

Waders wintering in Morocco: national population estimates, trends and site-assessments

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Population sizes of wintering waders are estimated for Morocco based on mid-winter counts during 1991–95. For some species, these are compared with data for 1983–87 to indicate trends. Comparisons made with total biogeographic populations show that a high proportion of several winter in Morocco.

Analysis of data for individual sites using Ramsar criteria identified seven internationally important sites and four other wetlands as potential Ramsar sites. Application of national criteria showed 41 sites as nationally important for waders. These criteria were also used to identify a network of key sites for the winter monitoring of waders, classified in three priority levels.

INTRODUCTION

Morocco is located at the crossroads of several bird migration routes between Europe and Africa. With its numerous wetlands and its 3,500 kilometres of coast, 90% of which belong to the East-Atlantic flyway, this country plays a major role in the migration of waterfowl. Of these, waders are the most important both in numbers and diversity. This is mainly due to the presence of several large coastal wetlands, which are important stopover sites for species that winter south of the Sahara. By reason of its position in the extreme southwest of the Palearctic region, Morocco also provides a favourable wintering area for several important European wader populations.

The coastal margin is particularly suitable for waders due to the presence of four lagoon complexes, thirty large estuaries, several vast bays and hundreds of kilometres of sandy beaches and/or tidal rocky coasts.

Studies of wintering of waders in Morocco are numerous and the first censuses organised within the context of the International Waterbird Census (IWC) date back to the 1960s–1970s (Blondel & Blondel 1964, Thévenot & Magnin 1971, Hovette & Kowalski 1972, Zwarts 1972, Johnson & Biber 1974, Juana 1974, Hope-Jones & Wilson 1975, Vandembulcke 1976, Kersten & Peerenboom 1978). However, these early studies were sporadic and often only covered limited numbers of important wetlands.

Regular censuses began in 1983 (Beaubrun & Thévenot 1983, 1984, 1988, Beaubrun *et al.* 1986, 1988a,c, Dakki & El Agbani 1993, Dakki *et al.* 1989, 1991, 1995, El Agbani & Dakki 1992, 1994, El Agbani *et al.* 1990), thanks to a network of observers co-ordinated by the *Institut Scientifique* of Rabat. However, not all bird groups were counted system-

atically. The Anatidae were the main target of the counts. Therefore waders, when counted, were not always identified up to the species level. Since 1991, when a research team was constituted and a database created in order to manage these censuses, efforts were increased in order to obtain comprehensive good quality data. After that time all sites were covered and more effort was put into identification of species.

In addition to these organised censuses, the *Centre d'Etude des Migrations d'Oiseaux* receives several reports on occasional observations including winter counts. From these, it is often possible to extract more information on waders.

The main objectives of the present work were to estimate and analyse the national population sizes of regular wintering waders in Morocco and to identify the most important wintering sites, particularly those meeting the Ramsar Convention criteria relative to waterfowl.

METHODS

This analysis is based mainly on the IWC results. However, a literature search was necessary in order to make an exhaustive inventory of the rare wintering waders in view of the fact that most of them are not often observed during regular censuses.

A total of 144 sites were visited at least once during the period 1991–95. This corresponds to 83% of the national network of IWC sites identified up to January 1995 (Figure 1) and includes all the main wader sites. A high proportion of those not visited are either not used by waders or were dry during this period.

The field methodology was relatively standardised after 1991, allowing some comparison of numbers between sites and between years. Most counts took place during January,

