ANNUAL ANALYSIS OF THE STATUS OF WADERS IN THE PORT OF BRISBANE PTY LTD LAND 2014/2015

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

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Table of Contents

Section Page

EXECUTIVE SUMMARY

2015 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. None of the summer average counts of the 12 most abundant migratory wader species were below the updated critical low count thresholds for each species. However, five species had individual counts below their threshold during mid-summer (Eastern Curlew, Grey Plover, Red-necked Stint, Ruddy Turnstone and Sharp-tailed Sandpiper). An additional species (Great Knot) had a count in March below the threshold. It is highly likely that the low count of Eastern Curlew and Great Knot in March was due to birds leaving Moreton Bay earlier than previous years to commence their migration.

Maintenance mud was pumped into Ponds R3 (December 2014) and C2 (January – February 2015). This mud contained small invertebrates that provide food for waders, terns and Silver Gull during high tide when alternate prey are scarce. Analysis of the monthly counts in Ponds R3 and C2 made before, during and after the infill did not detect changes in the counts of waders in either pond that could be attributed to the maintenance mud infill process. Higher counts were made in Pond C2 in January and February 2015, but these were of Gull-billed Terns (January) and Silver Gull (February).

Two wader banding catches were made in the POB Pty Ltd reclamation area in 2014 – 2015. These events caught 63 waders of seven species. All waders were fitted with individually-labelled lime green leg flags to allow resighting of individual birds. Six waders of three species were resighted during the remainder of 2014 – 2015. All resightings were within Moreton Bay, with an immature Lesser Sand Plover moving the greatest distance to Geoff Skinner Reserve at Wellington Point. Additional resightings outside Moreton Bay will be expected during coming years as more birds get flagged and they undertake annual migration.

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 third annual report on the status of waders in the POB land. This report updates the previous report (October 2014) and highlights any changes that have occurred during the year.

POB Pty Ltd has detailed reports on bird usage of the their 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 third of what will become regular yearly reports of the counting being 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 2014 to June 2015 are tabulated. Yearly 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 15 species are regularly recorded at any one time. Numbers of resident waders are marginally higher during the winter months. Over the last decade, the numbers of migratory waders 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 four species of wader (Great Knot, Greater Sand Plover, Lesser Sand Plover and Sharp-tailed Sandpiper) may have increased slightly since 2003. The proportion of Moreton Bay counts of three other species have decreased during the same period (Eastern Curlew, Pacific Golden Plover and Red-necked Stint).

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. These patterns are described and continued sampling will help to establish whether there are cyclical patterns or distinct increasing or decreasing trends in counts. Greater Sand Plover, Grey Plover and Pacific Golden Plover counts need closer scrutiny. Critically low count values 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 critical value 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 holds large populations of migratory waders. 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 Commonwealth under the 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 third of these annual assessments will summarise data collected to June 2015 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. Assess changes in the use of Ponds C2 and R3 as a consequence of infill by maintenance mud in December 2014 and January 2015.
3. 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.
4. Graphical presentation of annual changes in wader numbers by species for each subgroup of sites and within the most recently preferred sites (subgroup D).
5. 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).

6. 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. * Counts that included both the reclamation area and the claypan. N = the number of monthly surveys since January 2003 that included that species.

Species	Maximum count (% flyway population)	Proportion of POB counts (%) (N)
Grey-tailed Tattler	1288 (2.6)	88 (84)
Red-necked Stint	6803 (2.1)	100 (96)
Lesser Sand Plover	2413 (1.7)	95 (91)
Curlew Sandpiper	2712 (1.5)	98 (94)
Sharp-tailed Sandpiper	1990 (1.2)	76 (73)
Eastern Curlew	473 (1.2)*	66 (63)
Pacific Golden Plover	1090 (1.1)	82 (79)
Great Knot	2600 (0.7)*	91 (87)
Greater Sand Plover	669 (0.6)	86 (83)
Ruddy Turnstone	207 (0.6)	86 (83)
Bar-tailed Godwit	1604 (0.5)	98 (92)
Grey Plover	145 (0.1)	54 (52)

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 June 2014 and June 2015 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. Each 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 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 "2014" label represents the period from September 2014 to August 2015.

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. 6). 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 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 POB land remains 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 Grey-tailed Tattler, Bar-tailed Godwit, Curlew Sandpiper, Red-necked Stint and Lesser Sand Plover. Another three species reached important numbers during the periods of migration. These were the Sharp-tailed Sandpiper, Eastern Curlew 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).

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 periods and across the whole, or parts of the POB land.

Table 2. Counts of all migratory wader species (a) total birds and (b) number of species recorded in each subsection of the Port between July 2014 and June 2015. 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).

(a) Total counts

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	8	50	–	–	481	92	509	836	119	86	123	2	2306
PBAR	29	398	599	529	423	559	94	240	30	–	–	–	2901
PBC2	9	4	–	3	2	–	–	–	31	–	24	17	90
PBC3	1	3	–	–	23	2	1709	4840	8622	2066	26	145	17437
PBR3	91	319	4314	6222	4418	3219	6152	2687	2606	16	15	18	30077
PBS1	–	–	–	–	199	20	11	36	164	–	–	73	503
PBS2	2	–	–	–	–	–	–	–	–	–	–	–	2
PBS3	16	41	523	73	673	42	161	124	886	52	12	347	2950
PBS4	492	621	1097	952	881	61	12	28	5	–	2	102	4253
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	–
PFPE	252	114	41	43	131	1291	105	211	470	1638	52	32	4380
Total	900	1550	6574	7822	7231	5286	8753	9002	12933	3858	254	736	64899

(b) Number of species

	Breeding		South migration			Non breeding		North migration			Breeding	
Site Code	13-Jul-14	17-Aug-14	28-Sep-13	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15
FICP	2	1	–	–	5	5	9	6	8	4	5	1
PBAR	4	6	8	7	7	10	5	6	5	8	4	5
PBC2	1	2	–	2	1	–	–	–	2	–	2	1
PBC3	1	1	–	–	3	1	8	10	11	10	2	3
PBR3	5	4	12	13	14	11	14	13	14	2	2	2
PBS1	–	–	–	–	3	2	4	3	4	–	–	1
PBS2	1	–	–	–	–	–	–	–	–	–	–	–
PBS3	1	3	8	3	6	3	4	4	4	3	4	2
PBS4	4	7	7	8	9	5	6	3	2	–	2	7
PLDE	–	–	–	–	–	–	–	–	–	–	–	–
PFPE	5	6	5	4	5	8	3	6	9	7	2	4
Total no. spp.	8	12	17	18	18	16	18	15	18	15	8	12

Table 3. Counts of all resident wader species (a) total birds and (b) number of species recorded in each subsection of the Port between July 2014 and June 2015. Refer to Table 2 and Figure 1. Seasons are winter (breeding), summer (non-breeding) and migration (south and north migrations).

(a)	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	2	–	–	2	3	5	53	5	6	35	136	75	322
PBAR	213	113	103	148	131	70	8	8	4	4	7	8	817
PBC2	6	3	3	7	2	–	1	3	–	–	16	4	45
PBC3	3	6	–	18	–	48	198	13	26	103	2652	319	3386
PBR3	8	–	212	34	55	3	94	189	428	27	17	121	1188
PBS1	2	2	–	2	1	28	9	4	68	–	2	14	132
PBS2	2	3	–	–	–	–	2	1	23	–	4	7	42
PBS3	14	6	46	31	4	94	5	–	20	1510	225	354	2309
PBS4	6	92	18	45	16	6	1	2	1	75	64	72	398
PLDE	–	–	–	2	–	–	–	–	–	2	–	–	4
PFPE	254	61	47	61	51	11	2	–	20	4	3	5	519
Total	510	286	429	350	263	265	373	225	596	1760	3126	979	9162

(b)	Breeding		South migration			Non breeding		North migration			Breeding	
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15
FICP	1	–	–	1	1	1	2	2	3	1	1	2
PBAR	2	4	4	5	4	5	2	4	2	2	2	3
PBC2	2	1	1	1	1	–	1	1	–	–	2	3
PBC3	1	1	–	2	–	1	3	2	2	1	1	2
PBR3	2	–	4	3	3	2	3	3	4	3	2	4
PBS1	1	1	–	1	1	1	2	2	1	–	1	2
PBS2	1	1	–	–	–	–	1	1	2	–	1	3
PBS3	2	2	–	1	2	3	2	–	2	2	2	3
PBS4	2	4	2	4	1	2	1	1	1	2	1	4
PLDE	–	–	–	1	–	–	–	–	–	1	–	–
PFPE	3	1	1	2	1	1	1	–	2	2	1	1
Total no. spp.	4	4	5	6	5	5	5	5	6	6	4	5

Table 4. Counts of the 12 most abundant migratory wader species recorded in each subsection of the Port between July 2014 and June 2015. 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			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	–	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	2	118	9	–	–	–	129
PBR3	–	–	–	–	12	32	597	404	912	–	–	–	1957
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	–	–	–	28	–	–	–	–	– –
PBS4	462	416	974	815	740	52	2	26	–	–	–	86	3574
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	42	–	–	–	1146	1	25	12	507	12	–	1745
Total	462	458	975	815	752	1230	602	601	933	507	12	86	7433

Red-necked Stint

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	2	–	–	–	3	8	17	15	15	–	69	–	129
PBAR	22	55	56	73	30	60	57	173	24	–	–	–	550
PBC2	9	3	–	2	2	–	–	–	30	–	15	17	78
PBC3	1	3	–	–	12	2	1079	2870	5066	152	–	–	9185
PBR3	29	–	1422	1952	–	233	1405	159	669	–	–	–	5869
PBS1	–	–	–	–	186	11	4	9	61	–	–	73	344
PBS2	2	–	–	–	–	–	4	2	199	–	–	4	211
PBS3	16	29	50	38	397	15	124	86	590	35	5	226	1611
PBS4	1	35	11	26	31	3	2	1	–	–	–	4	114
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	7	16	16	9	51	13	15	7	15	759	40	–	948
Total	89	141	1555	2100	712	345	2707	3322	6669	946	129	324	19039

Sharp-tailed Sandpiper

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	4	–	4	–	2	25	15	–	–	50
PBAR	1		72	83	164	62	32	39	3	–	–	–	456
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	12	88	510	1378	–	–	1988
PBR3	–	–	38	103	12	334	33	71	236	4	–	–	831
PBS1	–	–	–	–	–	60	3	11	–	–	–	–	74
PBS2	–	–		–	–	–	1	1	22	–	–	–	24
PBS3	–	–	1	1	48	6	29	9	36	–	–	–	130
PBS4	–	–		1	4	–	3	–	–	–	–	–	8
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	12	–	–	–	21	–	–	–	121	–	–	154
Total	1	12	111	192	228	487	113	221	832	1518	0	0	3715

Curlew Sandpiper

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	12	1	–	5	–	–	–	12	–	30
PBAR	4	43	14	71	15	102	3	23	–	–	–	–	275
PBC2	–	1	–	1	–	–	–	–	1	1	9	–	13
PBC3	–	–	–	–	8	–	332	600	611	164	–	58	1773
PBR3	23	–	462	985	144	679	799	702	239	–	–	–	4033
PBS1	–	–	–	–	5	9	3	16	–	–	–	–	33
PBS2	–	–	–	–	–	–	–	–	546	–	–	–	546
PBS3	–	11	19	34	145	21	6	1	259	–	4	121	621
PBS4	16	11	10	12	41	3	3	–	–	–	–	–	96
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	17	16	1	7	55	–	–	–	15	103	–	–	214
Total	60	82	506	1122	414	814	1151	1342	1671	268	25	179	7634

Great Knot

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	11	4	15	–	–	–	30
PBAR	–	9	–	–	–	1	–	–	–	–	–	–	10
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	–	–	41	–	–	–	41
PBR3	–	–	519	375	534	252	226	140	4	–	–	–	2050
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	4	–	–	–	–	–	–	–	–	–	0
PBS4	–	67	–	–	–	–	–	–	–	–	–	2	69
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	21	–	–	–	–	–	–	–	–	–	–	–	21
Total	21	76	523	375	534	253	237	144	60	0	0	2	2225

Bar-tailed Godwit

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	349	–	311	695	40	19	19	–	1433
PBAR	2	289	427	258	9	290	–	–	–	–	–	–	1275
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	–	29	489	20	25	75	638
PBR3	–	–	493	669	694	665	679	454	334	–	–	–	3988
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	3	–	–	–	3
PBS3	–	–	306	–	–	–	–	–	–	–	2	–	308
PBS4	–	86	55	33	2	1	–	–	4	–	1	5	187
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	208	–	21	26	23	10	91	7	33	–	–	–	419
Total	210	375	1302	986	1077	966	1081	1185	903	39	47	80	8251

