Monitoring waterbird populations on the Tejo, Sado and Guadiana estuaries, Portugal: 2011 report

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SUMMARY

ALVES, J. A., P. M. LOURENÇO, M. P. DIAS, L. ANTUNES, T. CATRY, H. COSTA, P. FERNANDES, B. GINJA, J. JARA, R. MARTINS, F. MONIZ, S. PARDAL, T. PEREIRA, M. J. RAINHO, A. ROCHA, J. C. RODRIGUES & M. ROLO 2012. Monitoring waterbird populations on the Tejo, Sado and Guadiana estuaries, Portugal: 2011 report. *Anuário Ornitológico* 9: 66-87. Portuguese wetlands harbour numbers of international importance for several populations of waterbirds, which designate those areas as key sites for wader species on the East Atlantic Flyway (EAF). The monitoring programme of waterbird populations in several major Portuguese wetlands aims to describe the abundance and phenology of the several species that use the high tide roosts in these sites throughout the annual cycle. In 2011 this programme included three major wetlands, covering during that year high-tide roosts on the Tejo, Sado and Guadiana estuaries in which waterbirds were counted monthly. The importance of these three estuaries is particularly clear during the non-breeding season, being used by considerable numbers of several species during the migratory and winter periods. Most noticeably, in 2011 the peak count in each estuary was not recorded during winter but during pre- or post-nuptial migration. As turnover calculations are not possible with count data, the real number of waterbird using these wetlands is certainly higher than presented here and therefore the role of these wetlands as staging sites within the EAF is quite relevant. Inter-annual variation in species' phenology is relatively small, with only few exceptions to this general pattern. Despite its relatively short duration, this programme already allows unravelling the dominant annual patterns for the majority of the most abundant species and the importance of the several wetlands and high-tide roosts for the different groups of waterbirds.

RESUMO

ALVES, J. A., P. M. LOURENÇO, M. P. DIAS, L. ANTUNES, T. CATRY, H. COSTA, P. FERNANDES, B. GINJA, J. JARA, R. MARTINS, F. MONIZ, S. PARDAL, T. PEREIRA, M. J. RAINHO, A. ROCHA, J. C. RODRIGUES & M. ROLO 2012. Monitorização das populações de aves aquáticas nos estuários do Tejo, Sado e Guadiana: relatório do ano de 2011. *Anuário Ornitológico* 9: 66-87. Portugal acolhe efectivos populacionais de várias espécies de aves aquáticas em números que têm importância internacional. No caso das aves limícolas, este facto confere a várias zonas húmidas nacionais o estatuto de sítios-chave na denominada rota migratória do Atlântico Este. Em 2007 iniciou-se a monitorização das populações de aves aquáticas no estuário do Tejo com o objectivo de documentar a abundância e fenologia das várias espécies que utilizam esta zona húmida ao longo do ciclo anual. Esta monitorização foi posteriormente alargada ao estuário do Guadiana em 2009 e ao estuário do Sado em 2010, sendo 2011 o segundo ano consecutivo com cobertura mensal dos refúgios de preia-mar nestes estuários. A importância destes três estuários é particularmente notória durante o período não reprodutor, acolhendo números consideráveis de várias espécies durante a migração e invernada. Em 2011 os números mais elevados não foram registados no Inverno mas durante os períodos de migração pré- ou

pós-nupcial. Uma vez que não é possível realizar o cálculo do número exacto de indivíduos que usa estes estuários durante a migração apenas com dados de contagens, o número real de aves aquáticas em migração estará certamente subestimado, o que reforça o papel vital destes estuários como zonas de descanso e reabastecimento para as aves aquáticas no contexto desta rota de migração. As variações interanuais são relativamente reduzidas, sendo que a maioria das espécies mantém padrões similares entre anos. Apesar de ainda relativamente recente, este programa de monitorização permite já clarificar os padrões anuais dominantes para a maioria das espécies mais abundantes, bem como a importância das várias zonas húmidas e refúgios para os diferentes grupos de aves aquáticas.

INTRODUCTION

Several recent studies have highlighted the growing conservation concerns of the international community towards wetlands and waterbirds. The recently published Millennium Ecosystem Assessment indicates that more than 50% of European and North American wetlands have been degraded (Millennium Ecosystem Assessment, 2005). Another recent review has also provided a global list of present and future issues likely to affect waders (Sutherland *et al.* 2012). Indeed, several populations of this group are experiencing global and local declines (Delany *et al.* 2009, Catry *et al.* 2011).

Portugal has seven areas currently designated as key sites for waders therefore holding more than 1% of any wader population (Delany *et al.* 2009), and another 10 sites have been protected by the Ramsar convention in the Portuguese mainland (Ramsar 2013). For two of these sites (Castro Marim and Lagoa dos Salgados) this criterion is met for the breeding populations of Black-winged Stilt *Himantopus himantopus*, but for the remaining five sites (Minho, Tejo and Sado estuaries and rias of Aveiro and Formosa) the same criterion is met for non-breeding populations, with a total of 14 populations. Four of these sites hold more than 40 000 waders in winter and the Tejo estuary is the second most important area for waders in the Iberian Peninsula and the 12th most important on the East Atlantic flyway context (Delany *et al.* 2009).

Given the current global threats faced by waders and waterbirds (Sutherland *et al.* 2012), the Portuguese wetlands are a natural heritage that must be preserved, and monitoring waterbirds populations is an essential step leading to their effective conservation. In 2007 we initiated a monthly monitoring programme for the waterbirds using the high-tide roosts of the Tejo estuary, which revealed the importance of the distinct areas of the estuarine complex and their variation throughout the year (Catry *et al.* 2011). The monthly counts of the high-tide roots are mostly aimed at waders, but several other species (mostly waterbirds) are also included in this programme. In 2009 this programme was extended to the Portuguese area of the Guadiana estuary (henceforward Guadiana), and in 2010 to the Sado estuary. Thus, 2011 is the second year in which the waterbird populations on these wetlands were monitored simultaneously. In the present report we describe the results attained during that year documenting the abundances, phenology and use of high-tide roosts by waterbirds at those three wetlands.

METHODS

During 2011 we performed monthly counts on 12 high tide roosts in the Tejo, seven in the Sado and five in the Guadiana estuaries (Fig. 1). In the Tejo estuary, six roosts are exclusively composed of old saltpans, one of which is partly currently used for salt production (Samouco), with the remaining ones being used for extensive shrimp production (Vale Frades, Vasa Sacos, Atalaia, Bela Vista and Tarouca). All of these six saltpan roosts are managed for waterbirds to some extent, namely Vale de Frades which was not managed until 2010 but benefited from rehabilitation works that year that intended to improve waterbird habitat quality. Three other roosts of the Tejo estuary are

composed of both saltmarshes and abandoned saltpans (Sarilhos, Alhos Vedros and Moita); and the remaining three are exclusively composed of saltmarsh habitat (Coina, Seixal and Corroios). Only part of these roosts are included within the areas of the Tejo Estuary Nature Reserve and the Tejo Estuary Special Protection Area (Fig. 1).

In the Sado estuary all roosts are located inside the Sado Estuary Nature Reserve and only Praias do Sado 1 and 2 are located outside the Sado Estuary Special Protection Area (Fig. 1). All roosts consist of saltpans on the northern bank of the estuary: four are totally abandoned (Gâmbia, Limpersado and Praias do Sado 1 and 2); two are mostly abandoned but some pans are used for low-intensity aquaculture (Zambujal and Pinheiro Torto); and one still has some pans being used for salt production (Mouriscas).

