000
0
2004
2006
2008
2010
2012
2014
(c) Sharp-tailed Sandpiper
Average count
2500
2000
1500
1000
500
0
2004
2006
2008
2010
2012
2014
Avg Summer
Avg Winter
Max Summer
Avg Migration

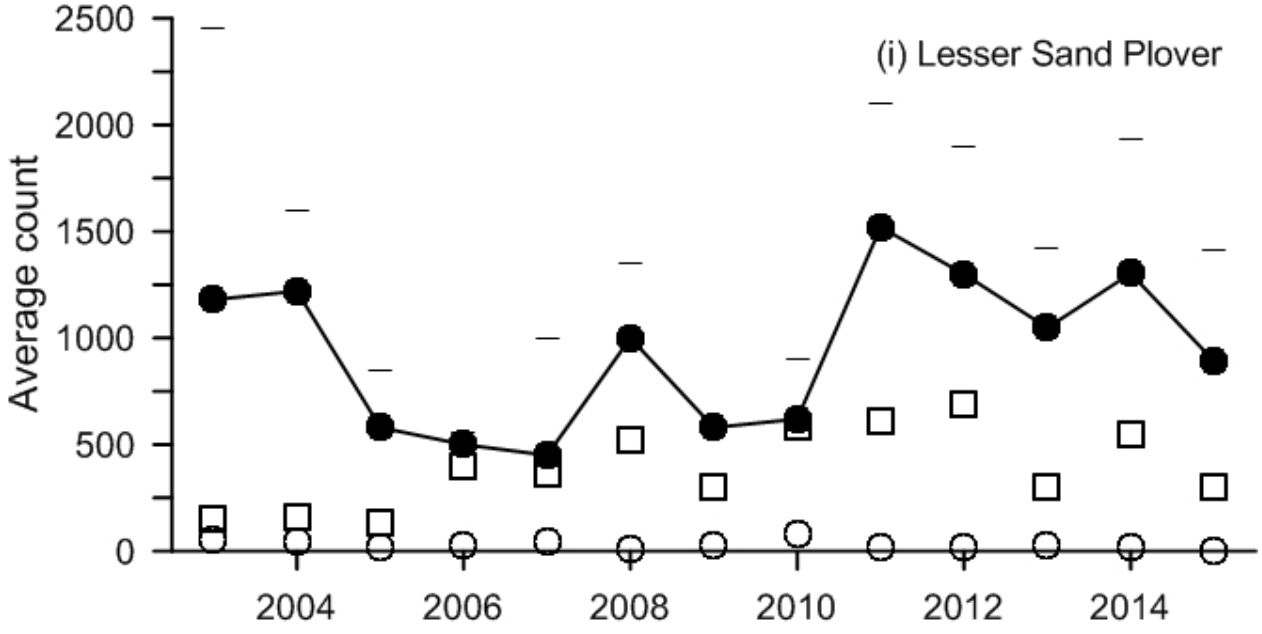

(d) Curlew Sandpiper
Average count
2500
2000
1500
1000
500
0
2004
2006
2008
2010
2012
2014


(e) Great Knot
Avg Summer
Avg Winter
Max Summer
Avg Migration
Average count
600
400
200
0
2004
2006
2008
2010
2012
2014


(f) Bar-tailed Godwit
Average count
1600
1200
800
400
0
2004
2006
2008
2010
2012
2014


(g) Eastern Curlew
Average count
400
300
200
100
0
2004
2006
2008
2010
2012
2014


(h) Ruddy Turnstone
Average count
250
200
150
100
50
0
Avg Summer
Avg Winter
Max Summer
Avg Migration
2004
2006
2008
2010
2012
2014


(i) Lesser Sand Plover
Average count
2500
2000
1500
1000
500
0
2004
2006
2008
2010
2012
2014