Eastern Curlew

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	6	50	–	–	86	64	136	102	13	37	18	2	514
PBAR	–	1	1	2	–	1	1	2	1	–	–	–	9
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	–	–	–	1	1	–	2
PBR3	–	–	–	208	–	–	–	–	–	–	–	–	208
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	137	–	79	–	–	–	–	15	1	–	232
PBS4	–	–	–	–	–	–	–	–	–	–	–	1	1
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	–	1	–	–	–	–	–	–	–	–	–	1
Total	6	51	139	210	165	65	137	104	14	53	20	3	967

Pacific Golden Plover

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	10	17	–	5	–	–	–	32
PBAR	–	–	–	–	–	3	–	1	1	–	–	–	5
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	3	–	–	–	3	1	–	–	7
PBR3	21	–	208	309	328	297	634	254	58	–	–	–	2109
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS4	–	–	–	–	–	–	–	1	–	–	–	–	1
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	–	–	–	–	43	13	88	336	–	–	–	480
Total	21	0	208	309	331	353	664	344	403	1	0	0	2634

Ruddy Turnstone

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	–	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	–	1	8	–	–	–	9
PBR3	–	–	1	4	14	7	15	9	–	–	–	–	50
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	–	–	2	–	–	–	–	–	2
PBS4	13	4	31	56	60	–	–	–	1	–	–	–	165
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	9	–	2	–	1	25	–	51	53	4	–	2	147
Total	22	4	34	60	75	32	17	61	62	4	0	2	373

Lesser Sand Plover

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	–	0
PBAR	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	250	936	1693	278	–	–	3157
PBR3	11	–	676	1063	535	715	1665	411	132	–	12	16	5236
PBS1	–	–	–	–	8	–	–	–	100	–	–	–	108
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS4	–	–	–	–	1	–	–	–	–	–	–	–	1
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	–	–	1	1	31	–	33	4	140	–	25	235
Total	11	0	676	1064	545	746	1915	1380	1929	418	12	41	8737

Greater Sand Plover

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	–	–	–	–	–	–	
PBAR	–	–	–	–	–	–	–	–	–	–	–	–	
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	
PBC3	–	–	–	–	–	–	31	164	169	64	–	–	428
PBR3	–	–	5	118	55	3	–53	62	3	–	–	–	246
PBS1	–	–	–	–	–	–	–	–	1	–	–	–	1
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	1	–	–	–	–	–	–	–	1
PBS4	–	–	–	–	–	2	1	–	–	–	–	–	3
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	–	–	–	–	–	–	–	–	4	–	1	5
Total			5	118	56	5	84	226	173	68	0	1	684

Grey Plover

	Breeding		South migration			Non breeding		North migration			Breeding		
Site Code	13-Jul-14	17-Aug-14	28-Sep-14	26-Oct-14	23-Nov-14	14-Dec-14	11-Jan-15	8-Feb-15	8-Mar-15	19-Apr-15	17-May-15	14-Jun-15	Total
FICP	–	–	–	–	–	–	3	–	–	–	–	–	3
PBAR	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBC3	–	–	–	–	–	–	1	33	23	3	–	–	60
PBR3	–	–	26	33	34	–	33	5	2	–	–	–	133
PBS1	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS2	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS3	–	–	–	–	–	–	–	–	–	–	–	–	0
PBS4	–	–	–	–	–	–	1	–	–	–	–	3	4
PLDE	–	–	–	–	–	–	–	–	–	–	–	–	0
PFPE	–	–	–	–	–	–	–	–	1	–	–	–	1
Total	0	0	26	33	34	0	38	38	26	3	0	3	201

TEMPORAL CHANGES IN DIVERSITY AND COUNTS OF BIRDS IN PONDS C2 AND R3 DURING THE PERIOD OF MAINTENACE MUD INFILL

Approximately 5,000 m^3 of maintenance mud was pumped into Pond R3 between 7 and 25 December 2014, Additional 120,000 m^3 of maintenance mud was pumped into Pond C2 between 4 January and 14 February 2015. Many waders were observed feeding on invertebrates found in the mud as it was pumped into each pond. To assess the potential effects of these events on bird counts in these ponds, the number of species and the total counts of birds were plotted for the period between October2014 and March 2015. This period was chosen as it included counts prior to the addition of the mud and covered the "summer" period when the wader numbers were most stable (Figure 2).

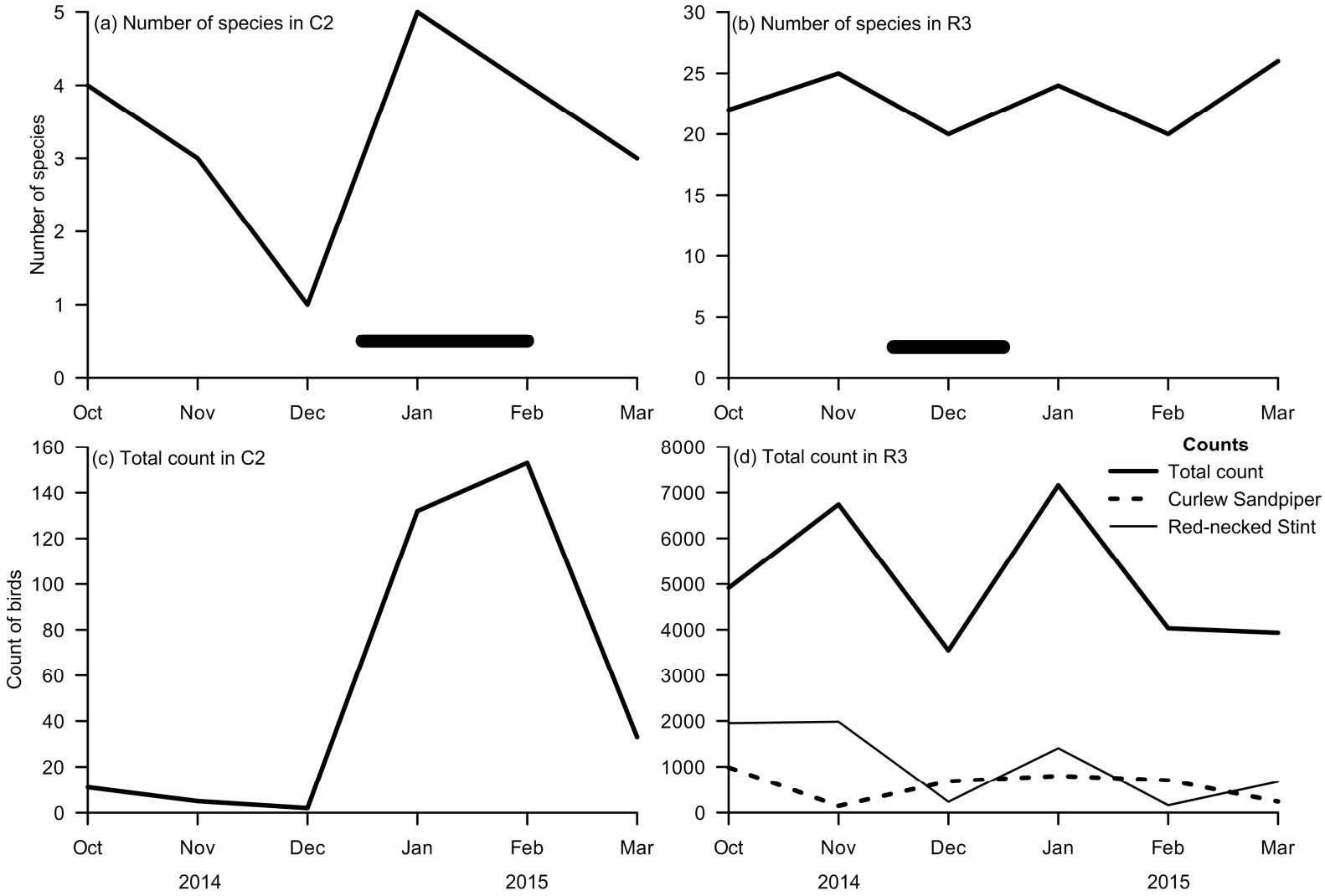


Figure 2. The trend in (a) the number of species counted in Pond C2, (b) Pond R3, (c) the total number of birds in Pond C2 and (d) Pond R3 during the period spanning inflow of maintenance mud to each pond in December 2014 (R3) and January - February 2015 (C2). The heavy solid line shows the period of operations within each pond.

The number of species and the total number of birds counted in Pond C2 increased during the period of inflow of the maintenance mud (Figure 2). However, these increases were due to an influx of Gull-billed Terns in December and Silver Gull during the January count.

The pattern is less clear in Pond R3, where the diversity and total count of birds appears to vary independent of the infill of maintenance dredge mud during December 2014 (Figure 2). Two species of wader known to take advantage of increased invertebrate densities in maintenance mud during infill are Red-necked Stint and Curlew Sandpiper. Counts of these species during the period of mud infill show little evidence of responding to the potentially-increased density of prey in Pond R3 (Figure 2). The Red-necked Stint count was lower during pumping in December and only returned to similar numbers to the pre-maintenance infill period for the January 2015 count (Figure 2).

COMPARISON OF WADER NUMBERS BETWEEN THE POB AND ELSEWHERE

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 with which to compare to 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 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 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

There was a statistically significant trend in the IRI for seven of the 12 species of wader examined (Figure 3). Five species, Bar-tailed Godwit, Curlew Sandpiper, Grey-tailed Tattler, Grey Plover and Ruddy Turnstone showed no temporal trend in the IRI. For Eastern Curlew, the POB land 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 land was between 56 and 65%.

The fit of the significant trends in the IRI were all quite weak, with the best correlation being Greater Sand Plover ($r^2 = 0.14$; $P<0.001$). The correlations for the six other species were all less than $r^2 = 0.1$ but were still highly significant ($P<0.01$). Four of the seven species of wader had a significant increasing temporal trend in the IRI. This implies that these species are leaving other high tide roosts to use the POB land. Since 2003, the POB land regularly held the entire Moreton Bay count for three of the seven species – Lesser Sand-Plover, Ruddy Turnstone and Sharp-tailed Sandpiper. 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.

It is not completely clear why the POB land has become less important to Pacific Golden Plover and Red-necked Stint (Fig. 2). 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.

In the case of Red-necked Stint, the POB reclamation area attracted an increasing number of birds while active dredging infill occurred. The active pumping of dredge material for several years since 2003 attracted Red-necked Stint as it enabled them to forage throughout the tidal cycle within the POB reclamation area. The relative importance the POB reclamation area for Red-necked Stint appears to have peaked in 2012 (Fig. 2f) and more Red-necked Stint have been counted elsewhere in Moreton Bay in 2013 and 2014.

ANNUAL CHANGES IN WADER NUMBERS BETWEEN SITES WITHIN THE POB

This section firstly examines annual changes in total migratory wader numbers since 2003 (Fig. 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 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. PRB3 has maintained its importance since 2009 (about half the birds), whereas PBS1 was important in 2008 but not again until 2012. In 2014, the new site PBS4 (see Fig. 1) was enclosed and immediately began being used by birds that have shifted from other sites (Figure 4). 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 POB lands.