Similarly, the high-tide roosts in the Guadiana estuary are composed by saltpans. One is inside an industrial saltpan complex (Cerro do Bufo), one in semi-industrial saltpans (Sinexpral) and three in traditional saltpans (Cepo Velho, Taborda e Castro Marim). However, in April and May it

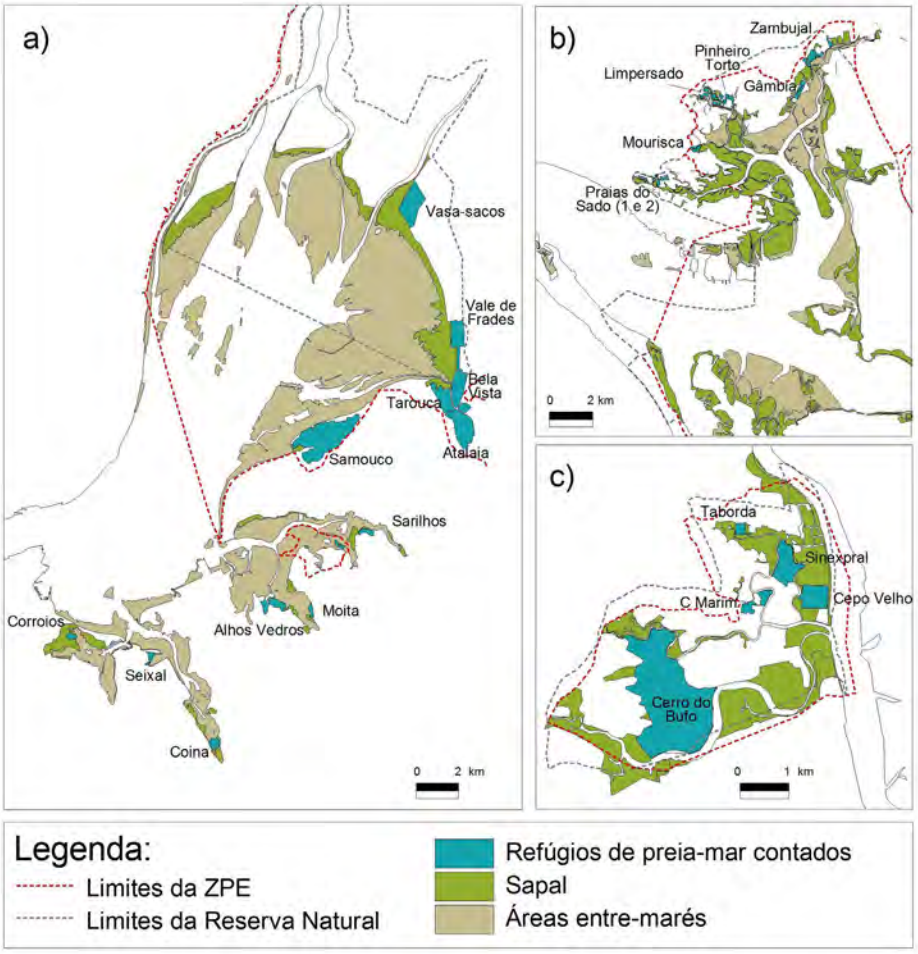

Figure 1. Location of the monitored high-tide roosts in the Tejo (a), Sado (b) and Guadiana (c) estuaries. *Localização dos refúgios de preia-mar monitorizados nos estuários do Tejo (a), Sado (b) Guadiana (c).*

was not possible to survey this area due to adverse weather conditions, as well as in August due to logistic difficulties.

All counts took place around high tide during spring tides (tide level above 3.3 m), a period when most waterbirds move into high tide roosts in the Tagus estuary (Rosa *et al.* 2006). During the counts we determined the total number of individuals of each species. For the purpose of this study, the term waterbirds applies to all the species of Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Anseriformes and Charadriiformes, as well as a few Gruiformes and Falconiformes (although these are not systematically recorded) typically associated with wetland habitats (see Appendix A).

Some of the roosts in the Tejo estuary were merged into groups for ease of presentation (ribeira das Enguias: also includes Tarouca, Bela Vista and Atalaia; Alhos Vedros and Moita are merged).

Here, we indicate and discuss differences between the three or two monitoring years for Tejo, Sado and Guadiana wetlands (Alves *et al.* 2010, 2011) whenever relevant.

RESULTS

Tejo estuary

During 2011 a total of 286 203 waterbirds of 65 different species were counted in the high-tide roosts of the Tejo estuary (see Appendix A), which indicates a slight decrease in the total number of birds (-1104) and species (-14) when compared with 2010. Waders were the most important group, both in numbers and specific diversity (a total of 196 060 birds of 29 species), followed by gulls and terns (57 743 birds of 10 species). Together these two groups represent nearly 90% of all birds counted.

The ten most abundant species (Table 1) were the same as in the previous year (2010), with only small changes in their ranks, the largest belonging to the Black-tailed Godwit *Limosa limosa* which went from second to fifth most abundant species in the estuary. This stability in the relative abundance of different species holds true when considering the forty most abundant species (Table 1), with only two new species in this list, Glossy Ibis *Plegadis falcinellus* and European Golden Plover *Pluvialis apricaria,* replacing Sandwich Tern *Sterna sandvicensis* and Gull-billed Tern *Gelochelidon nilotica*.

Seasonal variation in waterbird abundance

All groups showed their highest abundances in autumn and winter, which roughly correspond to the post-nuptial migration and wintering period, respectively (Fig. 2). The waders showed the highest numbers before February and after August, with peak abundances in January (wintering period) and September (post-nuptial migration). There was also a smaller peak in April, during pre-nuptial migration. Gulls, terns, herons and egrets all showed maximum numbers during the post-nuptial migration, in July-September, but the latter group also presented a smaller peak in March, which may correspond to the beginning of the pre-nuptial migration. Wildfowl were mainly present during winter between December and February, with a smaller peak in May during pre-nuptial migration.

Among the most abundant waders, Dunlins *Calidris alpina* and Avocets *Recurvirostra avosetta* were the only species with maximum abundance during the winter period (November-February, Fig. 3), while Grey Plovers *Pluvialis squatarola*, Redshanks *Tringa totanus*, Ringed Plovers *Charadrius hiaticula* and Black-tailed Godwits, showed peak abundances during post-nuptial migration (July-September, Fig. 3). These trends are mostly similar to the previous two years, with the exceptions being the timing of peak abundance for Grey Plovers and Black-tailed Godwits, which was recorded during winter in 2010 but not in 2009. As in previous years, the Black-winged Stilt *Himantopus himantopus* showed highest abundance during the breeding season (Fig. 3).

The Greater Flamingo *Phoenicopterus roseus* showed peak abundances during the migratory periods (March and July-October, Fig. 3), with low numbers during the rest of the year. This pattern is different from the previous two years, when this species was either more abundant in winter (2009)

or remained stable throughout the year with much smaller migratory peaks (2010).

Relative importance of the high-tide roosts

The Samouco roost remains the most important in the Tejo estuary receiving almost 35% of the waterbirds. It is followed by three roosts, ribeira das Enguias, Vasa Sacos and Corroios, each receiving 13.8-15% of the birds (Table 4). When comparing these data with the previous year, there is an increase in the proportion of waterbirds using Samouco and Corroios, while Vasa Sacos was used by fewer birds, no longer being the second most important roost in the estuary. Samouco and ribeira das Enguias were particularly important for Dunlins, Redshanks, Ringed Plovers, Greater Flamingos and Black-winged Stilts, harbouring these in all periods when they were found in the Tejo estuary (Fig. 3). They also received important numbers of Black-tailed Godwits during winter and post-nuptial migration. Vasa Sacos was particularly important for the Grey Plover during winter and for Dunlins during winter and the pre-nuptial migration (Fig. 3). Corroios was particularly important for Grey Plovers during winter and spring (Fig. 3).

Corroios, together with Alhos Vedros/Moita, Coina and Seixal, received over 25% of the waterbirds counted in the Tejo estuary during 2011 (Table 4). However, these roosts remain with no legal protection. Some of the most abundant wintering species use these areas in considerable numbers, namely Dunlins, Grey Plovers, Black-tailed Godwits, Redshanks and Avocets, indicating the importance of these roosts for wintering waders.

Sado estuary

During 2011, a total of 49 276 waterbirds were counted in the high-tide roosts of the Sado estuary, covering 45 different species (see Appendix A). These numbers indicate a large increase in total numbers (+ 14 795), but fewer species when comparing with 2010. This change is partially explained by the addition of a new high-tide roost to the counting scheme, Limpersado. But the total number of waterbirds counted here (7068) only accounts for roughly half of the increase. Similarly to the previous year, waders were by far the most abundant group (with a total of 40 662 birds and 23 species), followed by gulls and terns (6411 birds and eight species).

The ten most abundant waterbirds remained mostly the same, with only one new species, the Kentish Plover *Charadrius alexandrinus*, replacing the Lesser Black-backed Gull *Larus fuscus*. The relative rank of each species showed very small changes, with the exception of the Black-tailed Godwit, which went from eighth to third most abundant species. Interestingly, the inverse change was noted in the Tejo estuary (see above). When considering the 40 most abundant species (Table 2) there are five new species on the list: Cattle Egret *Bubulcus ibis*, Common Moorhen *Gallinula chloropus*, Shelduck *Tadorna tadorna*, Whimbrel *Numenius phaeopus* and Common Tern *Sterna hirundo*, replacing: Lapwing *Vanellus vanellus*, Glossy Ibis, Bar-tailed Godwit *Limosa lapponica*, Marsh Harrier *Circus aeruginosus* and Green Sandpiper *Tringa ochropus*.