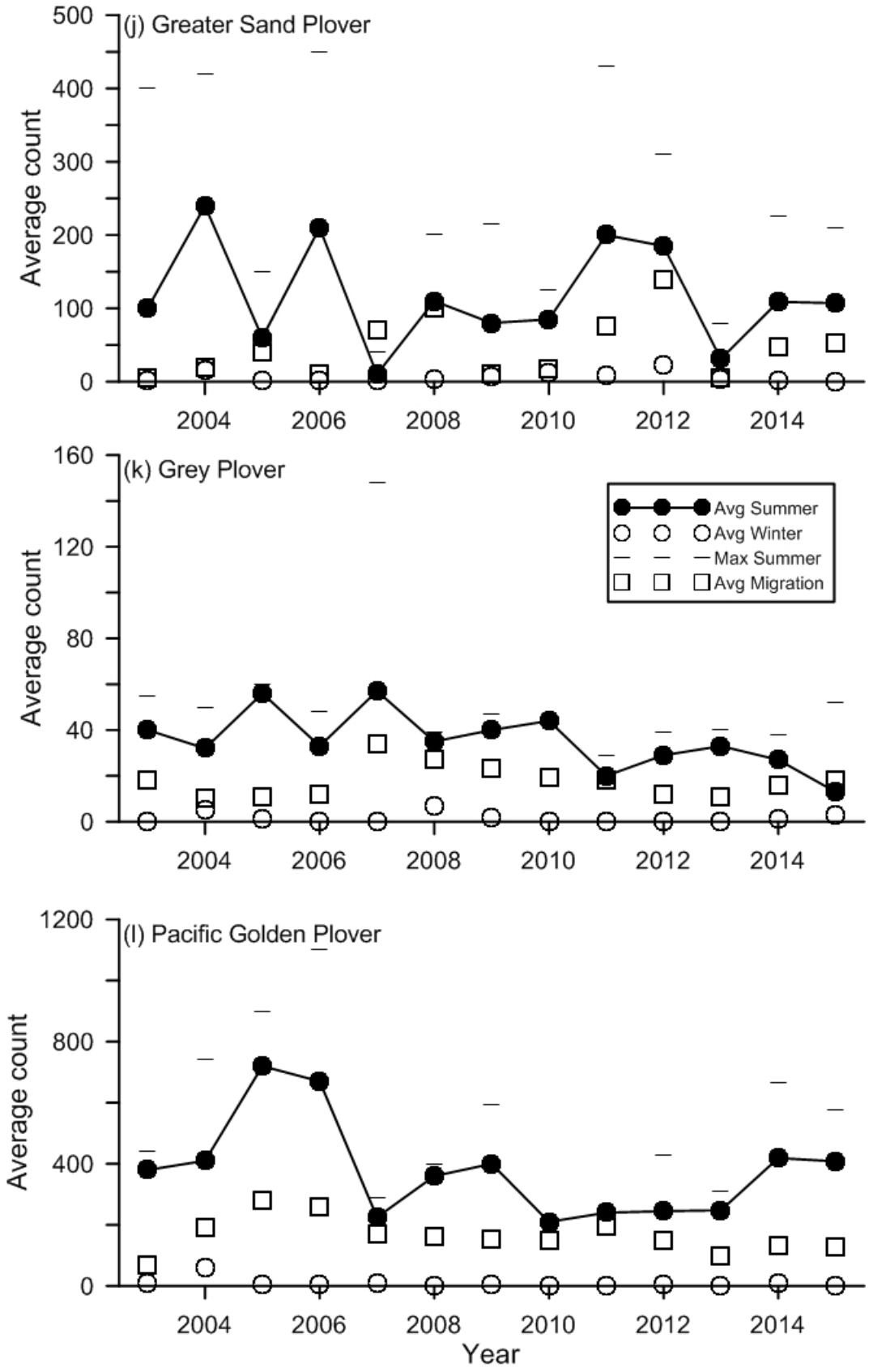


Figure 8. Average annual counts of 12 species of wader in the POB lands (including the claypan) (Fig. 1) for different seasons: Winter (n = 2), Summer (n = 5), and Migration (n = 4)) and maximum summer counts.