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

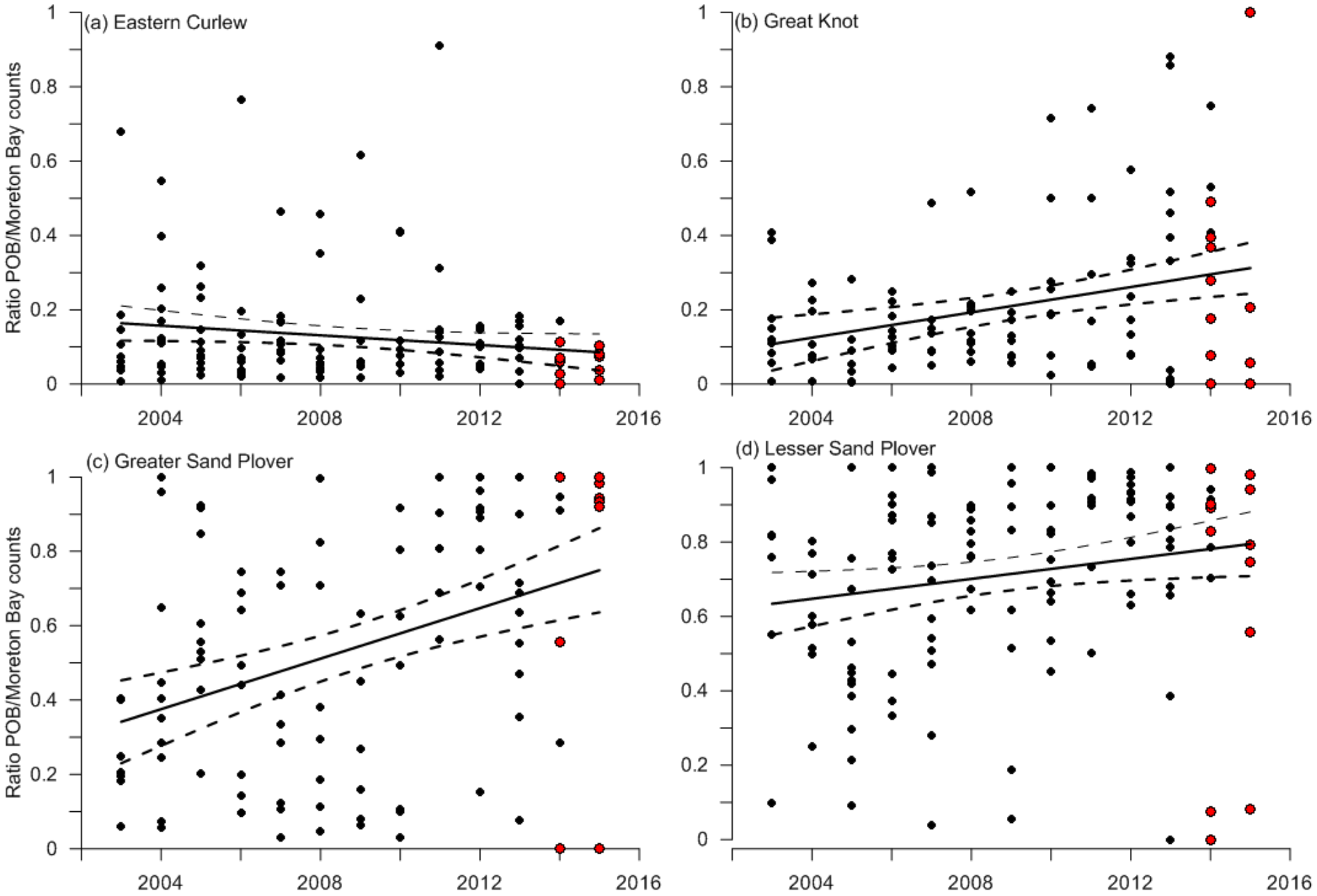

(a) Eastern Curlew
(b) Great Knot
(c) Greater Sand Plover
(d) Lesser Sand Plover
Ratio POB/Moreton Bay counts
0
0.2
0.4
0.6
0.8
1
2004
2008
2012
2016

Figure 3. The species of migratory wader that showed a significant temporal trend in the IRI in 2015. 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 2014 – June 2015.

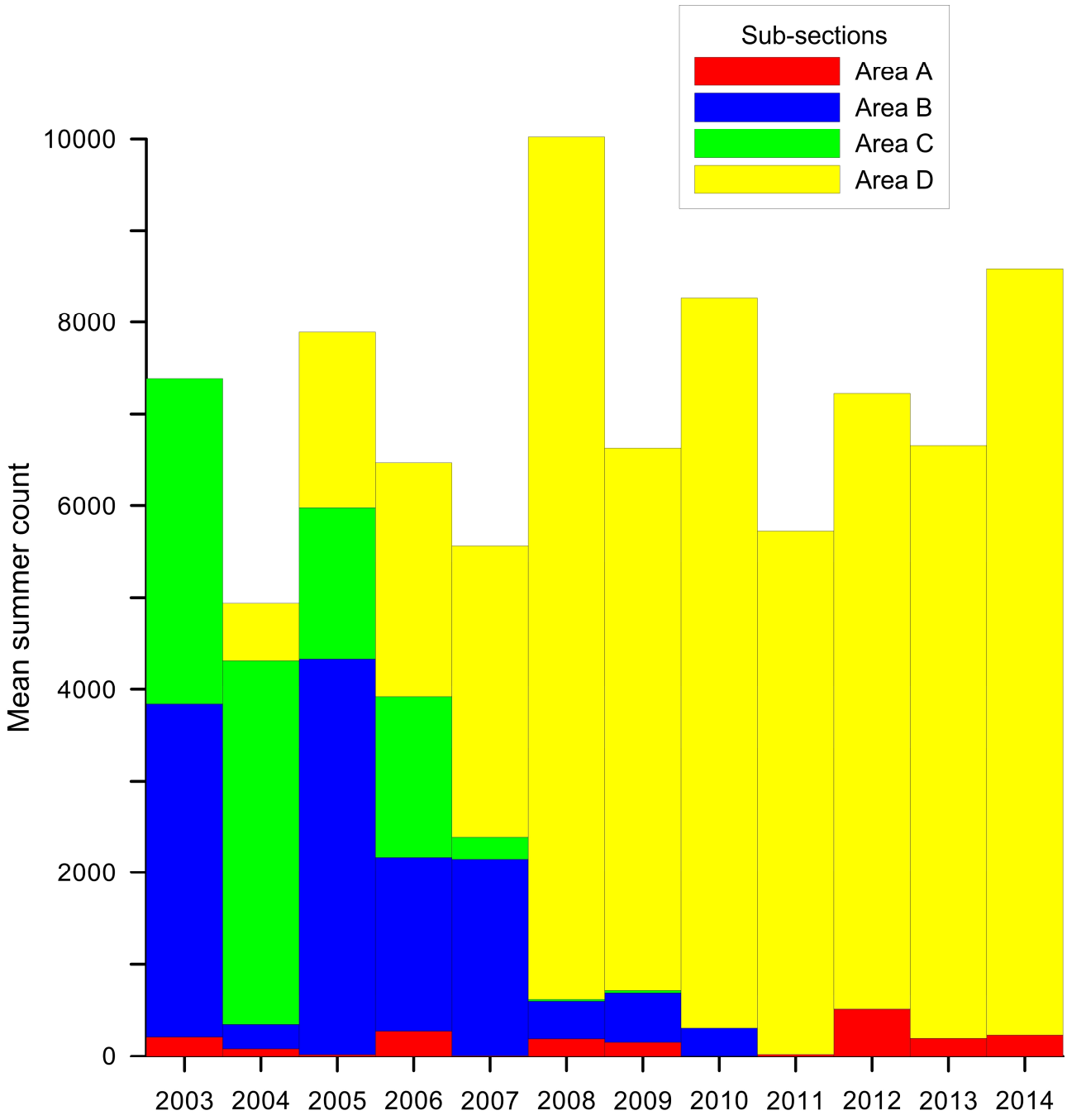


Figure 4. Average counts for the summer period of all migratory waders in four subsections of the Port lands for each "wader" year since 2003. Area A is the purpose built artificial roost site (PBAR) and the other areas are groupings of ponds (see Fig. 1).