Seasonal variation in waterbird abundance

The waders are present in high numbers during the wintering period, showing also abundance peaks during migratory periods (in April and in August, Fig. 2), while gulls and terns are mainly present during the post-nuptial migration, between July and November, despite the irregular pattern recorded this year (Fig. 2). The group including egrets, herons and Greater Flamingos show two abundance peaks, coinciding with the pre-nuptial (March-April) and the post-nuptial (July-September) migrations (Fig. 2). Wildfowl are only present in small numbers, not showing any obvious seasonal trends other than their almost complete absence between June and September (Fig. 2).

The most abundant wader species follow the same general patterns as recorded in the Tejo and Sado estuaries in 2010. They are mainly present in winter and in some cases during migratory periods. Grey Plover and Avocet are mainly present during

winter but both have higher numbers than in the previous year and the Grey Plover's highest peak was recorded during late post-nuptial migration (November) whereas it was in the winter in the previous year (January). Conversely, the Dunlin, which is mostly present during winter, had a large abundance peak during pre-nuptial migration (April, Fig. 4), whereas the largest peak in the previous year was recorded in winter (December). The Black-tailed Godwit, Ringed Plover and Redshank were mainly present during winter and post-nuptial migration (June-September, Fig. 4). In comparison with the previous year, the Black-tailed Godwit showed much higher numbers throughout the year and so did the Redshank during the peak in June. The Black-winged Stilt is present in the area throughout the year with an abundance peak during the breeding season. The Greater Flamingo, another of the most abundant species in the Sado estuary, is mainly found during the second half of the year much like it was recorded in 2010, but with an abundance peak in March-April (Fig. 4), which had not been recorded in the previous year.

Relative importance of the high-tide roosts

In 2011, the two most important roosts in the Sado estuary were Mouriscas and Praias do Sado 1, together harbouring over 58% of the waterbirds counted (Table 4). These two were followed by Limpersado (14.2 %) and Gâmbia (11.2%). Comparing these data with the previous year, Mouriscas confirms its role as the most important high-tide roost in the Sado estuary, while Gâmbia lost some of its importance. As Limpersado was not counted in 2010, no comparisons can be made for this roost and the remaining roosts are also conditioned by this fact.

Mouriscas, Praias do Sado 1 and Limpersado were mostly used during winter and migratory periods, while Gâmbia and Pinheiro Torto were mostly important during the migratory periods (Fig. 4). Limpersado was particularly important for Black-tailed Godwits during winter while Pinheiro Torto and Praias do Sado 1 received high numbers of Black-winged Stilts in the breeding season (Fig. 4).

Guadiana estuary

During 2011 a total of 54 853 waterbirds was counted in the high-tide roosts of the Guadiana estuary, representing 54 different species (see Appendix A). These figures are higher than in the previous year, but they are not comparable since in 2010 the coverage was lower in some of the roosts (Alves *et al.* 2011). Following the same trend as in 2009 and 2010, waders were the most abundant group (24 518 birds and 24 species), followed by gulls and terns (14 604 birds and 10 species). We must also emphasize the presence of large numbers of Greater Flamingos, which were in fact the most abundant species in this estuary (Table 3), as in the two previous years.

Seasonal variation in waterbird abundance and relative importance of the high-tide roosts

Unlike in the Tejo and Sado, the high-tide roosts in the Guadiana estuary were not covered every month with missing counts in April, May and August (see Methods). Nevertheless, it is possible to observe some phenological patterns. Both waders, gulls and terns, and egrets, herons and Greater Flamingo all showed high abundances in July or September (Fig. 2) suggesting a peak during post-nuptial migration. The first two groups also showed high numbers during November and December (Fig. 2), suggesting that this estuary also supports important wintering populations. Wildfowl were only present in the area during late autumn and winter, being mostly absent during the rest of the year (Fig. 2).

At the species level, all of the most abundant waders followed the general pattern of maximum abundances during winter and post-nuptial migration (Table 3, Fig. 5), with the exception of the Black-winged Stilt, which was most abundant during the breeding season. Numbers of Avocets were more stable this year than in 2009, peaking both in the breeding season and in winter. The peak abundance of Redshank was recorded in July that year as opposed to September in

Table 1: Total number of individuals recorded monthly during high-tide roost counts on the Tejo estuary in 2011 (three roosts were not counted once, see Table 4). The 40 most abundant species are shown. *Número total de indivíduos contados mensalmente nos refúgios de preia-mar do estuário do Tejo em 2011 (três refúgios ficaram por contar uma vez, ver Tabela 4). Apenas são apresentadas as 40 espécies mais abundantes.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calidris alpina	10751	8916	5115	8329	6694	519	2305	6254	6286	5882	10855	11191
Larus ridibundus	3931	2900	1732	983	406	1120	6230	4005	6103	2546	1370	2048
Pluvialis squatarola	3590	3436	3252	3616	802	493	459	1540	6013	1559	2322	2820
Larus fuscus	1871	2328	2096	791	107	393	1699	3153	2480	2370	1178	2431
Limosa limosa	2590	1020	584	184	296	1157	3324	3313	3014	1310	1383	1721
Tringa totanus	1267	1317	638	29	12	170	1600	2010	1750	1678	1129	1120
Phoenicopterus roseus	131	199	1638	676	267	79	1809	1517	1951	1279	277	694
Recurvirostra avosetta	2004	2512	344	279	297	14	91	51	84	633	1171	1873
Himantopus himantopus	528	297	630	784	700	919	1692	1147	614	464	459	319
Charadrius hiaticula	377	257	75	174	277	25	106	2032	2049	1196	516	1069
Egretta garzetta	90	139	80	165	297	668	867	610	508	253	141	174
Fulica atra	335	328	90	93	123	206	292	92	80	0	1040	1131
Limosa lapponica	455	31	107	18	50	16	390	1328	2	973	237	168
Calidris canutus	354	184	74	8	937	31	124	530	66	750	510	4
Anas platyrhynchos	307	455	353	338	660	215	53	51	182	233	259	250
Anas crecca	543	1113	54	0	0	0	1	0	1	45	376	929
Charadrius alexandrinus	40	70	65	68	85	168	236	424	626	504	298	243
Calidris ferruginea	0	0	41	44	23	90	20	118	1082	1035	232	7
Numenius arquata	395	230	113	17	0	295	591	211	175	244	172	227
Arenaria interpres	313	156	128	299	39	164	156	304	144	193	198	356
Phalacrocorax carbo	654	202	86	31	2	0	0	1	1	86	271	533
Larus melanocephalus	0	9	7	1	9	99	565	703	61	35	0	1
Ardea cinerea	149	75	53	41	66	113	130	149	178	132	154	165
Anas clypeata	365	796	4	3	0	1	1	1	12	13	8	189
Tringa nebularia	144	176	103	174	0	6	38	101	212	139	165	113
Larus michahellis	196	0	1	0	1	2	34	1010	11	0	0	27
Sternula albifrons	0	0	0	134	197	224	189	255	14	0	0	0
Vanellus vanellus	78	68	0	0	0	0	1	133	265	241	129	30
Calidris alba	300	96	50	150	2	0	0	0	52	199	30	32
Numenius phaeopus	7	77	1	276	33	0	86	124	85	94	0	105
Tringa erythropus	72	97	102	49	0	0	34	137	54	88	56	78
Anas penelope	144	115	0	0	0	0	0	0	5	143	70	220
Calidris minuta	33	0	72	32	7	0	0	40	110	120	136	73
Plegadis falcinellus	0	300	0	0	0	0	1	42	269	0	0	1
Platalea leucorodia	66	25	2	0	51	24	2	2	55	74	88	165
Tachybaptus ruficollis	61	15	2	0	0	1	23	91	92	38	121	105

Table 1: cont.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Actitis hypoleucos	21	31	47	39	2	1	25	55	62	38	41	33
Pluvialis apricaria	355	0	0	0	0	0	0	0	0	0	0	0
Haematopus ostralegus	0	81	100	0	0	2	0	55	62	16	8	0
Philomachus pugnax	13	13	42	15	0	0	15	62	80	22	1	0

2011, whilst the peak abundance of Dunlin was recorded in April in 2009 and was now recorded in December. The Greater Flamingo and the Audouin's Gull show their highest abundances in June-September, as it was also recorded in 2009 for the Greater Flamingo. The Black-headed Gull peak recorded in March 2009 and 2010 (although to a lesser extent) was not found in 2011. Noticeably, the number of Audouin's Gull found in 2011 was considerably higher than those registered in previous years.