Average counts of Grey-tailed Tattler show a steady rise until 2007, then a reduction in 2008 to return to the longer-term average count in 2013. The mean summer count during the last two years have both been similar to the highest mean of the previous 11 years. Numbers of Red-necked Stint have fluctuated from year to year. The mean summer count was similar to those made during the last five years and appear to be a distinct shift to a lower number after the higher counts seen in 2008 – 2010. The 2015/2016 Sharp-tailed Sandpipers count is the fourth lowest count since 2003. It is the second lowest count since 2004 and may reflect the continuing lack of surface water in the reclamation ponds during the 2015/2016 "wader" year. 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 counts have fluctuated with peaks every 2 to 3 years. The counts in 2015/2016 were slightly lower than in 2014/2015, but similar to 2012/2013 and 2013/2014, but still somewhat lower than counts during the previous decade (2003 – 2010). In contrast, Great Knot numbers over the last four years have been higher than in other years since 2003. It appears to reflect a trend of increasing Great Knot counts that has occurred in other regions in south-eastern Queensland such as the Great Sandy Strait (Milton unpubl. data). Bar-tailed Godwit counts may be cyclical with a peak in 2013/2014 – 2015/2016 similar to that in 2006/2007. The 2006/2007 count was followed by reducing counts until 2012/2013, when the counts increased again. Again, continued monitoring will help clarify whether there is a cyclical pattern.

Eastern Curlew counts have been showing a fairly consistent downward trend since the unusually high count in 2006. This trend may be due to reductions in the availability of their preferred roosting habitat or the result of the documented regional and national decreases in counts (Wilson et al. 2011; Clemens et al. 2016). IN contrast, Ruddy Turnstone numbers appear to be stable, following the two lowest average counts recorded in 2003 and 2004. The mean summer 2015/2016 count was higher than the low 2014/2015 count. Lesser Sand Plover continues to occur on the POB reclamation in high numbers. However, there has been a downward trend in mean summer counts in the five years since the peak mean counts in 2011/12. By comparison, the counts of Greater Sand Plover are much more variable than for the Lesser Sand Plover. The count in 2013/2014 was the lowest since the program began. However, the mean summer count in 2014/2015 and 2015/2016 were closer to the long-term mean

The data for Grey Plover and Pacific Golden Plover had suggested an overall downward trend is average summer counts when examined in the 2013 report (2013/2014). The mean Grey Plover summer counts in 2015/2016 was the lowest since intense monitoring began in 2003. This continues the consistent slow reduction in Grey Plover numbers within the POB reclamation area. In contrast, the average summer count of Pacific Golden Plover has increased in 2014/2015 and remained at similar levels in 2015/2016. This is positive for the Pacific Golden Plover population in Moreton Bay, as the proportion of the Moreton Bay total count of Pacific Golden Plover in the POB reclamation area is showing a weak insignificant trend of reducing relative important (see Fig. 2 in 2014 report). This suggests the Moreton Bay population of Pacific Golden Plover may be slowly increasing, or is at least stable.

LOW COUNT THRESHOLDS FOR EACH IMPORTANT SPECIES

Low summer count thresholds for individual counts made on the POB land (including the claypan) were calculated as the lower 90% confidence limit of the sample mean of all post 2002 summer counts (November – March) excluding the period being considered (November 2015 – March 2016) (Table 5). These values were calculated with the natural log transformed non-zero counts for each summer survey in the POB area since 2003. That is, any single count lower than these expected value limits will only occur by chance on average once in every ten counts (every two years).

Table 5. Low count thresholds (see text) and standard deviation of the untransformed non-zero summer counts since 2003. Survey months in 2015/2016 when counts of the twelve important migratory wader species were below the Low count threshold are also provided.