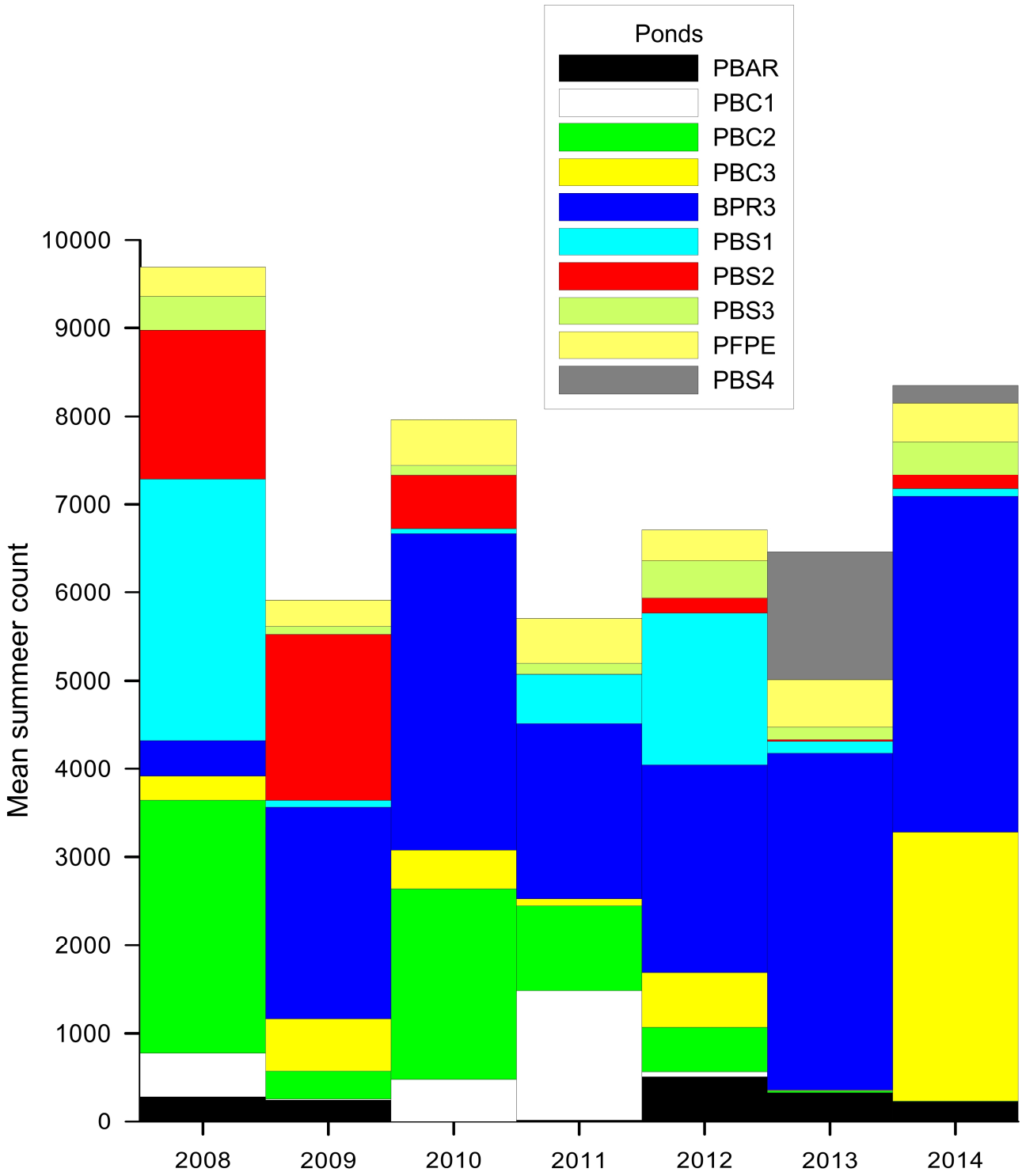
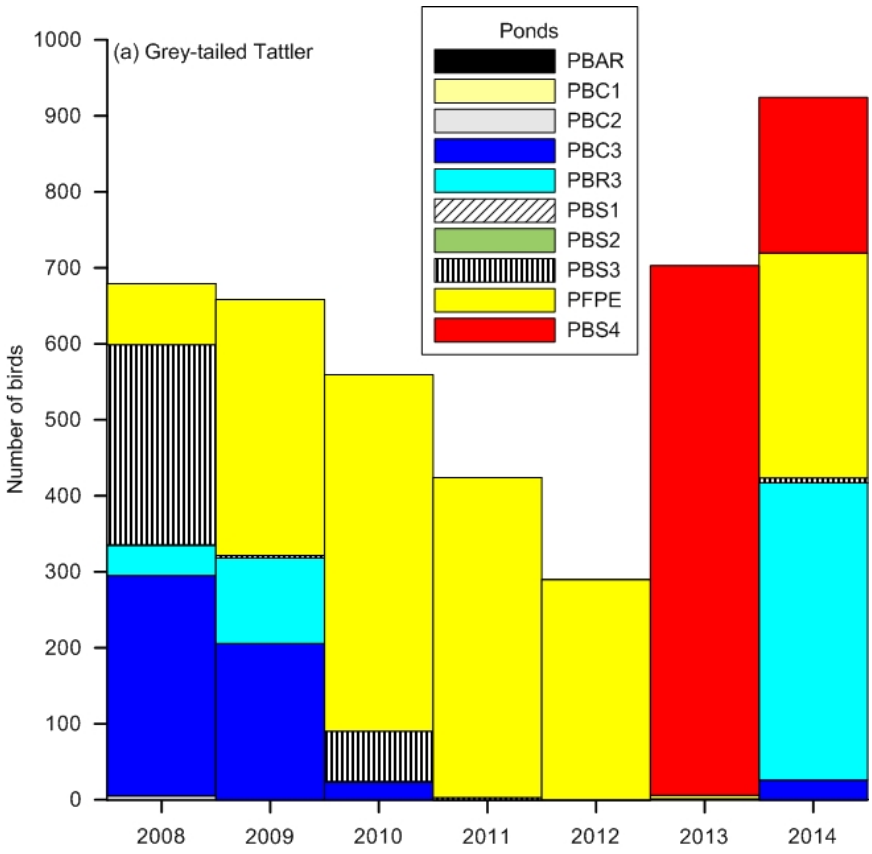
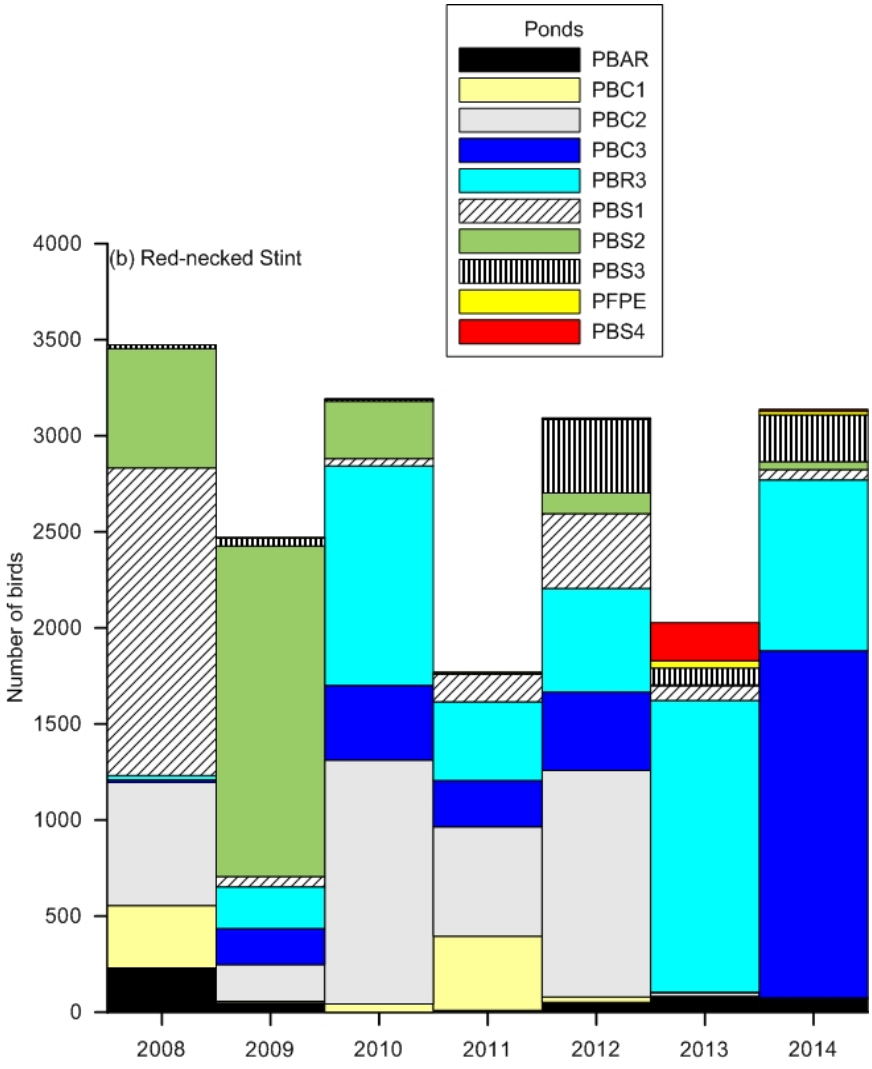
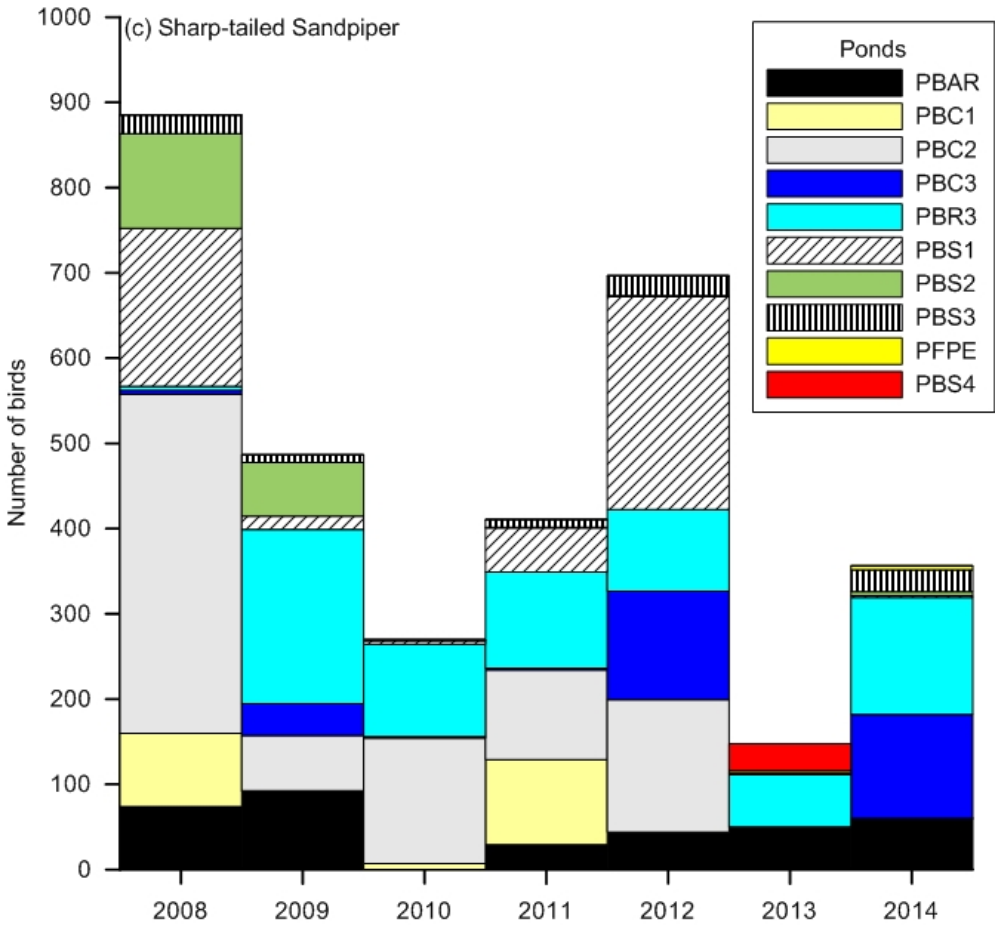
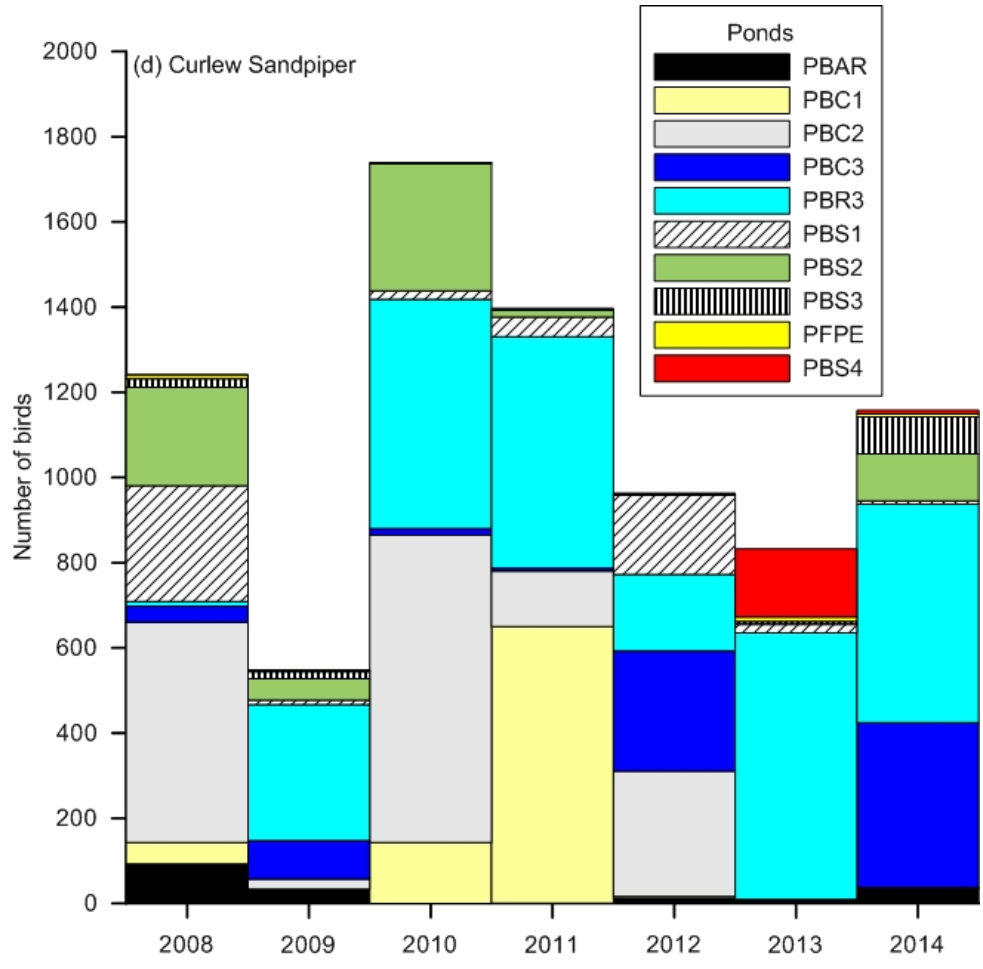


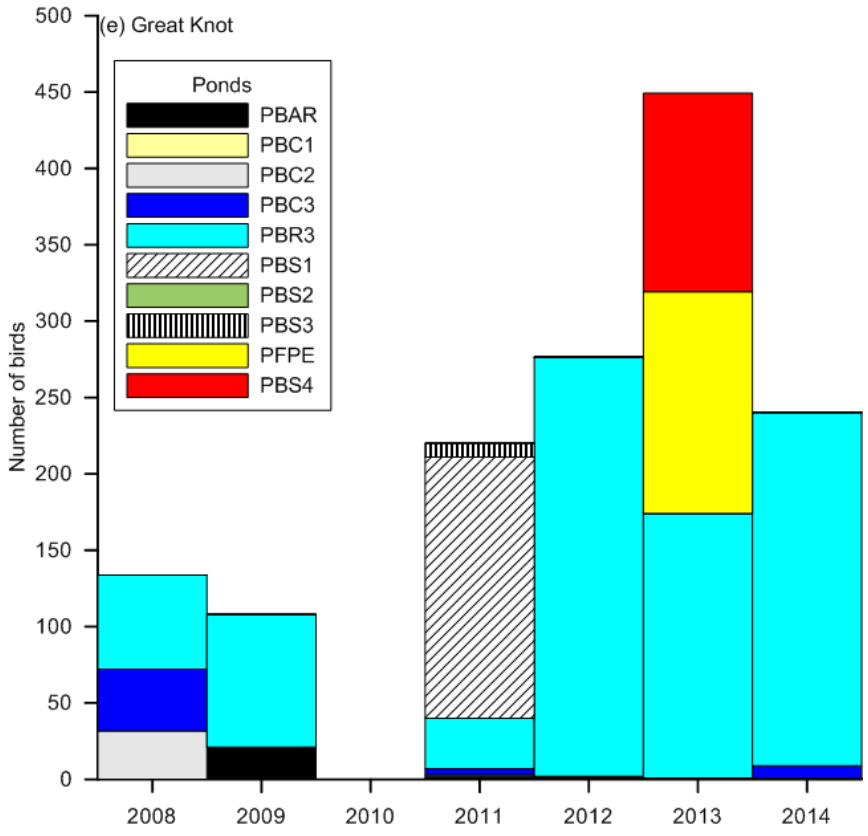
Figure 5. Average counts (summer) of all migratory waders in ponds within Area D (see Fig. 1).