Much like in the previous two years, Cerro do Bufo high-tide roost was by far the most important throughout the year, harbouring over 75% of the birds counted in the Guadiana estuary (Table 4, Fig. 5).

DISCUSSION

The importance of the Tejo, Sado and Guadiana estuaries for waterbirds using the East Atlantic Flyway is notorious and confirmed by the results presented here. The role of these wetlands as wintering grounds for the most abundant species had already been described, but their importance as staging-sites during pre- and particularly, post-nuptial migration is perhaps even more relevant and not so well known (but see Alves *et al.* 2010, 2011). For all groups in all estuaries, with the exception of waders in the Tejo and of wildfowl in the Tejo and Guadiana, peak abundances were recorded during the migratory periods (Fig 2). In fact, on all the estuaries the total peak abundance of waterbirds was recorded during either the post-nuptial (Tejo, 35 010 birds and Guadiana, 10 428 birds in September) or pre-nuptial (Sado, 7223 birds in April) migratory periods. Although for some sites the mid-winter (January) count was not vastly lower (Tejo -2418; Sado -2322; Guadiana -6785), the number of waterbirds counted during the migratory periods is most likely an underestimation of the total volume using these staging areas as these counts do not accommodate the turnover of individuals moving throughout each site. These wetlands are therefore likely to play a vital role in the migratory movements between northern Europe and Africa for thousands of migratory waterbirds using the East Atlantic Flyway.

As in previous years, waders were the most abundant group even when compared to other potentially more abundant groups, namely the gulls and terns. This is most probably due to the methodology used in this monitoring scheme which is mostly aimed towards estuarine waders and therefore excludes other areas in the vicinity of the estuaries which are also used by gulls, such as beaches, harbours and rubbish tips. Furthermore, the high-tide roosts included here are those possible to access by land, thus excluding some salt-marsh areas as well as islands, which can only be accessed by boat. This limitation is likely to differently affect the counts of waterbird species, and to currently produce an underestimation for all groups, particularly for wildfowl, which are known to regularly use several areas not surveyed. It should also be noted that we aim to rectify this limitation in future years by having boat counts performed by Instituto da Conservação da Natureza e Florestas (ICNF – Institute for the Conservation of Nature and

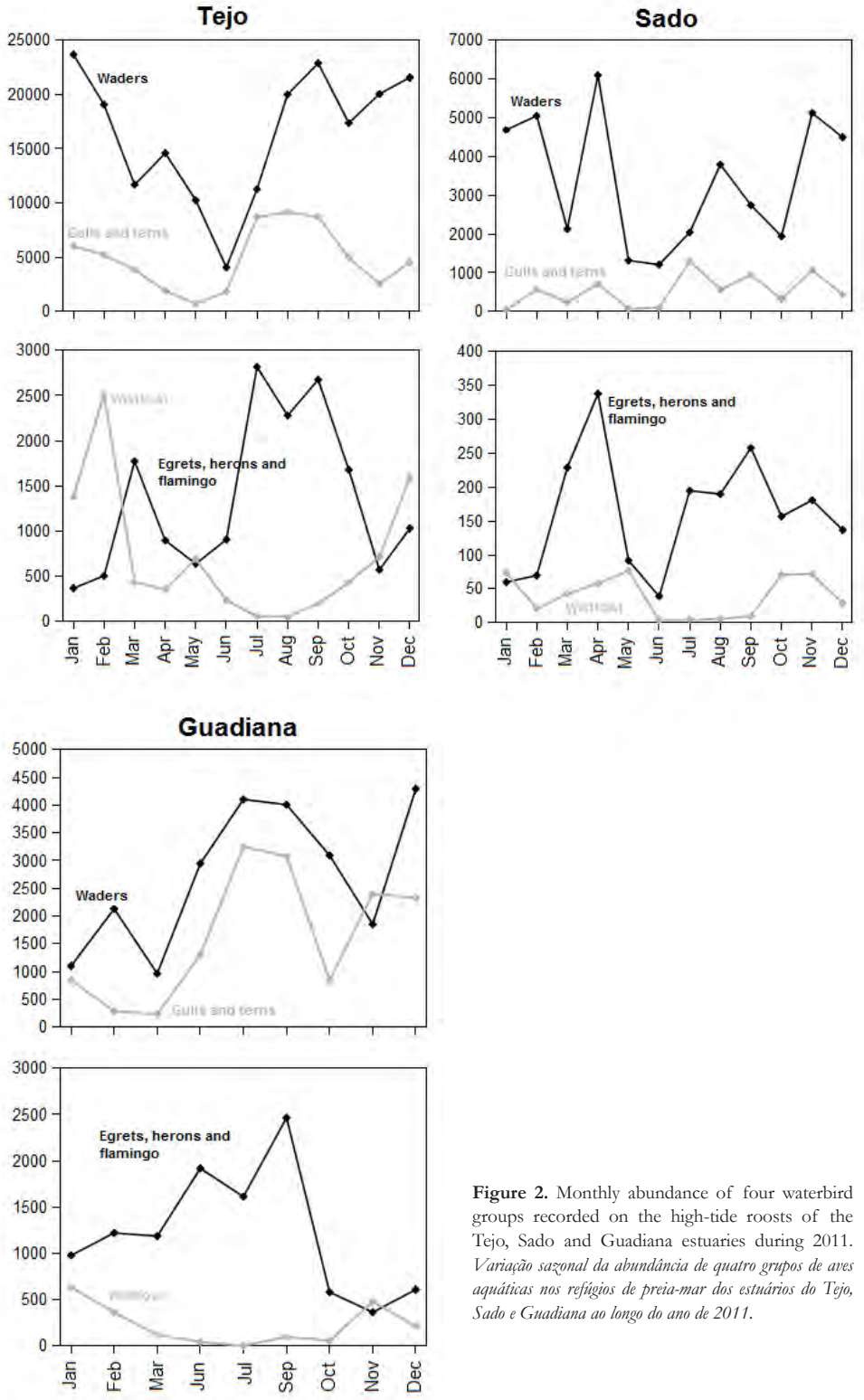

Figure 2. Monthly abundance of four waterbird groups recorded on the high-tide roosts of the Tejo, Sado and Guadiana estuaries during 2011. *Variação sazonal da abundância de quatro grupos de aves aquáticas nos refúgios de preia-mar dos estuários do Tejo, Sado e Guadiana ao longo do ano de 2011.*

Forests) joining this programme, namely in the Tejo and Sado estuaries.

Tejo estuary

As in the two previous years, the period with lowest numbers in this estuary was recorded in late spring (May-June), which is likely to indicate the end of pre-nuptial migration. But contrary to the two previous years, which recorded the highest numbers of waterbirds in winter period (January in 2009 and November in 2010), it was in September that the peak count was recorded. The reasons for these fluctuations are not straightforward but these might be due either to a decrease in wintering numbers (with the exception of wildfowl the totals of all other groups were lower in 2011 than previously recorded) or to an increase of passage waterbirds if weather conditions in migration were unfavourable thus forcing these to make a prolonged stop-over.

The high-tide roost of Samouco maintains its role as the most important in the estuary holding on average one third of all waterbirds. The roost of Vasa Sacos has seen a slight decrease from the previous year (-4.9%) when the coverage of ribeira das Enguias complex was improved (see Alves *et al.* 2010), whilst numbers in the roosts without any protection (Corroios, Seixal, Coina e Alhos Vedros/Moita) have increased, holding on average more than a quarter of all waterbirds in the estuary. The lack of protection on these areas remains a subject of concern, particularly when the roost which is property of the Tejo Estuary Nature Reserve (Vale de Frades) which had rehabilitation works with the purpose of being better managed for birds, holds the lowest proportion of waterbirds (3%), despite a slight increase in 2011.

The relative abundance and phenology of the most abundant species in 2011 was generally very similar to that recorded in previous years. As in the previous year, in 2011 only two new species were added to the list of the 40 most abundant species (Glossy Ibis and European Golden Plover replacing Sandwich Tern and Gull-billed Tern) and both showed numbers below 360 individuals (Table 1), suggesting annual and/or spatial fluctuations for species that are not the main aim of this monitoring programme.