Species	Low count threshold	standard dev.	Triggers in 2015 – 2016
Grey-tailed Tattler	733	492	December
Red-necked Stint	2381	2320	January – March
Sharp-tailed Sandpiper	301	703	January – March
Curlew Sandpiper	973	1004	December – March
Great Knot	106	275	–
Bar-tailed Godwit	563	555	–
Eastern Curlew	120	125	November, January – March
Ruddy Turnstone	57	97	November – December
Lesser Sand Plover	788	825	November, January
Greater Sand Plover	55	215	December
Grey Plover	33	29	November – January, March
Pacific Golden Plover	376	267	December, March

Ten of the 12 important migratory species had at least one count below the Low count threshold during the summer (Table 5). Many species had extended periods when counts were below the threshold (Table 6). Examining the Index of Relative Importance (IRI; Fig. 3) for the 10 species with counts below the Low count threshold suggests that most species have roosted at other sites within Moreton Bay (Table 6). However, for some species such as Curlew Sandpiper, Ruddy Turnstone and Grey Plover, counts were low in Moreton Bay during 2015/2016. Recent analysis of national trends in counts of waders found that all of these species had populations that were significantly decreasing (Clemens et al. 2016). Curlew Sandpiper was the most rapidly decreasing species of the 20 migratory waders examined. This has led to the species being listed as nationally Critically Endangered, which is the highest level of extinction risk.

For the other species that have chosen to roost elsewhere within Moreton Bay, the values below the trigger should be used to stimulate a closer examination of the data. A few species have been showing a reducing trend in their IRI and/or overall count in the POB reclamation area for some time (Eastern Curlew, Red-necked Stint, Sharp-tailed Sandpiper). Roosting locations are usually close to feeding areas (Zharikov and Milton 2009), so one possible explanation of the reductions in roosting at the POB reclamation area by these species may be reduced local food supply. Red-necked Stint and Sharp-tailed Sandpiper opportunistically take advantage of the enriched food supply in newly-pumped dredge spoil. The slowing of the rate of reclamation within the POB land has probably reduced the attractiveness of the reclamation area to these species. In the case of Eastern Curlew, the majority roost in the claypan as they are the most wary migratory wader and prefer to roost on open habitats surrounded by mangroves (Zharikov and Milton 2009). The reduced use of the claypan by Eastern Curlew suggests that it may be becoming too vegetated as small mangrove seedlings colonise the claypan or it has been drier for longer periods than in the past. Birds appear to be choosing alternate roosts such as the nearby claypan at Lytton or Geoff Skinner Reserve further south at Wellington Point.

Table 6. The months that had counts below the Low count threshold (<90% long-term expected mean count) based on counts made since January 2003 within the POB Pty Ltd land, including the claypan. Two possible explanations are highlighted: grey = moved to other roosts within Moreton Bay; blue = overall low count for the species at high tide roosts in Moreton Bay that were surveyed by QWSG.

Species	Month below Low count threshold				
	November	December	January	February	March
Grey-tailed Tattler					
Red-necked Stint					
Sharp-tailed Sandpiper					
Curlew Sandpiper					
Great Knot					
Bar-tailed Godwit					
Eastern Curlew					
Ruddy Turnstone					
Lesser Sand Plover					
Greater Sand Plover					
Grey Plover					
Pacific Golden Plover					

These results do highlight the need to consider local management of the reclamation ponds if the site is to maintain its attractiveness to migratory waders. Site management responses may be necessary to address any local issues of changed habitat conditions. The probability of the multiple consecutive counts below these limits for Eastern Curlew, Red-necked Stint and Sharp-tailed Sandpiper due to random movements was extremely unlikely. The occurrence of these low counts should trigger further investigations of the possible causes.