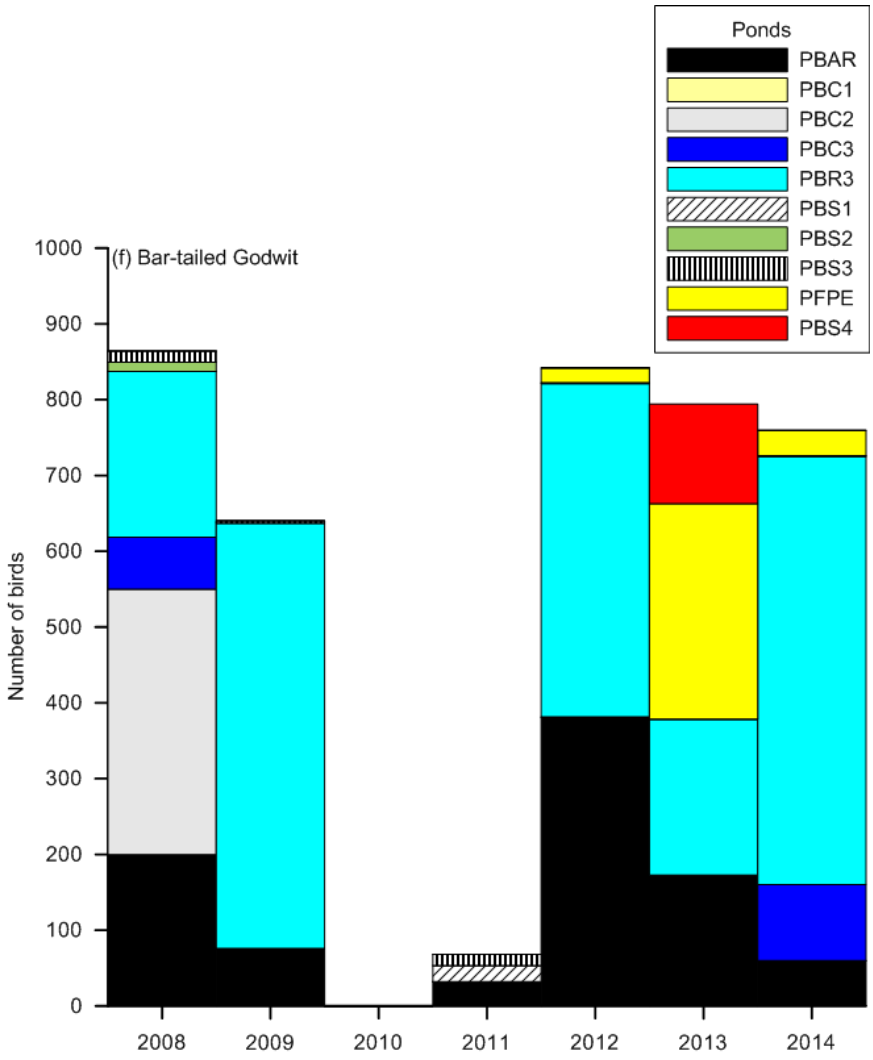

(a) Grey-tailed Tattler
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
100
200
300
400
500
600
700
800
900
1000
2008
2009
2010
2011
2012
2013
2014

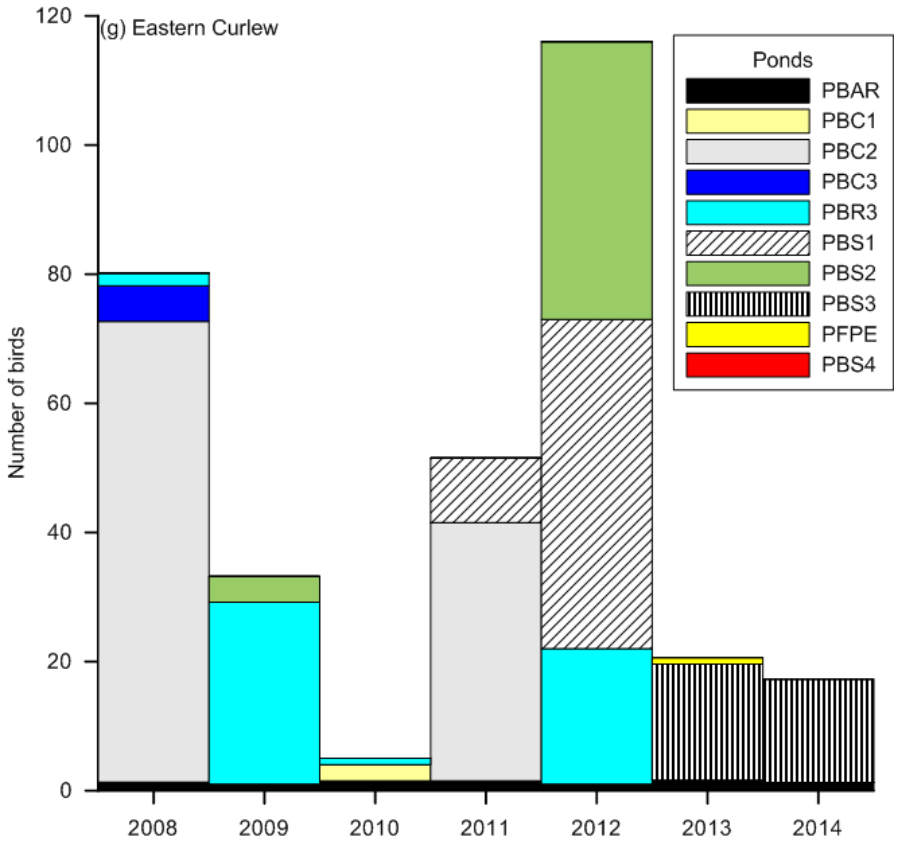

(b) Red-necked Stint
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
500
1000
1500
2000
2500
3000
3500
4000
2008
2009
2010
2011
2012
2013
2014

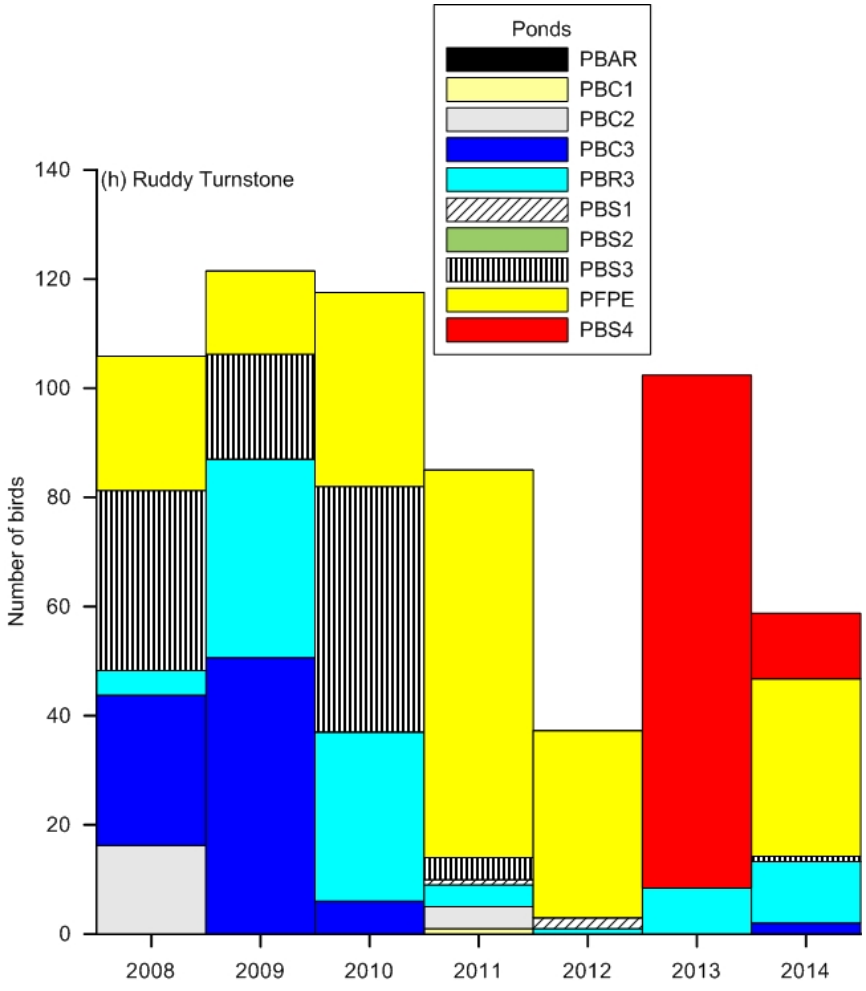

(c) Sharp-tailed Sandpiper
Number of birds
1000
900
800
700
600
500
400
300
200
100
0
2008
2009
2010
2011
2012
2013
2014
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4

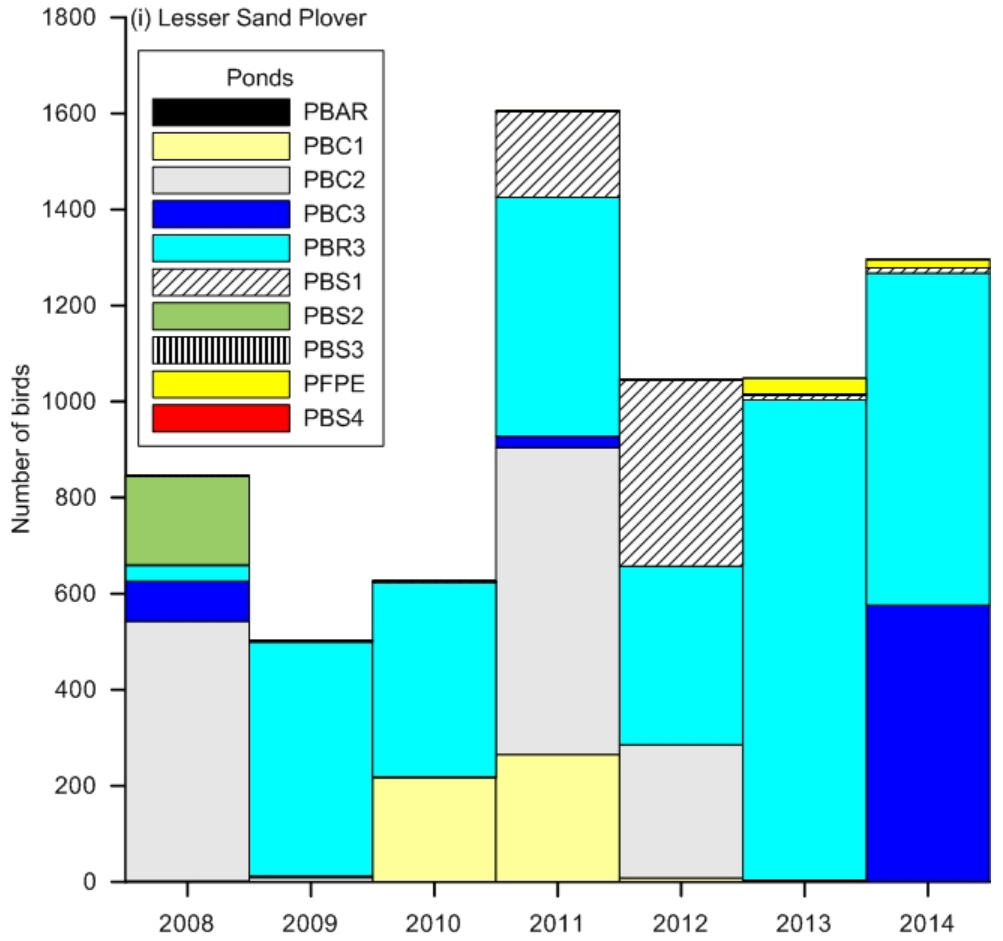

(d) Curlew Sandpiper
Number of birds
2000
1800
1600
1400
1200
1000
800
600
400
200
0
2008
2009
2010
2011
2012
2013
2014
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4