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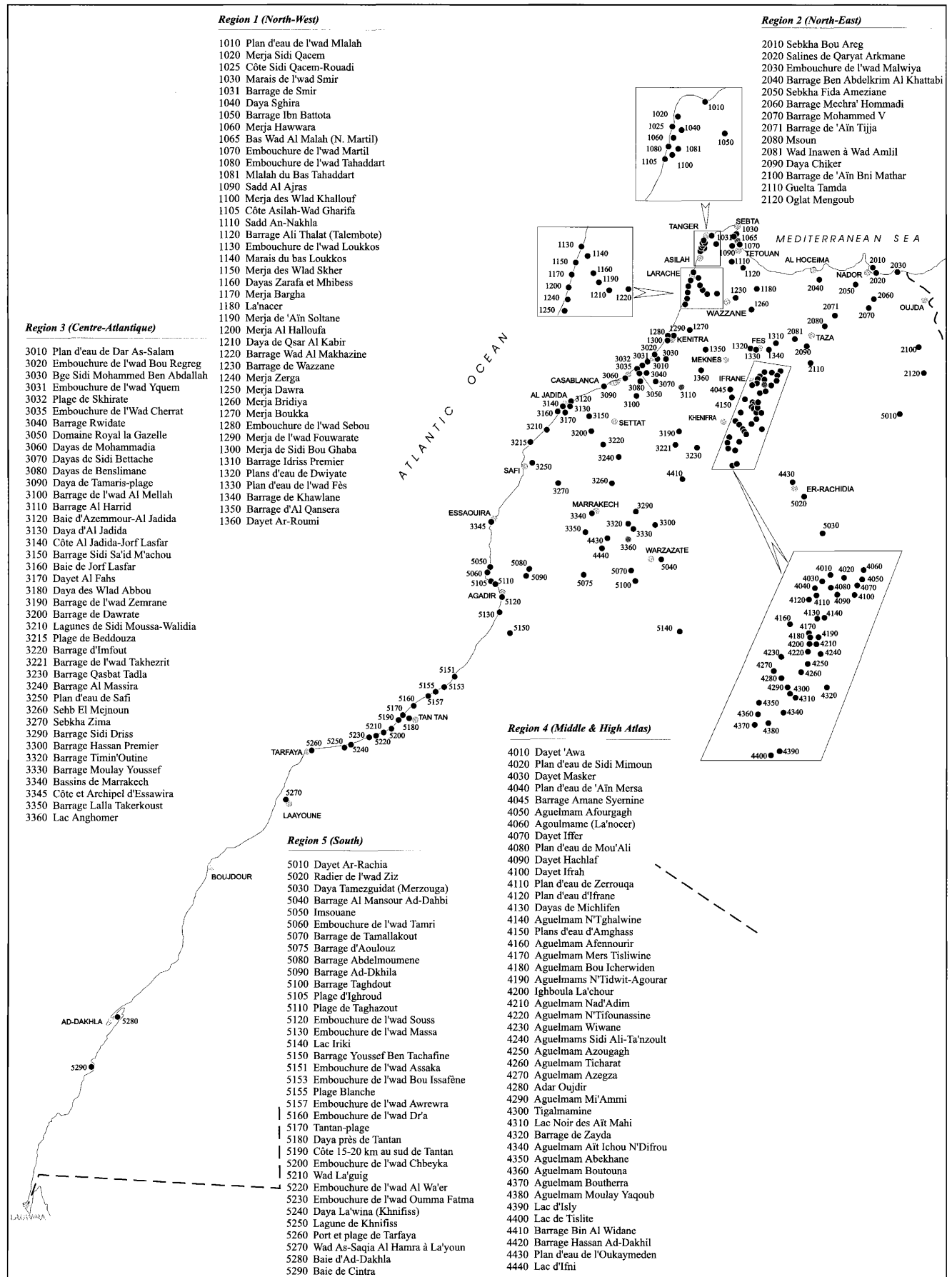


Figure 1. The Moroccan network of sites for the winter census of waterfowl (regions are not delimited, but indicated by the first character of the site codes).



particularly at the large sites. Sometimes, however, when January counts were missed, it was necessary to use censuses obtained at the end of December or, exceptionally, at the beginning of February.

In rare cases, the same site was visited more than once during the same winter. In these, the maximum number of each species from the different counts was used. This was done on the basis that the months of December and January are a period of stability in wintering populations. Therefore it was assumed that the maximum number corresponds to the most exhaustive census for the species concerned.

The size of the Moroccan wintering population has been estimated for each species based on the sum of average numbers recorded at all sites visited during 1991–95 (Table 2). Occasional wintering species are also inventoried (Table 3). These are not often recorded during the regular counts and the main source of data on them is bird-watching reports.

Population size has also been calculated for the period 1983–90. This has been used to show population trends in some species and also to illustrate the effect of major environmental changes that have affected certain wetlands. Some sites were dry during the winters of 1991–95 although they did support waders before then. The population estimate at such sites for 1983–90 is not included in the calculation of the size of the national populations for 1991–95, though they are considered in the discussion of the sites concerned.

The identification of Sites of International Importance (SII) was based on the three bird criteria of the Ramsar Convention. These are: (3a) sites regularly supporting 20,000 waterfowl (applied here only to total waders), (3b) sites regularly supporting substantial numbers of individuals from particular groups of waterfowl (waders, in the present case), indicative of wetland value, productivity or diversity and (3c) sites regularly supporting 1% of the individuals in a population of one species or subspecies. We consider, as suggested by Monval & Pirot (1989) and Rose & Scott (1997), that the regularity needed for the application of the numerical criteria, 3a and 3c, arises when the criteria level is reached by the five-year average. However, in addition to these averages, we also give the number of winters when the criteria levels were reached (Table 4).

The application of criterion 3c was based on the “biogeographic population” estimates published by Rose & Scott (1997) for each, largely discrete, wader population. These were based mainly on the estimates made by Smit & Piersma (1989), which are very similar to those compiled from the 1983–87 censuses by Beaubrun *et al.* (1988). The biogeographic population estimates therefore predate, but are nevertheless close to our survey period.

For two species, Dunlin and Black-tailed Godwit, birds wintering in Morocco could belong to more than one recognised population. In these, the 1% level for each species is taken as the sum of 1% of each population involved. This sum was applied to all the sites in the case of the Dunlin. (For scientific names of the species mentioned in this paper, please refer to Tables 1–5).

On the basis of ringing recoveries, Smit & Piersma (1989) considered that the entire wintering population of Black-tailed Godwits in Morocco belongs to race *islandica* for which the 1% level corresponds to 700 birds. This is the criterion we have used for this species. However, Beaubrun *et al.* (1988b) report ringing recoveries in Morocco from Holland, Belgium and Sweden. It is therefore possible that some wintering flocks belong to the nominate population.

We consider that Ramsar criterion 3b is fulfilled for a wetland when a relatively high number of species (at least 10 in the case of waders) reach the 1% Ramsar level and/or the 1% national level (see below).

A site where a species irregularly exceeds the 1% level of its biogeographic population, but its national population (average of the 1991–95 counts) does not exceed this level, is designated as a Site of Potential International Importance (SPII). In such cases, we take into account only the 1991–95 censuses. Figures for 1983–90 are only used for sites where data are missing for 1991–95 and which have not been destroyed and which would otherwise not be considered.