The ten most abundant species in this estuary are the same as in the previous two years and their phenology was also very similar. The exception to this stability is the pronounced post-nuptial migration peaks for Grey Plovers and Black-tailed Godwits, which were noted in 2009 but not in 2010. Such fluctuations are due to large numbers recorded in the winter of 2010 for Black-tailed Godwits (> 6000 birds) and Grey Plover (> 3000 birds), suggesting higher concentrations of these species during that winter. But for the Grey Plover in 2011, a record number was recorded during post-nuptial migration (> 6000 birds), again potentially indicating unfavourable conditions during migration. Showing a distinct phenology than in the previous two years is the Greater Flamingo, which for the first time presented a peak during post-nuptial migration (July), which is difficult to interpret given the annual variation in this species phenology. In any case, the known recent expansion of this population (Birdlife International 2004), with recorded breeding attempts in new locations (e.g. Salgados lagoon, Eufrásia & Leitão *in* Leitão & Cidraes-Vieira 2011), might in the future lead to breeding attempts in this estuary which would likely produce novel abundance patterns potentially including residency. However, the evidence provided here is not sufficient to clearly identify the causes of variation in the phenology of this species recorded in the Tejo estuary.

Sado estuary

Regarding the second most important wetland in Portugal and for which this is only the second year of monitoring, some interesting patterns are already emerging. In 2011 a higher number of individuals was counted, but contrary to the previous year, when the abundance peak of waders and egret and herons was recorded in winter, the peak abundance for these groups was recorded during pre-nuptial migration (April). The apparent reason for this is a combination

of both an increase in numbers during migration periods (also recorded in post-nuptial migration for waders, i.e. in August) and a reduction during winter, similar to what was recorded in the Tejo estuary (see above). A reduction was also noted for gulls and terns, which rarely reached 1000 individuals in 2011. Conversely, wildfowl showed an increase although numbers were always below 100 individuals. Given that only those roosts located in the north bank of the estuary are monitored, the reported numbers are a partial count of the total waterbirds using the Sado and should therefore be regarded with caution. Nevertheless, the comparison between

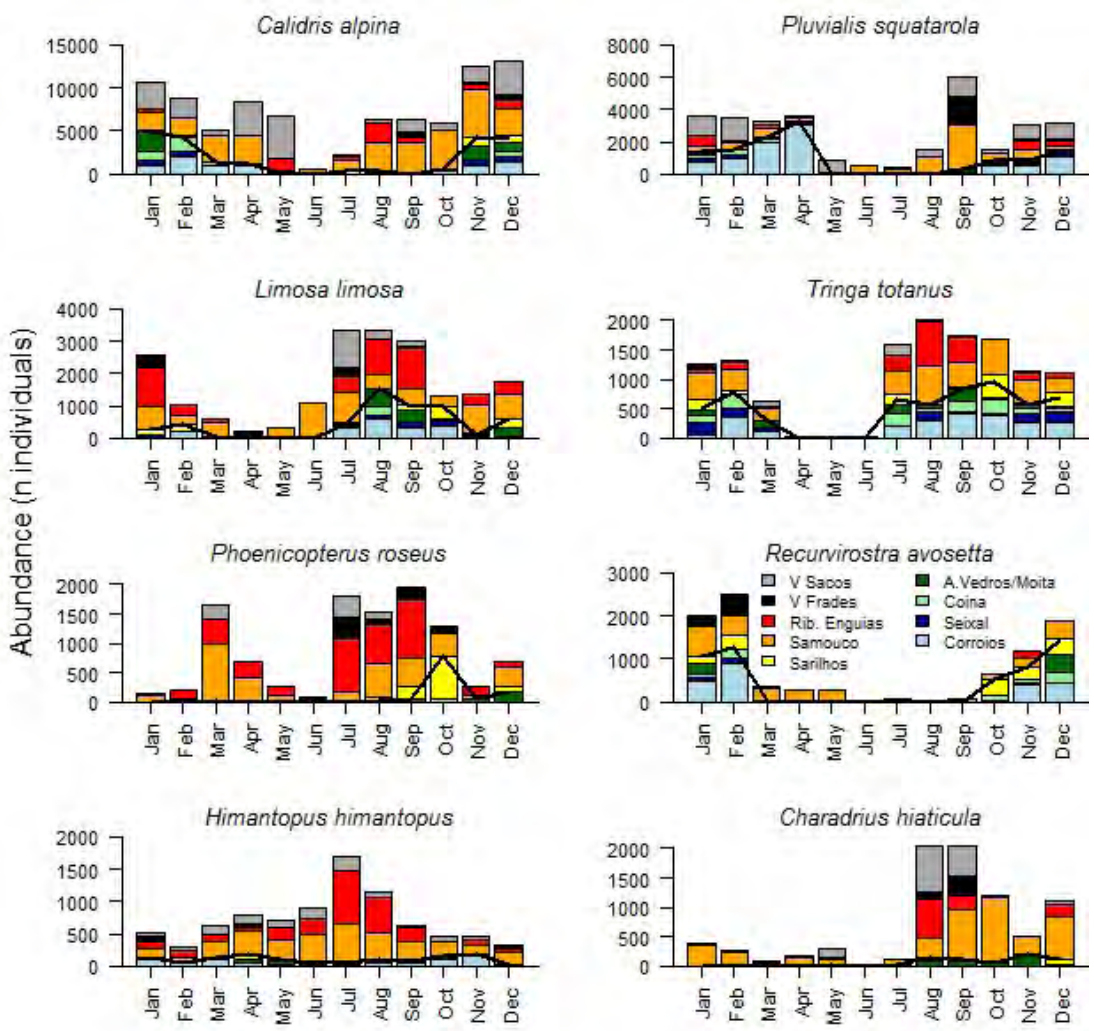

Figure 3. Seasonal variation and relative importance of the different high-tide roosts for the eight most abundant species (excluding gulls) in the Tejo estuary in 2011. The black line represents the number of birds counted outside the limits of the Tejo Estuary Special protection Area. *Fenologia e importância relativa dos vários refúgios para as oito espécies de aves aquáticas mais abundantes (excluindo as gaivotas) no estuário do Tejo em 2011. A linha a preto representa o n.º de aves contado fora dos limites da Zona de Protecção Especial do Estuário do Tejo.*

both years (2010-2011) showing a decrease in numbers particularly when a new roost has been included in 2011 (Limpersado), points towards a real reduction in total numbers. Although a re-distribution of individuals at the estuarine level cannot be discarded, it is unlikely given the high levels of site fidelity reported for many of these species (e.g. Burton 2000, Leyrer *et al.* 2006).

With the inclusion of a new roost (Limpersado) holding an average of 14% of the waterbirds in the estuary, comparisons with the previous years are limited. In any case, the rank order of some roosts was maintained with the most important roost being Mouriscas (holding approximately 30% of the waterbirds during winter as in the previous year) and Praias do Sado 2 holding the lowest proportion. The most relevant change occurred in Gâmbia that moved from the 2nd to 4th most important roost. The newly surveyed roost of Limpersado is mostly relevant during winter, as are Mouriscas and Gâmbia (the three most important roosts), whereas in the summer Pinheiro Torto and Praias do Sado 1 harbour the highest numbers of breeding Black-winged Stilts (Fig. 4). The seasonal use of distinct roosts by waders, demonstrates the importance in preserving distinct types of roost habitats, which are selected according to the ecology and seasonal state (breeding vs. non-breeding) of these species.

As in 2010, the similarity of relative abundance and phenology of waterbirds between the Tejo and the Sado estuaries is very high which is likely due to their proximity and habitat similarity. The nine most abundant species are the same in both estuaries (Tables 1 and 2) as were in 2010 (with the exception of the Lesser Black-backed Gull, for the Sado). The phenology of the eight most abundant species is also similar to previous year with the exception of the Black-tailed Godwit, Dunlin and Greater Flamingo. The Dunlin and the Greater Flamingo had peak counts in winter 2010 (December and November, respectively) but in 2011 the highest peak was recorded during pre-nuptial migration (April), which again could be due to the use of this area when conditions during migration are unfavourable. The Greater Flamingo shows abundance peaks in both migratory periods when it was absent in the previous year, a phenological pattern markedly different from that of the same species in the Tejo estuary. Ringed and Grey Plovers had peak counts during the winter period but in distinct months between the years (Ringed Plover – December 2010 and February 2011; Grey Plover January 2010 and November 2011), which might result from within estuary movements. The Black-tailed Godwit had in 2011 a more regular presence in this estuary with lower numbers only recorded during pre-nuptial migration and early breeding season (March to May). This is mostly due to the inclusion of the new roost, Limpersado, which holds considerable numbers of this species throughout the year (Figure 3) and is also the cause of the shift in the rank order of this species from 8th in 2010 to 3rd in 2011 in terms of relative abundance.