BANDING RECOVERIES

There have now been 211 waders caught and banded in the POB reclamation area between 2014 and 2016. Waders of seven species were caught by cannon net in the R3 reclamation pond on two occasions in 2014/2015 – 30 November 2014 (n = 32) and 1 March 2015 (n = 31) (Table 7). In 2015/2016, two more catches were made in the POB reclamation area: 104 birds of seven species on 22 November 2015 and 49 birds of four species on 28 February 2016. The most abundant species caught in 2015/2016 was Great Knot (n = 83) followed by Pacific Golden Plover (n = 34) and Bar-tailed Godwit (n = 13). There were 10 resightings from the 63 birds banded in 2014/2015 up to 29 August 2015 (16%). Since then, the number of resightings has greatly increased and there have now been 53 resightings (25%) of the 211 banded birds up to 16 August 2016. All resightings in 2014/2015 were in Moreton Bay, including four within the POB reclamation area. In 2015/2016, there have been multiple resightings of three species overseas (Table 7). A Bar-tailed Godwit was seen in Japan on northern migration, as was a Great Knot and Pacific Golden Plover. Other Great Knot were also seen on northern migration in Korea and Taiwan in early to mid-April.

QWSG member Robert Bush was part of an expedition team that resighted three Great Knot banded in the POB reclamation area during southward migration in July 2016 (Table 7). The birds were seen on the western coast of the Kamchatka Peninsula in eastern Russia at an estuary that is close to their breeding grounds in north-eastern Siberia. This suggests that these were adults that had either just completed nesting or had failed breeding and commenced southern migration back to Australia.

The increasing number of local resightings of flagged birds provides insight into the movement and feeding patterns of these species. The large number of resightings of several species at the Wynnum Esplanade suggests that the intertidal areas south of the POB are a major feeding area for birds roosting within the POB reclamation area. Other large intertidal areas north of the mouth of the Brisbane River from Luggage Point to Nudgee and Sandgate appear to be important for Pacific Golden Plover roosting at the POB. Observer coverage along this part of the western Moreton Bay foreshore is low, mostly due to restricted access around the airport. This will lead to under-estimating the relative importance of these intertidal areas to waders roosting at the POB reclamation area.

As more waders are banded within the POB reclamation area, additional resightings would be expected during their migrations through eastern Asia. Three of the nine overseas resightings were from Japan.

Although Japan is considered an important migration stopover location, the main stopover for most birds of these species is believed to be in the Yellow Sea along the Chinese and Korean coasts.

RECOMMENDATIONS

The analysis does not identify any clear trends in changes in the count of each wader species on POB land since 2003, with the possible exception of Grey Plover. However, these data and the experience of QWSG members during the 13 years of intensive monitoring of the site do suggest some recommendations that maybe helpful in maintaining the wader populations within the POB land.

1. The monitoring of waders and waterbirds within the POB land continues with the same intensity and data recording detail. These data should be sufficient to inform the POB Pty Ltd of substantial changes in counts of the most abundant species.

2. 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 identify habitat construction/maintenance priorities.

3. Sufficient quantity of each of the roosting habitat types preferred by the 12 species that are present in nationally and internationally-important numbers should be maintained. These habitats include wet margin of ponds, dry rubble/broken ground, shallow pools up to 5 cm deep and bund wall. Recent unseasonal heavy rainfall in early 2015 provided shallow pool habitat in both PBS3 and PBC3. Prior to these rainfall events, the POB land were less attractive to several species due to the prolonged dry period. Several species responded to the formation of pools in the two ponds. They were almost immediately heavily used by waders and led to an exceptionally high total wader count within the POB reclamation area in March 2015. As natural wetting and drying occurs and changes the availability of this ponded habitat type, the POB Pty Ltd could attempt to ensure all habitat types remain available.

4. The POB land 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 land. The POB needs to better understand the use of the reclamation area by these species (Curlew Sandpiper, Greater Sand Plover and Ruddy Turnstone) in order to plan for the future when the redevelopment of the site is complete.

Table 7. Details of the captures and resightings of waders caught and banded in the POB reclamation area in 2014 – 2016. N = number captured or resighted on each date.