The main objective of the use of criterion 3b is to draw attention to some sites with very irregular hydrology (partly or totally exposed to frequent droughts), which are relatively abundant in the Southern Mediterranean region. Every time they are flooded, some species may reach the 1% level of their biogeographic population. Similar situations are known in other arid regions, such as Australia (Watkins 1993 *in* Rose & Scott 1997). Therefore this criterion allows us to consider the international significance of some important sites which are only flooded infrequently.

A wetland is considered as a Site of National Importance (SNI) for a species, if average numbers wintering during 1991–95 reached 1% of the national population. However, we also show for each species at each site the number of winters when the 1% level was reached (Table 5).

This national criterion, already applied to the Anatidae (El Agbani *et al.* 1996), facilitates the identification of the most important sites for monitoring certain wintering species. It also allows the assessment of some sites that do not meet the Ramsar criteria, but to which could be assigned some educational or recreational value through the presence of waterfowl concentrations. Species considered rare in Morocco but whose biogeographic populations are high are not taken into account in this assessment.

One of the main objectives of the assessment parameters defined above is to identify a network of priority sites (or key-sites) for the winter monitoring of waders. This allows optimisation of counting effort as well as providing comprehensive data on wintering waders. This network will therefore include all the sites identified by the application of the assessment criteria described above. A classification of these sites into priority levels (Table 6) is possible based on international and national importance, the number of species verifying this importance, and the global number of waders at each site.

NATIONAL WINTERING POPULATIONS: SIZE ESTIMATES AND TRENDS

The national inventory of wintering waders in Morocco includes 49 species, of which 31 are regular (Table 2). The other 18 species (Table 3) are occasional or very rare (mainly one or two individuals, exceptionally eight in the case of the Marsh Sandpiper). An analysis of the Moroccan distribution of these species is published elsewhere (Qninba, 1999). Four of the regular wintering species are either terrestrial or not particularly wetland species (Stone-curlew, Cream-coloured Courser, Eurasian Dotterel and Woodcock). The estimates in this paper are therefore restricted to the other 27 regular species.

The total number of waders wintering in the Moroccan wetlands is estimated at 143,108 (Table 1), with a maximum of 208,837 birds recorded in 1995. This average number for



Table 2. Waders wintering in Morocco: national population estimates in respect of the regular species, trends and comparison with total biogeographic populations as determined by Rose & Scott (1997).