Guadiana estuary

The incomplete monitoring that occurred in this estuary during the previous year limits the comparison across the three years of this monitoring programme. However, the overall phenological patterns across this period have been similar with peak abundance recorded during post-nuptial migration and early winter. The peak number of waders was above 4000 for the first time this year whereas the gulls and terns reached that number in the previous year but not in 2011, although reaching ca. 3500 individuals (Fig 2). The number of wildfowl remains similar since 2009 with peaks of about 500 individuals, but the egrets and herons peaked at ca. 2500, whereas in 2010 the highest count was recorded at ca. 3000 individuals, with the Greater Flamingo being the highest contributor to this group (and to the estuary) for the 3rd consecutive year (Table 3). Interestingly, this group had the highest count during the post-nuptial period (September) as recorded in 2009 but not in 2010. These fluctuations in the peak abundances recorded either during pre-nuptial (2010) or post-nuptial periods (2009 and 2011) are likely caused

by movements of the Greater Flamingos to and from nearby breeding areas along the southern coasts of Iberia and the Mediterranean.

For the most abundant species the phenological pattern was similar to 2009 and despite the limitations due to missing counts in 2011, a few exceptions are clear. The peak abundance of Black-headed Gulls and Dunlins recorded during pre-nuptial migration in 2009 (March and April, respectively) was not recorded in 2011 when these species had higher abundances in winter (December for both species, although no counts were performed in April). Peak abundance of Redshanks recorded during post-nuptial migration in 2009 (July) was recorded in September in 2011. These cases may be related to the flexibility of migration when unfavourable conditions are encountered and/or of annual

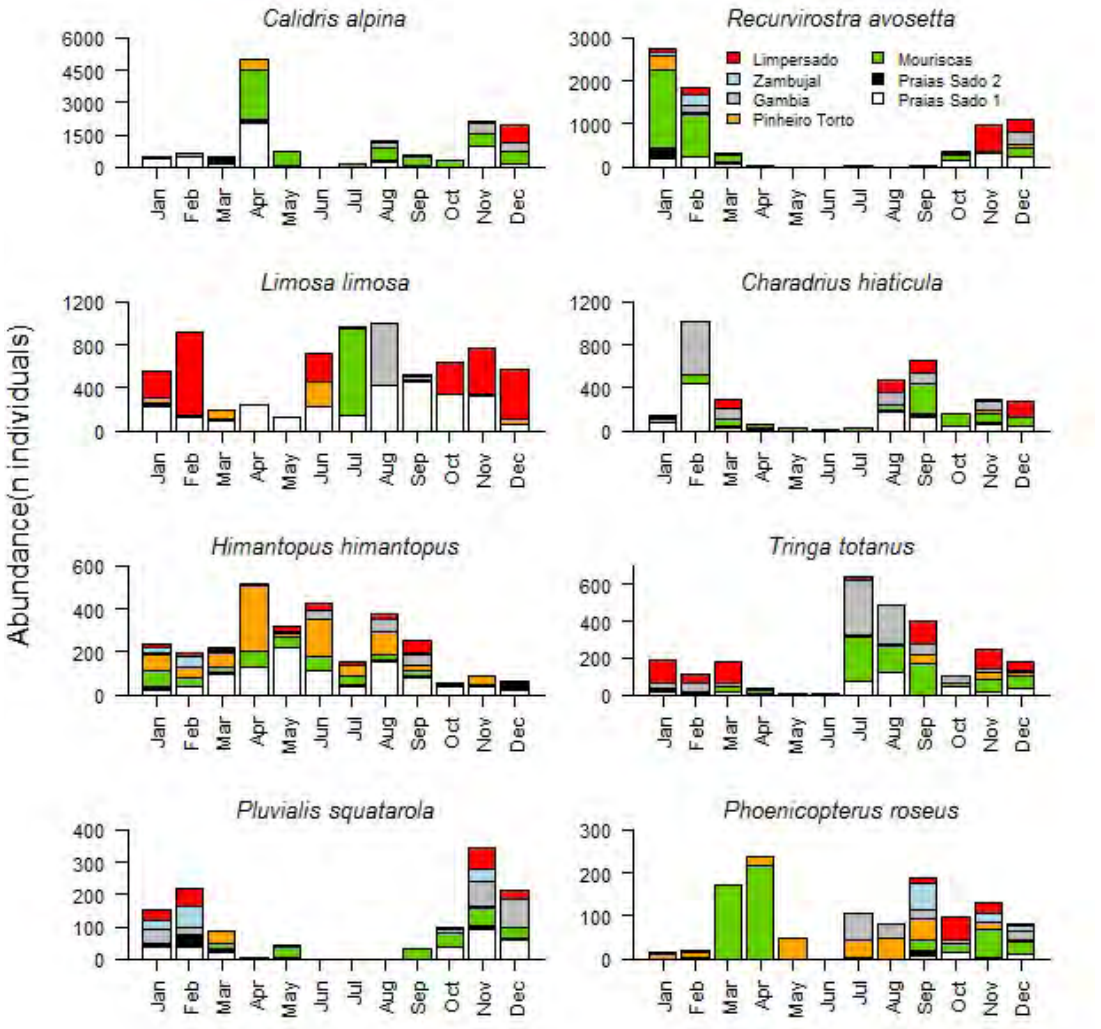

Figure 4. Seasonal variation and relative importance of the different high-tide roosts for the eight most abundant species (excluding gulls) in the Sado estuary in 2011. *Fenologia e importância relativa dos vários refúgios para as oito espécies de aves aquáticas mais abundantes (excluindo as gaivotas) no estuário do Sado em 2011.*

timing shifts linked to events occurring in other parts of the range (e.g. harsher or later breeding season).

The most important roost in this estuary is, as in previous years, Cerro do Bufo, which holds on average more than 75% of waterbirds during 2011. Despite its considerably larger area than any other roost in this estuary, this is nonetheless an industrial saltpan that although having intense human activity harbours considerable numbers of waterbirds, some of which of high conservation concern as the Audouin's Gull, whose numbers seem to be increasing during the post-breeding dispersion period.