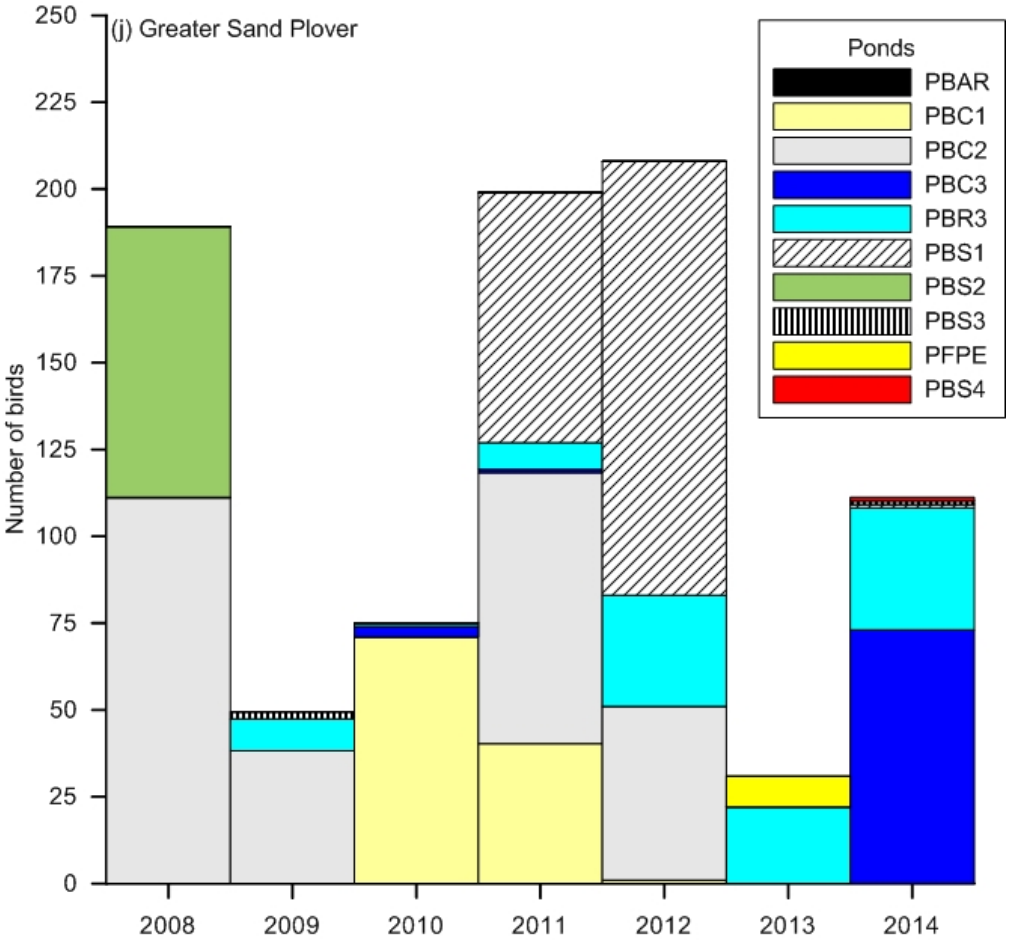

(e) Great Knot
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
50
100
150
200
250
300
350
400
450
500
2008
2009
2010
2011
2012
2013
2014

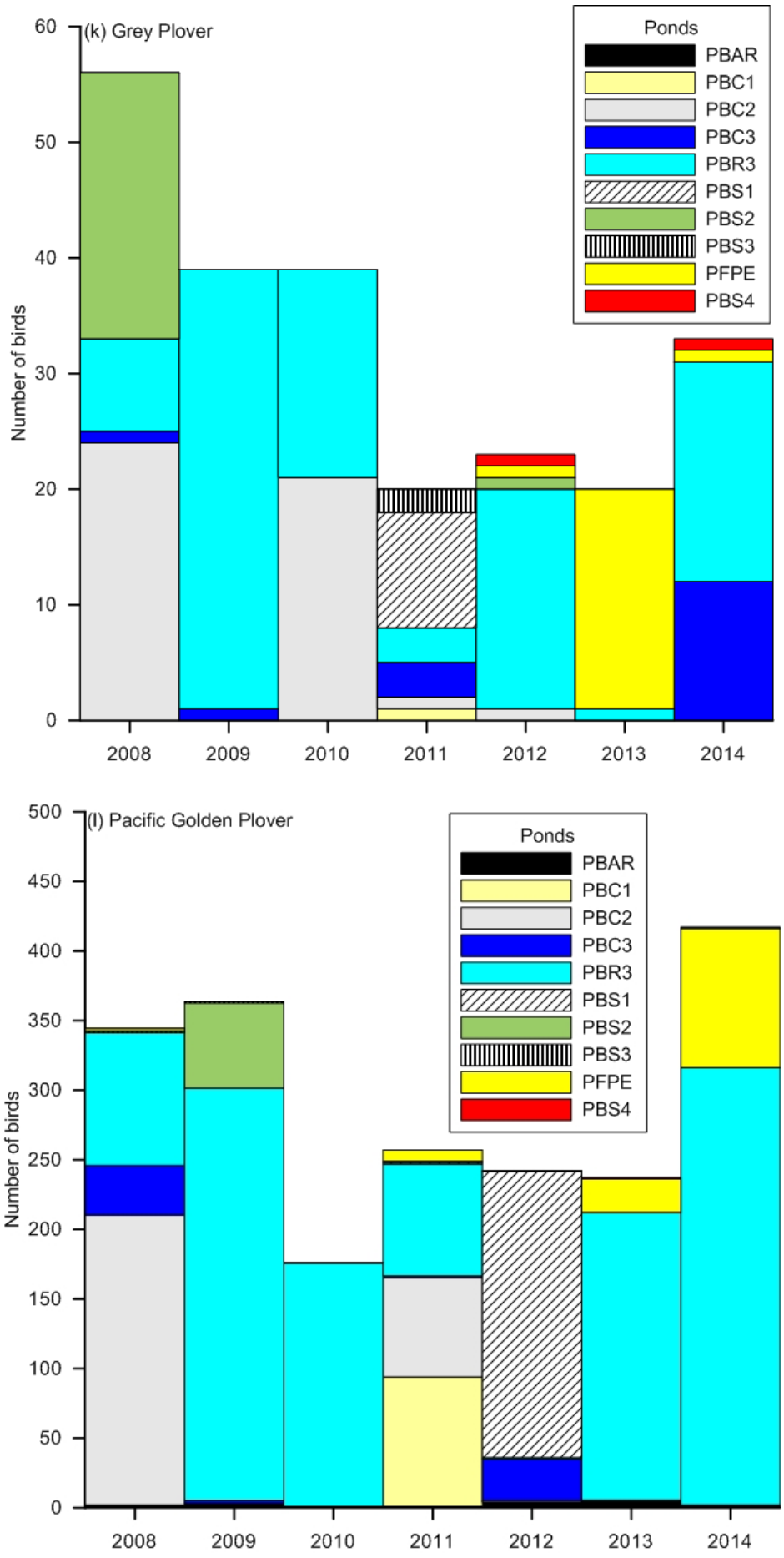

(f) Bar-tailed Godwit
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
0
100
200
300
400
500
600
700
800
900
1000
2008
2009
2010
2011
2012
2013
2014


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


(h) Ruddy Turnstone
Number of birds
0
20
40
60
80
100
120
140
2008
2009
2010
2011
2012
2013
2014
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4


(i) Lesser Sand Plover
Ponds
PBAR
PBC1
PBC2
PBC3
PBR3
PBS1
PBS2
PBS3
PFPE
PBS4
Number of birds
1800
1600
1400
1200
1000
800
600
400
200
0
2008
2009
2010
2011
2012
2013
2014


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



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 2014. 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 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 12 years (Fig. 6a). However, two of the three highest counts of total migratory waders occurred prior to 2009. The average count in 2014 was the highest for six years. Similarly, there is no distinct downward trend in total resident wader numbers on the POB land, although summer counts increased in 2013 and remained similar to the long-term average after three years of lower counts.

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 critically low count as discussed in the next section.