Species	Biogeographic population		National populations										Trend**	
			1970s–1980s estimates					1991–95 estimates						
			Prater (1976)	Karsten & Smit (1984)	Beaubrun et al. (1988b)	Smit & Piersma (1989)	IWC (average 1983–90)	Nat. pop. size (average 1991–95)	% Nat. pop./biogeog. pop.	1% National population	% Nat. Pop./Total Waders	Sum (% Nat.pop./Total Waders)		
Population	Size (<1000)	3c Ramsar Crit. (1% biogeog. pop.)												
National population > 1% National total waders														
Dunlin <i>Calidris alpina</i>	Greenl./Isl./Eur./N. Siberia/W. Afr.	2209	20,000	50000	40000	32000	32000	4868	40712	1.84	400	28.45	28.45	>>>
Ringed Plover <i>Charadrius hiaticula</i>	Eur. / N. Afr. (win)	47.5	500	10000	9000	4500	4300	1500	14090	29.66	140	9.85	38.29	>>>
Black-tailed Godwit <i>Limosa limosa</i>	Isl.(bre.) (+? W.Eur./W.Afr.)*	65 (415)	700 (4200)	30000	15000	18500	18500	6564	10883	2.62	100	7.60	45.90	<<<
Kentish Plover <i>Charadrius alexandrinus</i>	E. Atl.	67	700	1500	3000	4000	3600	2256	9279	13.85	90	6.48	52.38	>>>
Little Stint <i>Calidris minuta</i>	Eur. / W. Afr. (win)	211	2,100	1500	1000	2000	2000	500	9088	4.31	90	6.35	58.73	>>>
Eurasian Golden Plover <i>Pluvialis apricaria</i>	NW. Eur. (bre.)	1800	18,000	-	-	-	-	1810	8153	0.45	80	5.70	64.43	>?
Sanderling <i>Calidris alba</i>	E. Atl. / W/S. Afr.	123	1,000	3000	1500	2500	2100	1940	8072	6.56	80	5.64	70.07	>>>
Grey Plover <i>Pluvialis squatarola</i>	E. Atl. (win.)	168	1,500	10000	6000	4000	4000	2093	7045	4.19	70	4.92	74.99	---
Red Knot <i>Calidris canutus</i>	W/S. Afr. (win.)	516	5,000	5000	5000	2500	2500	748	6952	1.35	70	4.86	79.85	>>>
Bar-tailed Godwit <i>Limosa lapponica</i>	W/S. Afr. (win.)	700	7,000	5000	3000	3000	3000	431	5739	0.82	60	4.01	83.86	>>>
Avocet <i>Recurvirostra avosetta</i>	W. Eur. / W. Méd. (bre.)	67	700	4000	3000	3000	2900	2420	5462	8.15	55	3.82	87.68	>>>
Northern Lapwing <i>Vanellus vanellus</i>	Eur. (bre.)	7000	20,000	-	-	7500	-	4904	2893	0.04	30	2.02	89.70	<<<
Eurasian Oystercatcher <i>Haematopus ostralegus</i>	Eur. / N/W. Afr. (win.)	874	9,000	1500	1500	1500	1400	1272	2495	0.29	25	1.74	91.44	>>>
Redshank <i>Tringa totanus</i>	E. Atl. (win.)	177	1,500	10000	7000	7000	6600	1133	2287	1.29	25	1.60	93.04	<<<
Black-winged Stilt <i>Himantopus himantopus</i>	W. Méd. (bre.)	40	400	-	800	1000	900	1269	1526	3.82	15	1.07	94.11	>>>
Ruddy Turnstone <i>Arenaria interpres</i>	W/S. Afr. -	32	300	400	400	1000	600	532	1467	4.58	15	1.03	95.13	>>>
National population < 1% National total waders														
Eurasian Curlew <i>Numenius arquata</i>	Eur. (bre.)	348	3,500	3500	1500	1000	1000	384	858	0.25		0.60	0.60	---
Little Ringed Plover <i>Charadrius dubius</i>	Eur. / W. Afr. (win.)	100-1000	-	-	-	500	-	121	614	0.06		0.43	1.03	?
Curlew Sandpiper <i>Calidris ferruginea</i>	SW. Eur. / W. Afr.	436	4,500	-	-	200	200	165	518	0.12		0.36	1.39	>>>
Common Sandpiper <i>Actitis hypoleucos</i>	Eur. (bre.)	>1000	-	-	-	500	300	93	303	0.06		0.21	1.60	---
Common Snipe <i>Gallinago gallinago</i>	Eur. (bre.)	>2000	20,000	-	-	-	-	234	230	0.03		0.16	1.76	?
Ruff <i>Philomachus pugnax</i>	W. Afr. (win.)	>1000	-	-	500	450	-	254	206	0.03		0.14	1.91	<<<
Whimbrel <i>Numenius phaeopus</i>	Eur. / W. Afr. (win.)	600-700	6,500	-	-	600	600	93	198	0.03		0.14	2.05	<<<
Greenshank <i>Tringa nebularia</i>	Eur. / W. Afr.	100-1000	-	-	100	400	400	85	135	0.02		0.09	2.14	<<<
Spotted Redshank <i>Tringa erythropus</i>	Eur. / W. Afr.	75-150	1,200	-	400	300	300	160	131	0.13		0.09	2.23	<<<
Green Sandpiper <i>Tringa ochropus</i>	Eur. / W. Afr.	>100	-	-	-	-	-	24	27	0.03		0.02	2.25	?
Wood Sandpiper <i>Tringa glareola</i>	Eur. (bre.)	>1000	-	-	-	-	-	>2	24	0.00		0.02	2.27	?
Non-wetland species (national population not estimated)														
Stone-curlew <i>Burhinus oedicnemus</i> , Cream-coloured Courser <i>Cursorius cursor</i> , Eurasian Woodcock <i>Scolopax rusticola</i> and Eurasian Dotterel <i>Eudromias morinellus</i> .														

* For this species, the 1% level corresponds to 700 individuals on the basis that only the *islandica* race winters in Morocco (see Smit & Piersma, 1989). However, there is some evidence that birds from the West-European population (1% level = 3600 birds) may also occur (see text).

** Trends: <<< decreasing; >>> increasing; --- stable; ? unknown.

1991–95 is nearly three times higher than the 1983–90 average of 50,017. The difference is due mainly to the increase in counting effort since 1991, though it is possible that there have been real changes in some populations.

National population estimates

The average number of wintering birds is given for each regular species (Table 2) along with a comparison to the corresponding biogeographic population (according to Rose & Scott 1997) and to the national total number of waders. In most cases, these average numbers are probably fairly close to the real size of the populations. For the following, however, they should be considered as likely underestimates:

- species often hidden in aquatic vegetation: Snipe;
- species that sometimes feed away from wetlands, particularly in agricultural land: Black-tailed Godwit, Curlew and Eurasian Golden Plover;
- species often found at small inland wetlands not monitored by the winter counts: Little Ringed Plover, Wood Sandpiper, Green Sandpiper and Common Sandpiper;

- coastal species, habitually present in non-estuarine habitats (beaches and rocky coasts), which are not totally covered by the censuses: Sanderling, Eurasian Oystercatcher and Turnstone;
- pelagic species, rare in wetlands: Red-necked and Grey Phalaropes;
- unidentified waders (often as a consequence of bad visibility); their cumulated numbers are considered in the calculations of the total number of waders (Table 1) of which they represent about 2.5%; *Charadrius* and *Tringa* species are the main ones involved.

The species considered as occasional visitors (Table 3), unobserved in several rapid censuses, are certainly underestimated. The frequency of occurrence of some of them (Grey Phalarope, Slender-billed Curlew, Jack Snipe and Marsh Sandpiper) is sufficiently high for them to be considered as regular winter visitors, though in the 1990s their national populations were negligible.

For sixteen species, the national population exceeds 1,400 (Table 2), corresponding to 1% of the total waders wintering in Morocco. These populations together comprise 95.1%



Table 3. Waders wintering in Morocco: number of occurrences per site of occasional species (i.e. the number of times each species was recorded, not the number of individuals).