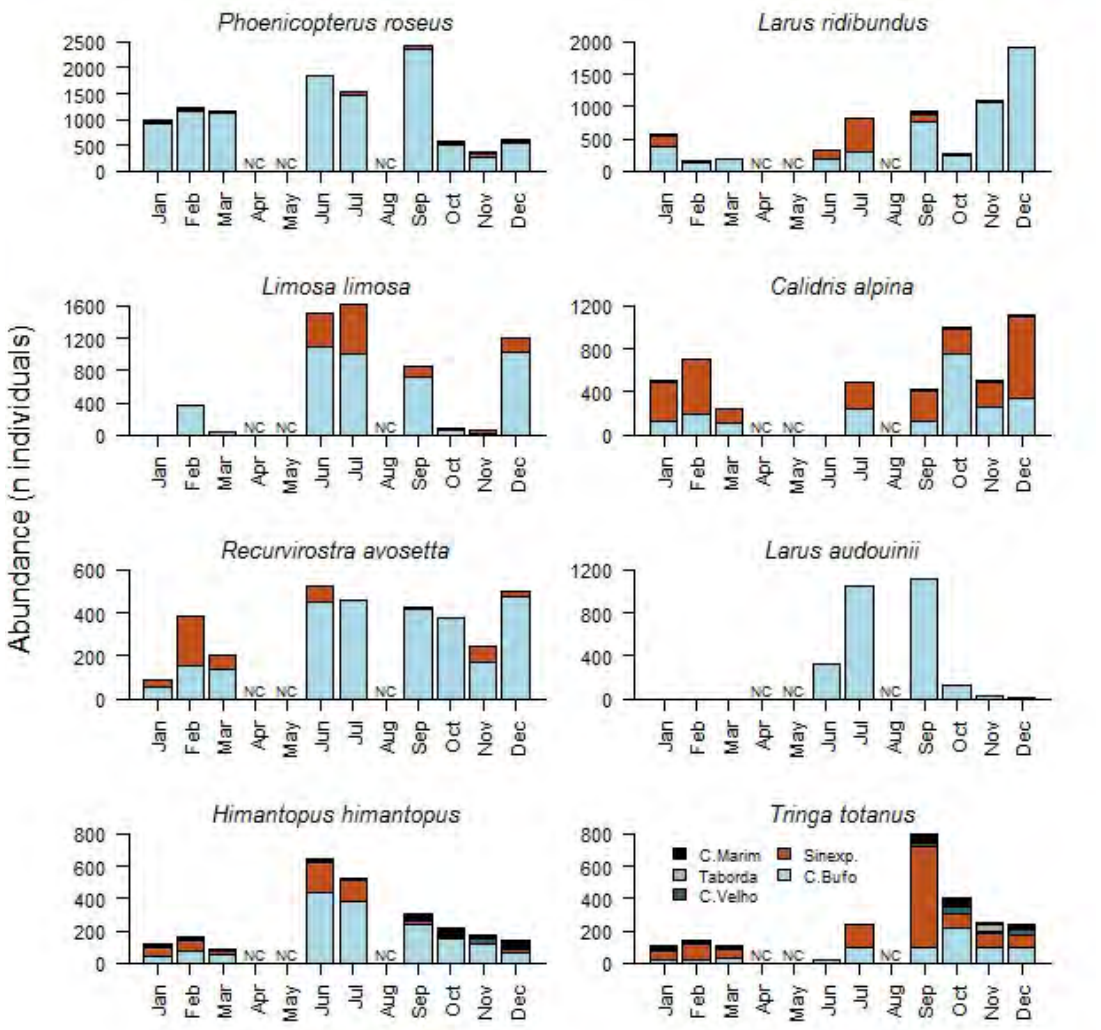

Figure 5. Seasonal variation and relative importance of the different high-tide roosts for the eitgh most abundant species in the Guadiana estuary in 2011 (n.c. – not counted). *Fenologia e importância relativa dos vários refúgios para as oito espécies de aves aquáticas mais abundantes no estuário do Guadiana em 2011 (n.c. – não contado).*

Table 2. Total number of individuals recorded monthly during high-tide roost counts on the Sado estuary in 2011. The 40 most abundant species are shown. *Número total de indivíduos contados mensalmente nos refúgios de preia-mar do estuário do Sado em 2011. Apenas são apresentadas as 40 espécies mais abundantes.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Calidris alpina	507	645	472	4987	691	18	168	1197	556	332	2155	1946
Recurvirostra avosetta	2752	1835	336	19	8	3	20	10	31	346	963	1096
Limosa limosa	558	924	199	251	130	715	960	995	519	632	771	565
Larus ridibundus	42	207	142	558	0	5	1161	421	781	245	1058	394
Charadrius hiaticula	152	1024	286	62	37	10	23	472	656	167	299	283
Himantopus himantopus	235	194	223	519	319	425	155	376	255	60	91	67
Tringa totanus	188	113	179	37	3	6	637	491	401	107	252	173
Pluvialis squatarola	153	218	89	5	43	0	0	0	34	98	346	211
Phoenicopterus roseus	17	21	171	239	49	0	105	80	187	99	129	82
Charadrius alexandrinus	95	54	53	16	42	35	60	175	182	6	96	52
Larus michahellis	2	360	22	62	1	2	27	34	74	0	3	0
Egretta garzetta	10	40	48	93	33	37	65	108	65	24	24	19
Tringa nebularia	31	15	102	58	3	0	19	22	13	123	31	25
Sternula albifrons	0	0	0	93	72	94	88	74	0	0	0	0
Anas platyrhynchos	56	11	33	52	71	4	4	0	0	40	39	20
Arenaria interpres	8	22	67	92	1	0	0	6	7	27	24	42
Calidris minuta	3	8	98	27	3	0	0	33	17	14	64	9
Larus fuscus	6	5	42	3	2	0	18	40	59	66	2	16
Ardea cinerea	33	9	9	6	7	2	25	2	6	34	28	36
Tachybaptus ruficollis	5	5	1	0	0	0	0	1	0	14	47	50
Sterna sandvicensis	0	1	20	0	0	0	0	0	32	20	11	10
Phalacrocorax carbo	2	14	42	3	0	0	0	4	2	0	11	5
Bubulcus ibis	10	0	0	0	0	0	0	66	1	0	1	0
Calidris ferruginea	0	0	3	1	8	0	0	6	57	0	0	3
Actitis hypoleucos	3	2	10	6	0	0	1	6	10	17	16	5
Calidris alba	0	0	0	0	0	0	1	0	3	12	15	0
Podiceps nigricollis	11	10	0	0	0	0	0	0	4	5	21	8
Anas clypeata	15	8	0	0	0	0	0	0	0	12	17	4
Calidris canutus	0	0	0	0	0	0	1	0	3	12	15	0
Gallinula chloropus	2	2	1	5	2	0	2	0	5	2	3	7
Hydroprogne caspia	*0*	*0*	13	0	0	0	2	0	0	0	2	12
Philomachus pugnax	0	0	4	14	0	0	0	4	0	0	0	1
Gallinago gallinago	1	0	7	0	0	0	0	0	1	0	1	0
Platalea leucorodia	1	0	1	2	1	0	2	0	0	0	0	0

Table 2: cont.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tringa erythropus	2	0	1	0	0	0	0	3	1	0	0	0
Tadorna tadorna	0	0	0	0	6	0	0	0	0	0	0	0
Egretta alba	0	0	1	0	3	0	0	0	0	0	0	0
Larus melanocephalus	0	0	3	0	0	0	1	0	0	0	0	0
Numenius phaeopus	0	0	0	2	0	0	1	0	0	0	0	0
Sterna hirundo	0	0	1	0	0	0	2	0	0	0	0	0

Table 3. Total number of individuals recorded monthly during high-tide roost counts on the Guadiana estuary in 2011 (two roost were not counted in 1-2 visits, see Table 4). The 40 most abundant species are shown. *Número total de indivíduos contados mensalmente nos refúgios de preia-mar do estuário do Sado em 2011 (dois refúgios não foram contados 1-2 vezes, ver Tabela 4). Apenas são apresentadas as 40 espécies mais abundantes.*

	Jan	Feb	Mar	Jun	Jul	Sep	Oct	Nov	Dec
Phoenicopterus roseus	971	1212	1147	1856	1525	2417	570	358	602
Larus ridibundus	566	161	182	327	809	935	262	1088	1919
Limosa limosa	5	362	36	1514	1619	851	75	58	1207
Calidris alpina	500	710	243	0	483	418	1003	514	1110
Larus sp.	271	115	29	541	1199	905	265	490	387
Recurvirostra avosetta	87	381	205	521	462	425	376	247	504
Larus audouinii	3	0	0	330	1057	1118	128	33	6
Himantopus himantopus	123	159	91	638	527	309	218	170	136
Tringa totanus	104	143	98	166	528	363	438	223	232
Charadrius hiaticula	44	124	97	0	19	632	295	143	628
Phalacrocorax carbo	169	140	8	0	0	15	247	279	291
Charadrius alexandrinus	25	74	38	37	237	160	103	220	184
Anas clypeata	276	129	23	0	1	90	32	406	113
Larus melanocephalus	0	0	0	0	0	0	151	788	0
Calidris ferruginea	2	9	2	0	177	464	253	28	0
Platalea leucorodia	50	32	50	102	93	433	33	42	84
Pluvialis squatarola	72	89	69	0	0	127	151	123	167
Tadorna tadorna	274	124	86	42	3	7	0	46	85
Calidris minuta	13	53	13	0	17	116	109	23	37
Podiceps nigricollis	91	63	0	0	0	103	16	17	43
Fulica atra	31	11	0	11	48	158	1	7	0
Egretta garzetta	2	5	40	64	77	33	3	2	4

Table 3: cont.