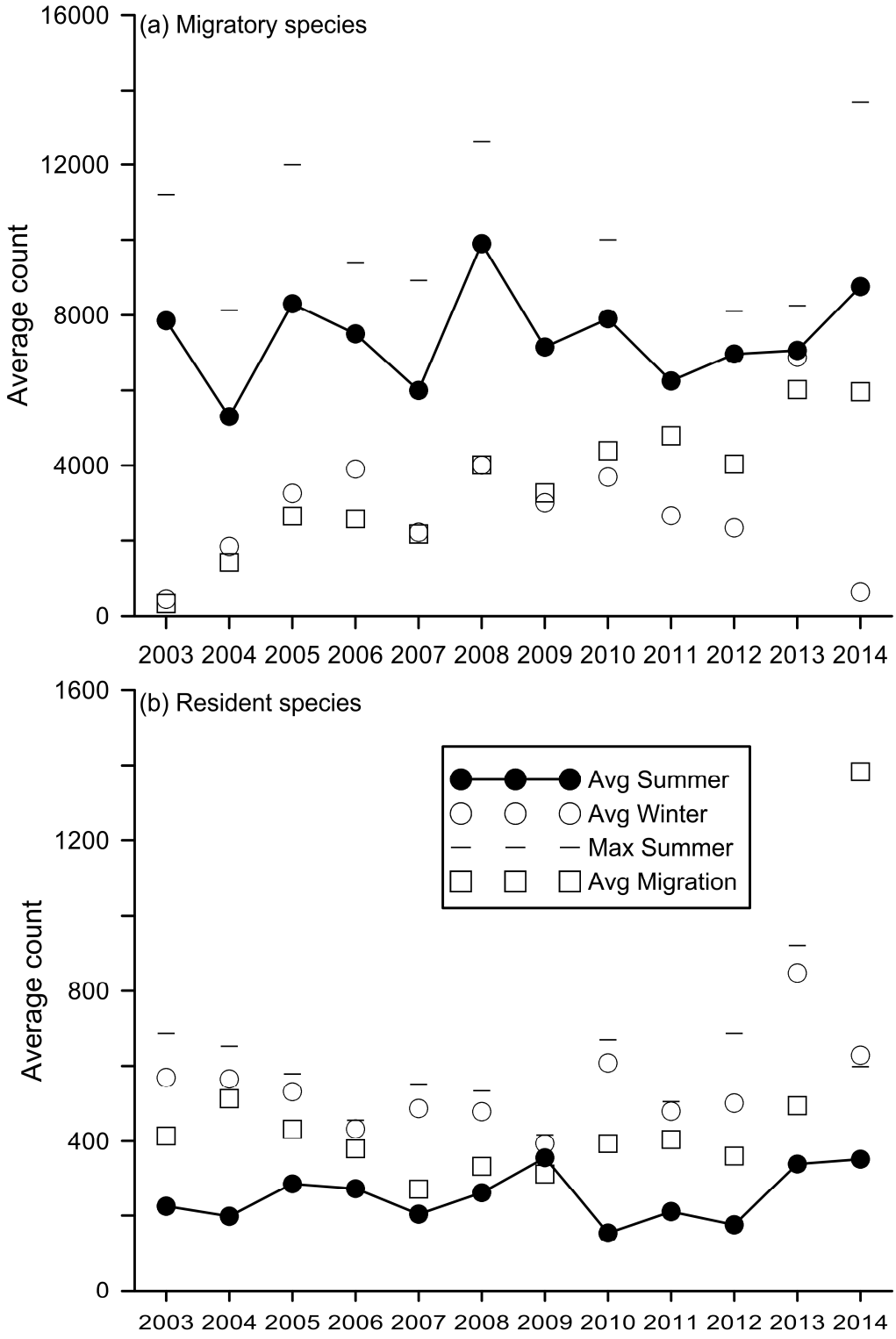
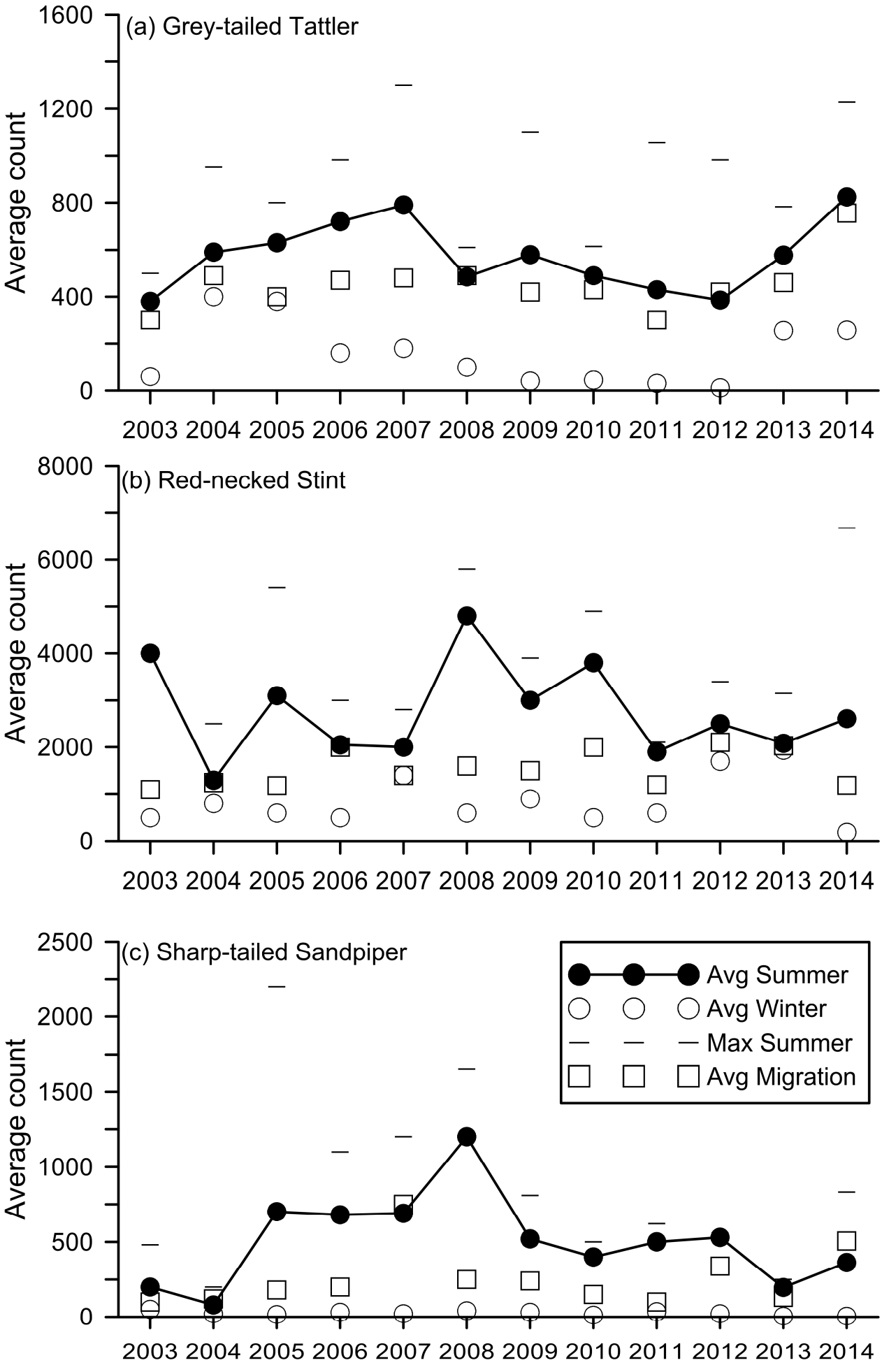
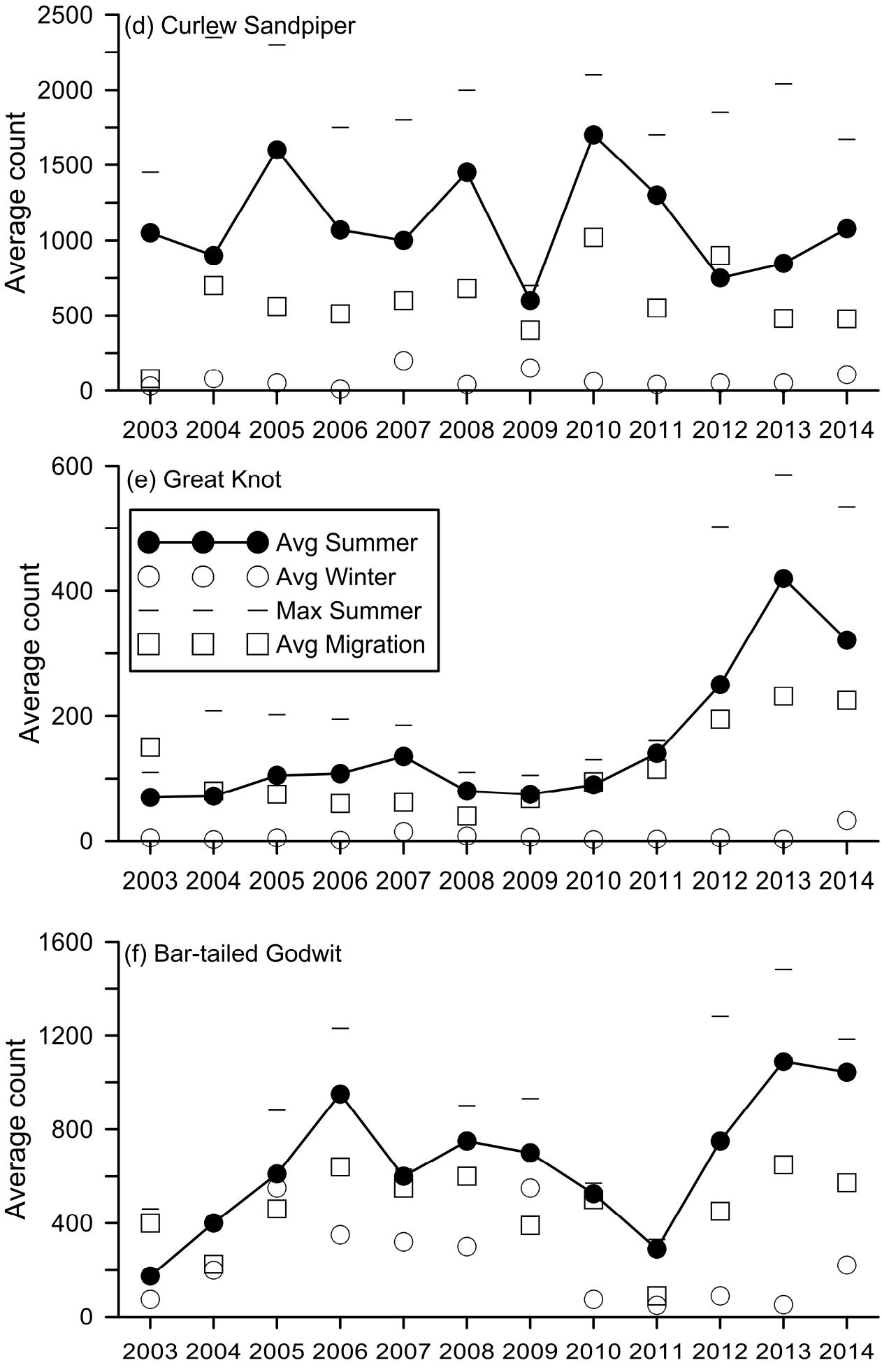
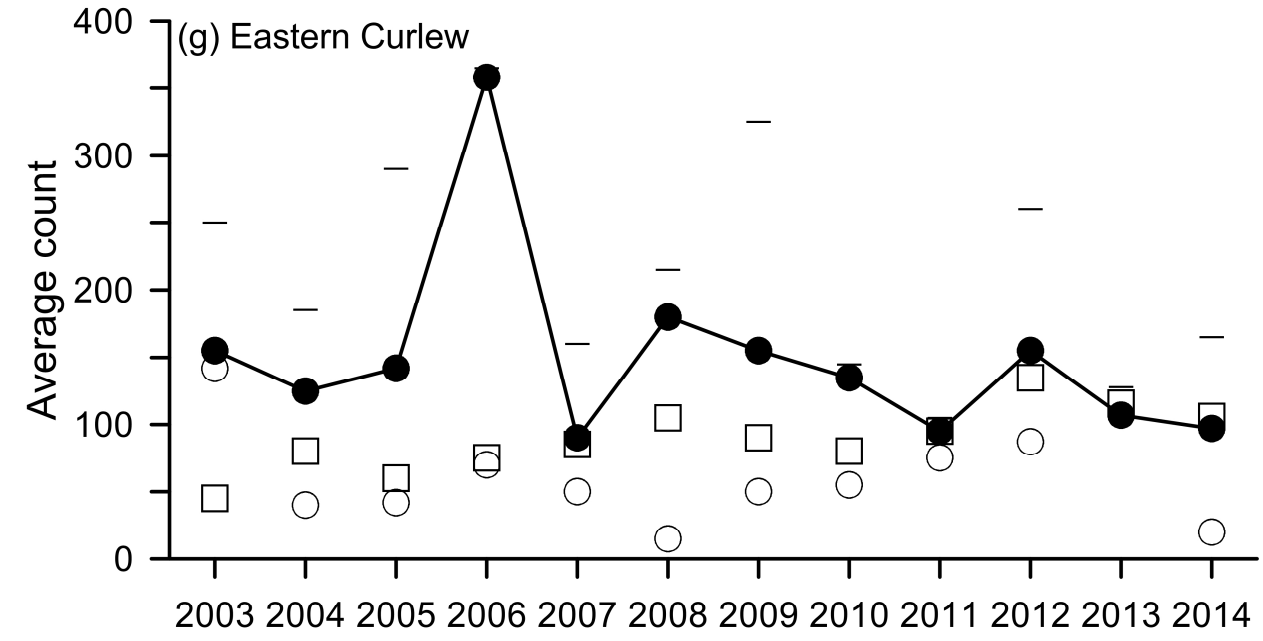
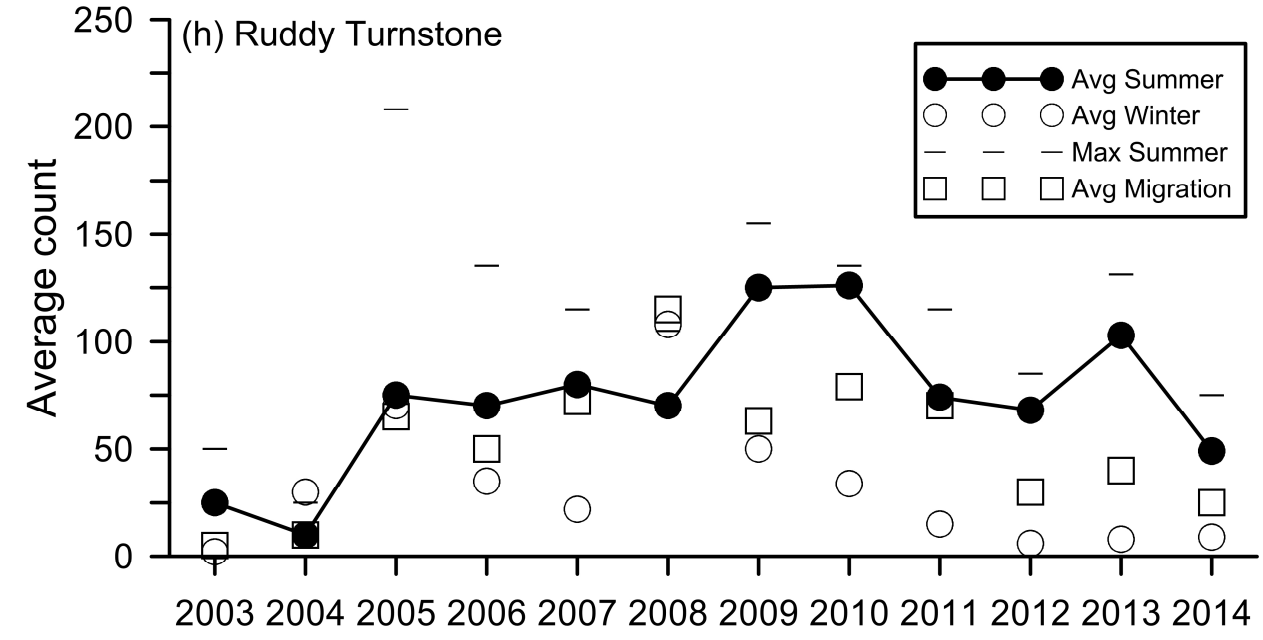