Site Codes	Site names	Grey Phalarope <i>Phalaropus fulicarius</i>	Slender-billed Curlew <i>Numenius tenuirostris</i>	Jack Snipe <i>Lymnocyptes minimus</i>	Marsh Sandpiper <i>Tringa stagnatilis</i>	Temminck's Stint <i>Calidris temminckii</i>	Red-necked Phalarope <i>Phalaropus lobatus</i>	Purple Sandpiper <i>Calidris maritima</i>	Great Snipe <i>Gallinago media</i>	Kittlitz's Sandpiper <i>Charadrius pecuarius</i>	Broad-billed Sandpiper <i>Limicola falcinellus</i>	Common Pratincole <i>Glareola pratincola</i>	Senegal Thick-knee <i>Burhinus senegalensis</i>	Wilson's Phalarope <i>Phalaropus tricolor</i>	Sociable Plover <i>Vanellus gregarius</i>	White-tailed Plover <i>Vanellus leucurus</i>	Pintail Snipe <i>Gallinago stenura</i>	Lesser Yellowlegs <i>Tringa flavipes</i>	Terek Sandpiper <i>Xenus cinereus</i>	Number of occurrences per site	
1240	Merja Zerga	4	13	6	7	4			2												36
3210	Lagunes de Sidi Moussa-Walidia	7	3	3	8	3	2		1												27
1140	Marais du bas Loukkos		3	1	6																10
5130	Embouchure de l'wad Massa	4	2	1	1		1				1						1				11
1130	Embouchure de l'wad Loukkos	1	1			4		1													7
1300	Merja de Sidi Bou Ghaba	4		1	1			1													7
1320	Plan d'eau de Dwiya	3		4																	7
3020	Embouchure de l'wad Bou Regreg	5																			5
5030	Daya Tamezguidat (Merzouga)	1		1			1			2											5
5120	Embouchure de l'wad Sous	1			1						1								1	1	5
2010	Sebkha Bou Areg		2		1							1									4
3035	Embouchure de l'wad Cherrat	2	1															1			4
1100	Merja des Wlad Khallouf		2												1						3
1250	Merja Dawra		3																		3
3032	Plage de Skhirate	2	1																		3
5280	Baie d'Ad-Dakhla			1																	1
1030	Marais de l'wad Smir		1					1													2
1170	Merja Bargha	1			1																2
2030	Embouchure de l'wad Malwiya			1	1																2
3260	Sehb El Mejnoun	2																			2
3270	Sebkha Zima	1				1															2
5250	Lagune de Khnifiss	1	1																		2
5270	Wad As-Saqia Al Hamra à La'youn												1	1							2
1080	Embouchure de l'wad Tahaddart		1																		1
1270	Merja Boukka		1																		1
1280	Embouchure de l'wad Sebou	1																			1
2070	Barrage Mohammed V	1																			1
3100	Barrage de l'wad Al Mellah			1																	1
3120	Baie d'Azemmour-Al Jadida			1																	1
3140	Côte Al Jadida-Jorf Lasfar		1																		1
3170	Dayet Al Fahs			1																	1
3215	Plage de Beddouza	1																			1
4090	Dayet Hachlaf			1																	1
4100	Dayet Ifrah	1																			1
4160	Aguelmam Afennourir		1																		1
5040	Barrage Al Mansour Ad-Dahbi	1																			1
5100	Barrage Taghdout			1																	1
5200	Embouchure de l'wad Chbeyka		1																		1
5220	Embouchure de l'wad Al Wa'er	1																			1
5230	Embouchure de l'wad Oumma Fatma	1																			1
5240	Daya La'wina (Khnifiss)	1																			1
no code	Sables d'or (plage)/Harhoura	2	1																		3
no code	Palmeraie de Marrakech			1								1									2
no code	Tangérois			3																	3
no code	Gharb							1													1
no code	Plage des Nations	1																			1
no code	Daya du Moyen Atlas						1														1
no code	Rabat	1																			1
Number of occurrences per species ->		51	39	28	27	12	5	4	3	2	2	2	1	1	1	1	1	1	1	1	182



of that figure. Dunlin is the most abundant species, with an average national population of 40,712 birds (28% of the total number of waders) and with a maximum of 57,600 birds (recorded in 1995). Ten other species represent 4–10% of the national population and the remainder 1–2%.

The number of national populations exceeding the 1% level of their biogeographic population is thirteen. Among these, the Moroccan populations of four species are considerably higher: Ringed Plover (29.7%), Kentish Plover (14.0%), Avocet (8.2%) and Sanderling (6.6%). In Turnstone, Little Stint, Grey Plover and Black-winged Stilt, this proportion is 4–4.5%.

Dunlin is the most numerous wader in the country, but its estimated population represents only 1.8% of all biogeographic populations of which representatives are supposed to winter in Morocco. This proportion could be higher if ringing data prove that the Moroccan wintering population has a more restricted origin than is considered at present.

National population trends

Before the 1990s, there had been four successive estimates of the Moroccan wintering wader population (Table 2): Prater (1976), Kersten & Smit (1984), Beaubrun *et al.* (1988b) and Smit & Piersma (1989). However, these were based on only partial censuses and some major sites, especially along the southern coast, were not covered at all. Furthermore, some species migrating along the East Atlantic flyway (particularly Eurasian Golden Plover) were omitted altogether.