	Jan	Feb	Mar	Jun	Jul	Sep	Oct	Nov	Dec
Sternula albifrons	0	0	1	47	142	16	4	0	0
Burhinus oedicnemus	119	0	15	0	4	0	1	8	33
Anas platyrhynchos	54	73	11	2	0	2	8	8	15
Calidris alba	4	5	16	0	8	64	8	35	31
Tringa erythropus	1	1	0	66	6	17	12	15	1
Larus genei	1	0	17	47	17	22	0	0	4
Hydroprogne caspia	7	16	2	2	6	16	29	0	15
Arenaria interpres	1	10	6	2	6	31	13	4	9
Philomachus pugnax	0	4	1	1	4	5	24	34	9
Sterna sandvicensis	0	0	4	14	6	33	11	5	2
Tringa nebularia	2	5	16	4	4	19	10	9	2
Ardea cinerea	7	5	1	0	12	17	9	5	4
Chlidonias niger	0	0	0	0	16	37	0	0	0
Anas strepera	17	27	4	0	0	0	0	0	0
Podiceps cristatus	1	2	0	5	2	36	0	0	0
Anas acuta	15	11	0	0	0	0	0	18	0
Tachybaptus rufficolis	0	1	0	0	0	14	0	3	5
Glareola pratincola	0	0	22	0	0	0	0	0	0

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Table 4. Total number of waterbirds recorded in each of the main high-tide roosts in the Tejo, Sado and Guadiana estuaries (see Fig. 1 for details) "n.c" – not counted. *Nº total de aves aquáticas contadas em cada um dos principais refúgios de preia-mar dos estuários do Tejo, Sado e Guadiana (ver Fig. 1). "n.c." não contado.*

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	% of estuary
Tejo estuary													
Corroios (CR)	3740	6658	4770	5019	142	257	2157	3405	2035	3125	3119	5010	13.8
Seixal (SX)	1546	1255	87	142	34	157	859	467	617	304	929	1044	2.6
Coina (CO)	1545	2788	551	297	3	9	210	416	265	987	366	1298	3.1
Alhos Vedros e Moita (AM)	5778	n.c.	877	797	110	251	1224	2693	1205	1401	2493	3357	7.1
Sarilhos (SR)	2359	1741	1176	873	322	n.c.	2118	1367	1439	3516	2083	2496	6.8
Samouco (SM)	7197	6327	7648	5626	2666	3830	6271	11941	13814	13540	11404	8739	34.5
Ribeira das Enguias (RE)	4577	3325	1383	884	2767	1224	5539	8082	6760	n.c.	3820	4669	15.0
Vale de Frades (VF)	807	769	25	124	16	62	1267	252	2918	264	468	758	2.7
Vasa Sacos (VS)	5043	5366	1440	4166	6458	299	3592	3148	5957	1558	780	3344	14.4
Sado estuary													
Zambujal (ZB)	170	377	42	21	26	17	51	92	289	55	336	138	3.2
Gâmbia (GB)	194	924	187	51	28	61	829	1383	395	43	687	803	11.2
Pinheiro torto (PT)	501	172	391	1155	131	450	485	402	136	58	334	358	9.2
Limpersado (LS)	643	1064	315	91	41	334	117	308	363	523	1363	1906	14.2
Mouriscas (MO)	1967	1189	713	2881	869	150	1575	1045	1925	694	1640	1028	31.4
Praias do Sado 1 (P1)	1094	1966	638	2730	468	342	446	1286	697	1077	1908	733	26.9
Praias do Sado 2 (P2)	332	55	404	294	6	8	48	113	180	62	256	197	3.9
Guadiana estuary													
Cerro do Bufo (CB)	2476	2851	2092	n.c.	n.c.	5239	6624	n.c.	8377	3551	4173	5876	75.8
Sinexpral (SP)	908	1281	372	n.c.	n.c.	1012	2463	n.c.	1825	1012	1038	1741	21.4
Castro Marim (CM)	174	50	17	n.c.	n.c.	80	36	n.c.	170	140	112	122	1.4
Cepo Velho (CV)	83	66	85	n.c.	n.c.	13	n.c.	n.c.	50	107	111	118	1.1
Taborda (TB)	2	14	8	n.c.	n.c.	n.c.	n.c.	n.c.	6	82	18	20	0.3

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Appendix A. Check-list of all aquatic bird species recorded in each of the high-tide roosts of the three estuarine areas during 2011. During the counts we recorded all Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Phoenicopteriformes, Anseriformes and Charadriiformes, as well the Gruiformes and Falconiformes typically associated with wetland habitats (see methods for details). *Lista de todas as aves aquáticas detectadas em cada um dos refúgios de preia-mar dos três estuários. Durante as contagens foram registados todos os Gaviiformes, Podicipediformes, Pelecaniformes, Ciconiiformes, Phoenicopteriformes, Anseriformes e Charadriiformes, assim como os Gruiformes e Falconiformes tipicamente associados a zonas húmidas (ver métodos).*

	Tejo											Sado					Guadiana				
Species	**CR**	**SX**	**CO**	**AM**	**SR**	**SM**	**RE**	**VF**	**VS**	**ZB**	**GB**	**PT**	**LS**	**MO**	**P1**	**P2**	**CB**	**SP**	**CM**	**CV**	**TB**
Anser anser						X											X				
Alopochen aegyptiacus									X												
Tadorna tadorna					X	X	X	X	X		X						X	X		X	
Anas penelope			X																		
Anas strepera					X	X	X										X			X	X
Anas crecca						X	X		X												
Anas platyrhynchos	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X
Anas acuta																	X				
Anas clypeata					X	X	X	X	X						X		X	X			
Mergus serrator						X															
Tachybaptus ruficollis				X	X	X	X	X	X	X		X		X	X	X	X			X	
Podiceps cristatus																	X				
Podiceps nigricollis							X		X	X		X	X	X		X	X				
Phalacrocorax carbo	X	X		X	X	X	X		X	X	X	X	X	X	X	X	X	X		X	
Bubulcus ibis	X	X		X	X	X	X		X	X		X			X		X				
Egretta garzetta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Egretta alba								X			X			X				X		X	
Ardea cinerea	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Ardea purpurea							X											X			
Ciconia ciconia							X	X							X		X	X	X	X	
Plegadis falcinellus							X		X								X				
Platalea leucorodia	X	X		X	X	X	X		X	X	X	X	X				X	X	X	X	
Phoenicopterus roseus	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	
Circus aeruginosus	X		X	X	X	X	X		X												

Appendix A. Cont.

	Tejo											Sado					Guadiana				
Species	**CR**	**SX**	**CO**	**AM**	**SR**	**SM**	**RE**	**VF**	**VS**	**ZB**	**GB**	**PT**	**LS**	**MO**	**P1**	**P2**	**CB**	**SP**	**CM**	**CV**	**TB**
Pandion haliaetus	X				X	X	X		X			X									
Rallus aquaticus						X											X				
Gallinula chloropus	X	X	X	X		X	X														
Fulica atra				X	X	X	X		X												
Haematopus ostralegus	X					X	X														
Himantopus himantopus	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Recurvirostra avosetta	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Burhinus oedicnemus						X											X		X		
Glareola pratincola									X								X				
Charadrius dubius				X		X		X													
Charadrius hiaticula			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Charadrius alexandrinus	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Pluvialis apricaria							X		X		X										
Pluvialis squatarola	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Vanellus vanellus				X		X	X	X	X		X			X			X				
Calidris canutus		X	X	X	X	X	X	X	X					X	X		X				
Calidris alba	X					X	X		X		X			X	X		X	X	X	X	
Calidris minuta				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Calidris ferruginea		X	X	X	X	X	X		X		X	X		X		X	X	X			
Calidris alpina	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Philomachus pugnax		X			X	X	X	X	X	X	X	X			X		X		X		X
Gallinago gallinago				X	X	X	X				X	X		X							X
Limosa limosa	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Limosa lapponica	X	X	X	X	X	X	X	X	X	X								X			
Numenius phaeopus	X	X	X	X	X	X	X		X		X					X	X	X		X	
Numenius arquata	X	X	X	X	X	X			X												
Actitis hypoleucos	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X

Appendix A. Cont.

	Tejo												Sado				Guadiana				
Species	**CR**	**SX**	**CO**	**AM**	**SR**	**SM**	**RE**	**VF**	**VS**	**ZB**	**GB**	**PT**	**LS**	**MO**	**P1**	**P2**	**CB**	**SP**	**CM**	**CV**	**TB**
Tringa ochropus					X	X	X	X	X			X							X		
Tringa erythropus				X	X	X	X		X	X	X	X		X			X	X	X	X	X
Tringa nebularia	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Tringa glareola				X		X	X														
Tringa totanus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Arenaria interpres	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X		
Larus melanocephalus	X	X		X	X	X	X		X		X			X		X	X				
Larus ridibundus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Larus genei																	X				
Larus audouinii																	X				
Larus fuscus	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Larus michahellis	X	X		X	X				X		X	X	X	X	X	X	X	X	X	X	
Hydrocoloeus minutus							X														
Gelochelidon nilotica				X			X		X												
Hydroprogne caspia											X		X	X		X	X	X			
Sterna sandvicensis	X			X	X	X	X		X	X		X		X		X	X	X			
Sterna hirundo					X				X					X	X						
Sternula albifrons	X			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Chlidonias niger						X	X		X								X				