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location	Leg flag code
Bar-tailed Godwit	22 November 2015	1	–	–	–	–
	28 February 2016	13	6 March 2016	1	Manly Harbour	CPT
			20 March 2016	1	Manly Harbour	CPT
			5 April 2016	1	Oyster Point, Cleveland	CPT
			19 April 2016	1	Manly Harbour	CPT
			10 April 2016	1	Saga, JAPAN	CPC
			6 August 2016	1	Wynnum Esplanade	CPD
Broad-billed Sandpiper	30 November 2014	2	–	–	–	–
	28 February 2016	1	–	–	–	–
Curlew sandpiper	30 November 2014	1	12 March 2016	1	Sandgate	ASC
	1 March 2015	2	–	–	–	–
	22 November 2015	1	–	–	–	–
Great Knot	22 November, 2015	83	30 January 2016	1	Wynnum Esplanade	BRY
			2 April 2016	1	Wynnum Esplanade	CMY
			14 February 2016	2	Port of Brisbane outer FPE	BRY, CMJ

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location	Leg flag code
			24 January 2016	1	Kakadu Beach, Bribie Is	BRP
			30 January 2016	1	Toorbul, Bribie passage	BRJ
			22 – 24 March 2016	2	Oyster Point, Cleveland	CMX
			8 April 2016	1	Alphae Island, KOREA	BNL
			13 April 2016	1	Asa R estuary, Yamaguchi-shi, JAPAN	CMC
			17 April 2016	1	Geumdeung-ri, Jeju Is, KOREA	BTS
			19 April 2016	1	Zhuangwei Yi-lan County TAIWAN	CNP
			23 April 2016	1	Toorbul, Bribie passage	BTL
			4 July 2016	1	Northern Kamchatka Peninsula, RUSSIA	BTK
			9 July 2016	1	Northern Kamchatka Peninsula, RUSSIA	BTJ
			26 July 2016	1	Northern Kamchatka Peninsula, RUSSIA	BNJ
Greater Sand Plover	30 November 2014	1	–	–	–	–
	1 March 2015	1	–	–	–	–
Grey-tailed Tattler	22 November 2015	1	–	–	–	–
Lesser Sand Plover	30 November 2014	19	8 February 2015	3	PBAR, PBC3	APZ
			7 March 2015	1	Wynnum Esplanade	APT
			28 March 2015	1	Wynnum Esplanade	APT

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location	Leg flag code
			4 April 2015	1	Wynnum Esplanade	APT
			12 December 2015 – 4 April 2016	6	Wynnum Esplanade	APT
			5 – 28 March 2016	3	Wynnum Esplanade	ALU
	1 March 2015	18	20 May 2015	1	Geoff Skinner Reserve, Wellington Pt	AKY
	22 November 2015	9	–	–	–	–
Pacific Golden Plover	30 November 2014	7	14 December 2014	1	PBR3	–
			11 January 2015	1	Sandgate	BVA
			12 March 2015	1	Sandgate	BVA
			18 March 2016	1	Sandgate	BVD
	22 November, 2015	4	17 January 2016	1	Nudgee Beach	BTC
	28 February 2016	34	18 March 2016	8	Sandgate	various
			24 April 2016	1	Oosukatsu, Ibaraki, JAPAN	BUA
Red-necked Stint	30 November 2014	2	–	–	–	–
	1 March 2015	7	–	–	–	–
	22 November 2015	4	–	–	–	–
	28 February 2016	1	–	–	–	–
Sharp-tailed Sandpiper	1 March 2015	3	11 April 2015	1	Wynnum Esplanade	AEP

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location	Leg flag code
TOTAL		211		50		

LITERATURE CITED

Clemens, R.S., Rogers, D.I., Hansen, B.D., Gosbell, K., Minton, C.D.T., Straw, P., Bamford, M., Woehler, E.J., Milton, D.A., Weston, M.A., Venables, W., Weller, D., Hassell, C., Rutherford, B., Onton, K., Herrod, A., Studds, C.E., Choi, C., Dhanjal-Adams, K.L., Murray, N.J., Skilleter, G.A. and R. A. Fuller 2016. Continental-scale decreases in shorebird populations in Australia. Emu 116: 119 – 135.

Zharikov, Y. and D.A. Milton 2009. Valuing coastal habitats: predicting high-tide roosts of nonbreeding migratory shorebirds from landscape composition. Emu 109: 107 – 120.