In addition to these estimates, the national censuses made during 1983–90 included a high proportion of unidentified flocks (more than 20% of all waders counted). Therefore some of the average numbers calculated for this period are not very accurate. Nevertheless they do give a general indication of approximate numbers and some are quite useful in relation to decreasing populations and sites that have been destroyed.

In order to show trends in Moroccan wader populations, the 1991–95 estimates have usually been compared with those of Beaubrun *et al.* (1988b) and Smit & Piersma (1989), which were both based on the 1983–87 counts.

Three species – Black-tailed Godwit, Lapwing and Redshank – appear to have decreased. Four others show declines, but the low size of their populations does not permit interpretation. It is also important to note the complete lack of recent observations (since the winter 1995) of Slender-billed Curlew, a globally threatened species that used to be a regular visitor to Morocco.

An increase was recorded in thirteen species. For most (Oystercatcher, Knot, Sanderling, Curlew Sandpiper, Dunlin, Bar-tailed Godwit and Turnstone), this was mainly due to better coverage during the recent censuses, particularly the inclusion of several major sites in the south. However, for Kentish Plover, Little Stint, Grey Plover and Ringed Plover, it is likely that there has been a real increase in the numbers wintering. Moreover, there have certainly been increases in the populations of Black-winged Stilts and Avocets.

The most spectacular increase is recorded for Kentish Plover, mainly because of the high number counted in Merja Zerga in January 1995. This may be explained by the severe drought that affected most of the inland wetlands during that winter (droughts normally lead to high concentrations of Kentish Plovers at artificial lakes and the coastal wetlands).

ASSESSMENT OF THE WINTERING SITES

Spatial distribution of waders

In winter, most waders in Morocco are found along the Atlantic coast (Figure 2). The Mediterranean margin, where estuarine and coastal habitats are often narrow, contains only two lagoon sites (Sebkha Bou Areg and Marais de l'wad Smir) supporting substantial numbers. Some inland wetlands are also used irregularly. This is particularly the case at the Sebkha Zima, the temporary site of Sehb El Mejnoun (dry during 1991–95, but when flooded in 1985, 1987 and 1988 thousands of waders – mainly Kentish Plovers – wintered there) and the old dam of Al Qansera where there is a vast mudflat. This distribution shows a clear preference of waders for lagoons, bays, estuaries, rocky shores and sandy beaches.

At ten sites, the average number of wintering waders exceeded 1,400 or 1% of the national population (Table 1). These together supported 89% of all waders in Morocco. Among them are four large lagoon sites – Merja Zerga, Baie d'Ad-Dakhla, Lagunes de Sidi Moussa-Walidia and Lagune de Khnifiss – which support 79.3% of this total, with 68% at the first two alone. This shows the great importance of these four wetlands. Moreover their latitudinal succession makes them an important network along the East-Atlantic flyway. The other sites are also located on this coast, except for the artificial lake of Al Qansera.

Comparison of the average numbers during 1983–90 and 1991–95 shows a decrease at several sites, particularly seven. For the Saharan site of Daya La'wina, this decrease is due to the shortness of the flooding periods and a total drought during 1991–95. In five other cases (Sehb El Mejnoun, Merja Dawra, Merja Boukka, Daya d'Al Jadida and Merjas Zarafa & Mhibess), there was a near-total loss of wader-habitat as a result of pumping and drainage. At the seventh site (Port & plage de Tarfaya), the lower numbers during 1991–95 may be the result of poorer coverage compared with 1985–86 (Baubrun *et al.* 1988b).

Sites of international importance

The application of the Ramsar waterfowl criteria identified seven Sites of International Importance (SIIs) for wintering waders (Table 4).

Two large coastal wetlands (Merja Zerga and Baie d'Ad-Dakhla) meet the Ramsar criterion 3a, even for waders alone. They also meet criterion 3c for seven and five species respectively. The four other SIIs that meet criterion 3c only do so for one species.

Two coastal wetlands (Lagunes de Sidi Moussa-Walidia and Lagune de Khnifiss) may be considered as easily meeting criterion 3b, in spite of the relative subjectivity of this criterion, in view of the fact that they are ranked third both for their total numbers of waders (6,000 and 10,000 birds respectively) and their species richness (11 regular wintering species, represented by more than 1% of their national populations). The first site also meets criterion 3c for at least one species. At Lagune de Khnifiss, counts were sometimes partial, which leads to underestimation (e.g. the count for January 1993). Better counts show that this lagoon qualifies as a SII, at least for Ringed Plover.

Finally, it is worth noting that of the sixteen SIIs identified in Morocco for wintering Anatidae (El Agbani *et al.*