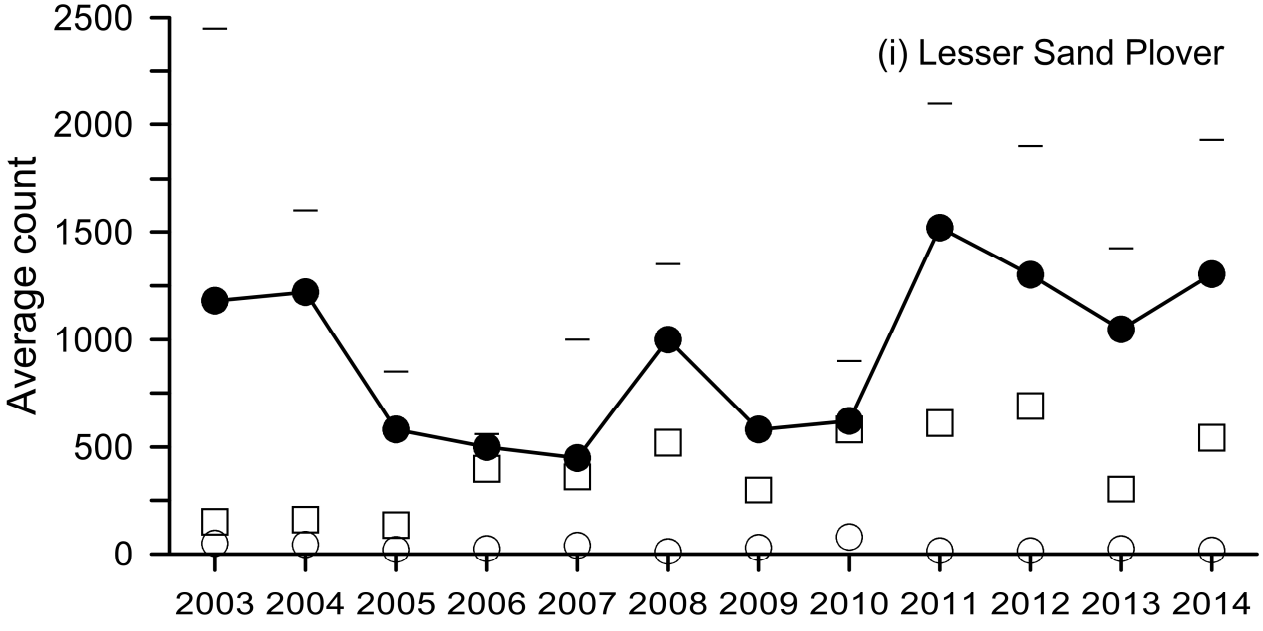
Figure 7. Average counts for each season and "wader" year since 2003 for all migratory and all resident waders throughout the POB lands, including the claypan (FICP). W: winter (June to August); S: summer (mid November to mid-March); M: migration periods (south – September to mid-November and north – 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
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
(b) Red-necked Stint
Average count
8000
6000
4000
2000
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
(c) Sharp-tailed Sandpiper
Average count
2500
2000
1500
1000
500
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
Avg Summer
Avg Winter
Max Summer
Avg Migration


(d) Curlew Sandpiper
Average count
2500
2000
1500
1000
500
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
(e) Great Knot
Avg Summer
Avg Winter
Max Summer
Avg Migration
Average count
600
400
200
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
(f) Bar-tailed Godwit
Average count
1600
1200
800
400
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


(g) Eastern Curlew
Average count
400
300
200
100
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


(h) Ruddy Turnstone
Avg Summer
Avg Winter
Max Summer
Avg Migration
Average count
250
200
150
100
50
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014


(i) Lesser Sand Plover
Average count
2500
2000
1500
1000
500
0
2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

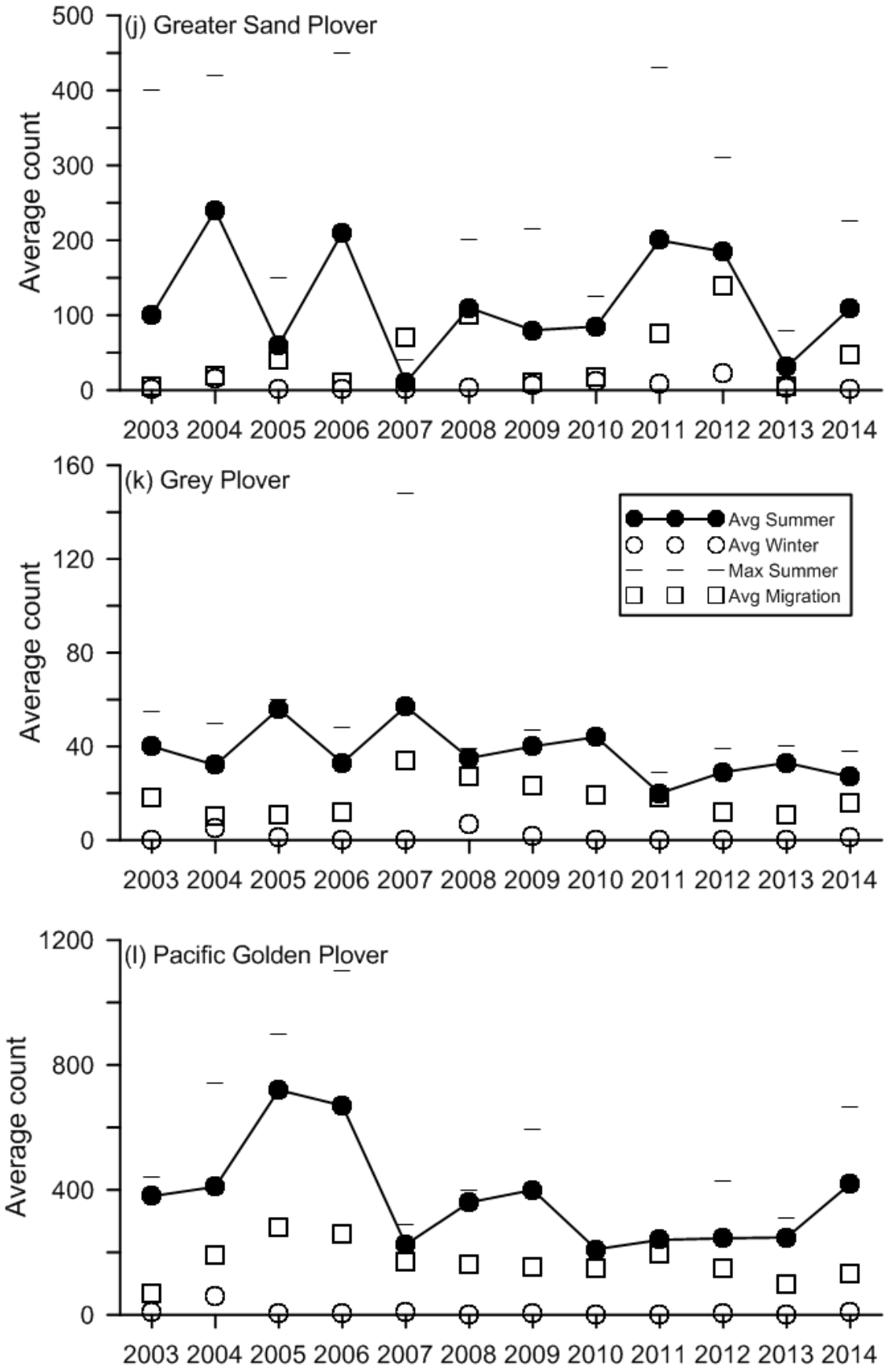


Figure 8. Average annual counts of 12 species of wader in the POB lands (including the claypan) (Fig. 1) for different seasons: Winter (n = 3), Summer (n = 5), and Migration (n = 4 counts)) and maximum summer counts.

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 and 2014. Numbers of Red-necked Stint have fluctuated from year to year. During the past 12 years, average summer counts have been higher than 2014 for five of those years and lower for six of those years. The 2014 count is the fourth lowest count of Sharp-tailed Sandpipers. It is the second lowest count since 2004 and may reflect the dry conditions in the reclamation ponds during the 2014 "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 were slightly higher than in 2012 or 2013, 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 the Great Sandy Strait region (Milton unpubl. data). Bar-tailed Godwit counts may be cyclical with a peak in 2013 – 2014 similar to that in 2006. The 2006 count was followed by reducing counts until 2012, when the counts increased again. Again, continued monitoring will help clarify whether there is a cyclical pattern.

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 trend over time, other than the two lowest average counts being in 2003 and 2004. The mean summer 2014 count was the lowest since 2005. Lesser Sand Plover continues to occur on the POB reclamation in high numbers with recent average summer counts in 2011 – 2014 being amongst the higher since 2003. By comparison, the counts of Greater Sand Plover are much more variable than for the Lesser Sand Plover. The count in 2013 was the lowest since the program began. However, the mean summer count in 2014 was closer to the long-term average

The data for Grey Plover and Pacific Golden Plover had suggested an overall downward trend is average summer counts when examined in the last report (wader year 2013). The Grey Plover counts in 2014 continue to be consistent with a 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. 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 reducing (Fig. 2). This suggests the Moreton Bay population of Pacific Golden Plover may be slowly increasing, or is at least stable.

CRITICAL COUNT VALUES OF EACH IMPORTANT SPECIES

Critical low summer values for any single count 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) (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 limits will only occur by chance on average once in every ten counts (every two years).

Table 5. Critical low counts (see text), standard deviation of the untransformed non-zero summer counts since 2003 and months in 2014 – 2015 when counts were below the Critical low count trigger for the twelve important migratory wader species recorded on the POB lands. (Dec = December)

Species	Critical low count	standard dev.	Triggers in 2014 – 2015
Grey-tailed Tattler	481	299	–
Red-necked Stint	1041	1790	December
Sharp-tailed Sandpiper	150	430	January
Curlew Sandpiper	176	608	–
Great Knot	72	216	March
Bar-tailed Godwit	204	451	–
Eastern Curlew	79	65	Dec, March
Ruddy Turnstone	53	49	Dec, January
Lesser Sand Plover	291	590	–
Greater Sand Plover	27	97	–
Grey Plover	18	13	December
Pacific Golden Plover	153	156	–

Six of the 12 important migratory species had at least one count below Critical low count trigger during the summer (Table 5). The values below the trigger should be used to stimulate a closer examination of the data. Initial examination of the patterns of variation in counts (Figure 8) has identified possible causes for some of the low counts. Populations of two species (Eastern Curlew and Great Knot) appear to have migrated from Moreton Bay prior to their low count in March 2015. However, the low counts of other species in December and January appear to be related to changed conditions within the POB reclamation area. The POB reclamation area was very dry during the 2014 summer, making the ponds less attractive to five species (Eastern Curlew, Grey Plover, Red-necked Stint, Ruddy Turnstone and Sharp-tailed Sandpiper). Counts of all species recovered following substantial rainfall in early 2015 and indeed the highest ever Red-necked Stint count was made in March 2015.

These results do highlight the need for local management of the reclamation ponds during periods of prolonged dry weather 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. A second consecutive count below these limits would be extremely unlikely and should trigger a higher level of concern by POB Pty Ltd with appropriate actions.

BANDING RECOVERIES

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 6). The most abundant species was Lesser Sand Plover (n = 37) followed by Red-necked Stint (n = 9) and Pacific Golden Plover (n = 7). There were 10 resightings from these 63 birds up to 29 August 2015. All resightings were in Moreton Bay, including four within the POB reclamation area. One Pacific Golden Plover was resighted at Sandgate in 2015 before migration on two occasions. One Lesser Sand Plover was resighted on three occasions along the Wynnum Esplanade foreshore during low tide foraging. Another Lesser Sand Plover was resighted at Geoff Skinner Reserve in late May 2015. This bird had been aged as a 2-yr old when banded and thus was immature and so probably overwintering in Moreton Bay (Table 6).

Table 6. Details of the captures and recoveries of waders caught and banded in the POB reclamation area in 2014 – 2015. N = number captured or resighted on each date.

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location
Broad-billed Sandpiper	30 November 2014	2	–	–	–
Curlew sandpiper	30 November 2014	1	–	–	–
	1 March 2015	2	–	–	–
Greater Sand Plover	30 November 2014	1	–	–	–
	1 March 2015	1	–	–	–
Lesser Sand Plover	30 November 2014	19	8 February 2015	3	PBAR, PBC3
			7 March 2015	1	Wynnum Esplanade
			28 March 2015	1	Wynnum Esplanade
			4 April 2015	1	Wynnum Esplanade
	1 March 2015	18	20 May 2015	1	Geoff Skinner Reserve, Wellington Pt
Pacific Golden Plover	30 November	7	14 December	1	PBR3

Species	Capture date	Captured (N)	Resighting date	Resightings (N)	Resighting location
	2014		2014		
			11 January 2015	1	Sandgate
			12 March 2015	1	Sandgate
Red-necked Stint	30 November 2014	2	–	–	–
	1 March 2015	7	–	–	–
Sharp-tailed Sandpiper	1 March 2015	3	11 April 2015	1	Wynnum Esplanade

As more banding of waders occurs within the POB reclamation area, additional resightings would be expected during their migrations through eastern Asia. The species that have been banded so far within the POB reclamation area have a greater preference for non-coastal habitats during migrations. Thus, the probability of getting many resightings of these species during migration is lower than for the sandpiper species. The sandpipers mostly prefer coastal habitats and thus are more easily detected by the growing band of wader enthusiasts in eastern Asia.

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 12 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. These 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 should attempt to ensure sufficient pond area of an appropriate depth (~ 5 cm) is maintained.

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 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.