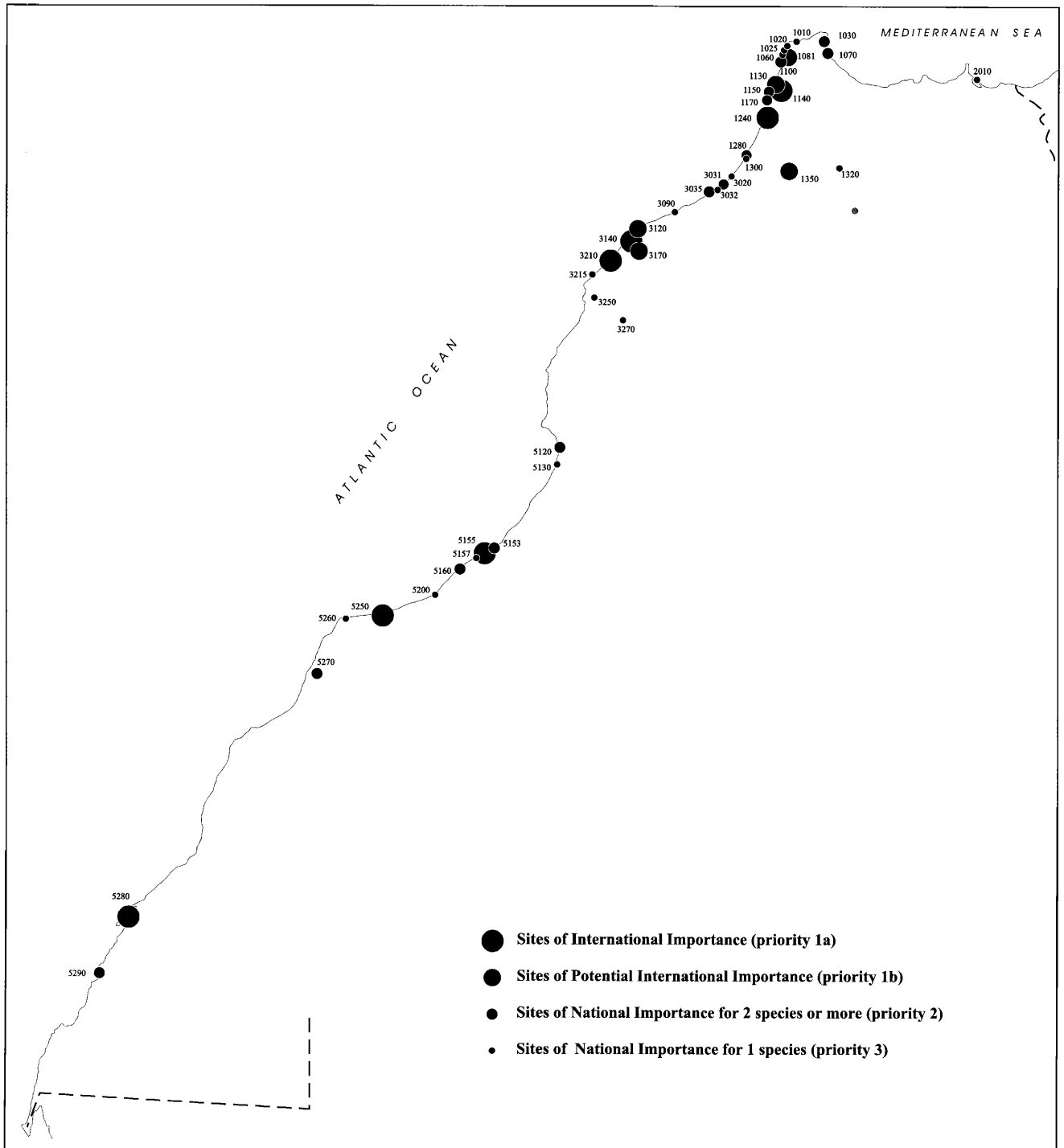


Figure 2. Relative importance of sites for waders wintering in Morocco (see Tables 1, 4, 5 & 6 for more detailed information).

1996), three are also SIIs for waders (Merja Zerga, Lagunes de Sidi Moussa-Walidia and Lagune de Khnifiss).

Sites of potential international importance

The analysis of the 1991–95 data of the IWC identified four Sites of Potential International Importance (SPII), in addition to seven others already classified as SII (Table 4). Four species (Black-tailed Godwit, Ruddy Turnstone, Kentish Plover and Ringed Plover) are responsible for these designations.

In addition, data from the 1983–90 censuses suggest that four other sites should be designated as SPIIs (Table 4). One

of them (Presquîle du Cap Blanc, located on the northern border of the Mauritanian wetland of Banc d’Arguin), not yet considered in the national network of IWC sites, could probably be added to the SII list. This site supports three wader species (Ringed Plover, Sanderling and Turnstone) that reached the 1% Ramsar level (Trotignon *et al.* 1980, Mahé 1985). The three other sites were very disturbed or not monitored during 1991–95.

The Khnifiss lagoon, considered by us as meeting Ramsar criterion 3b in full, constitutes a SPII for at least two species: Ringed Plover and Bar-tailed Godwit.

Finally, the Slender-billed Curlew, a critically endangered



Table 4. Moroccan wetlands of international importance for wintering waders: number of winters during 1991–1995 when Ramsar criteria level was reached (Bold numbers mean that the 1% level was regularly reached).

Site Codes	Site names	Ramsar Criteria => 3a					3b					3c				
		Ringed Plover <i>Charadrius hiaticula</i>	Kentish Plover <i>Charadrius alexandrinus</i>	Grey Plover <i>Pluvialis squatarola</i>	Ruddy Turnstone <i>Arenaria interpres</i>	Avocet <i>Recurvirostra avosetta</i>	Black-winged Stilt <i>Himantopus himantopus</i>	Little Stint <i>Calidris minuta</i>	Dunlin <i>Calidris alpina</i>	Sanderling <i>Calidris alba</i>	Black-tailed Godwit <i>Limosa limosa</i>	Bar-tailed Godwit <i>Limosa lapponica</i>	Red Knot <i>Calidris canutus</i>			
Sites of International Importance (SII)																
1240	Merja Zerga ¹	4	5	5	4		5	4	4	5						
5280	Baie d'Ad-Dakhla	2	2	2	1	1				2	1	1				
3210	Lagunes de Sidi Moussa-Walidia ²	*			1	1	2	4		1						
3140	Côte Al Jadida-Jorf Lasfar		2		2											
5155	Plage Blanche									1						
5250	Lagune de Khnifiss ¹	*	1							1						
1140	Marais du bas Loukkos									3						
Sites of Potential International Importance (SPII)																
3120	Baie d'Azemmour-Al Jadida		1			1										
1350	Barrage d'Al Qansera									1						
3170	Dayet Al Fahs									1						
1081	Mlalah du Bas Tahaddart			1												
Sites of Potential International Importance based on 1983–90 counts																
1130	Embouchure de l'wad Loukkos									1						
3270	Sebkha Zima									1						
3260	Sehb El Mejnoun			3												
no code	Presqu'île du Cap Blanc	*				*				*						

1. Wetlands already Ramsar sites.

2. For *R. avosetta*, the Ramsar 1% level was only approached twice

species, was regularly seen at Merja Zerga and occasionally at other sites (Table 1), although some records from the latter are probably doubtful. This species has an uncertain status in Morocco, its presence being unproved since the winter 1994–95. Therefore no site can now be considered to be of international importance for this species. Searches are regularly undertaken to verify its presence in the country.

Sites of national importance

Forty-one wetlands qualify as Sites of National Importance (SNI) (Table 5). Three more (Merja Boukka, Daya d'Al Jadida and Dayas Zarafa et Mhibess) met this criterion before 1996 but have since been partly or totally destroyed.

The majority of the SNIs are located along the Atlantic coast. On the Mediterranean margin, there are two sites – Marais de l'wad Smir and Embouchure de l'wad Martil – that

are a little distant from the East-Atlantic flyway. A third, Sebkha Bou Areg, meets the criterion for one widespread species, Redshank. Four inland sites were also selected, two of them solely for Lapwing.

At the top of the list of SNIs, based on the number of species meeting the national criterion, are the four largest Atlantic lagoon complexes, already considered as the best wintering SNI for waders (Table 5). These each have 11–12 species meeting the criterion. Twenty-two other wetlands meet the criterion for 2–8 species. The 18 remaining sites meet it only for one species.

Black-winged Stilt assigns a national importance to 17 sites. Lapwing, Grey Plover and Redshank each identify 13–14 sites, whereas Knot and Bar-tailed Godwit identify only the two Saharan bays of Khnifiss and Ad-Dakhla as nationally important.



Table 5. Moroccan wetlands of national importance for wintering waders. For each species and site, the number of winters when the site supported at least 1% of the national population is given.

Site Codes	Site names	<= Number of censuses	<= Number of species	Black-winged Stilt <i>Himantopus himantopus</i>	Redshank <i>Tringa totanus</i>	Northern Lapwing <i>Vanellus vanellus</i>	Grey Plover <i>Pluvialis squatarola</i>	Sanderling <i>Calidris alba</i>	Eurasian Oystercatcher <i>Haematopus ostralegus</i>	Ruddy Turnstone <i>Arenaria interpres</i>	Little Stint <i>Calidris minuta</i>	Black-tailed Godwit <i>Limosa limosa</i>	Eurasian Golden Plover <i>Pluvialis apricaria</i>	Kentish Plover <i>Charadrius alexandrinus</i>	Avocet <i>Recurvirostra avosetta</i>	Ringed Plover <i>Charadrius hiaticula</i>	Dumlin <i>Calidris alpina</i>	Bar-tailed Godwit <i>Limosa lapponica</i>	Red Knot <i>Calidris canutus</i>
Number of sites =>		17	14	14	14	11	10	9	9	8	8	8	7	7	4	2	2		
1240	Merja Zerga	5	12	4	5	5	5	2			4	5	4	5	5	5	5		
5280	Baie d'Ad-Dakhla	2	12		2		2	2	2	2	2	2		2		2	2	2	2
3210	Lagunes de Sidi Moussa-Walidia	5	11	5	5	1	5			4	3	3	4		5	3	4		
5250	Lagune de Khnifiss	5	11		4		4	3	5	3	3	4		4			3	4	4
3120	Baie d'Azemmour-Al Jadida	5	8			1	4	4	5	4	2		2			2			
3140	Côte Al Jadida-Jorf Lasfar	3	8		2		3	3	1	3	1			2		2			
5120	Embouchure de l'wad Souss	5	8	4	5		4	2	4		2			3		3			
1140	Marais du bas Loukkos	5	6	5	2	5	1					2	3						
1130	Embouchure de l'wad Loukkos	5	5	5	3	2	1								3				
1280	Embouchure de l'wad Sebou	3	4		1	1	2						1						
1350	Barrage d'Al Qansera	4	4			3					1	3			3				
3031	Embouchure de l'wad Yquem	4	4				1			3			2						
5290	Baie de Cintra	2	4					1	1	2							1		
1030	Marais de l'wad Smir	5	3	3	3	3													
1150	Merja des Wlad Skher	5	3	2								1							
3170	Dayet Al Fahs	5	3	4		1						2							
5270	Wad As-Saqia Al Hamra à La'youn	2	3	2	1									1					
1070	Embouchure de l'wad Martil	4	2		2											1			
1100	Merja des Wlad Khallouf	5	2											2	2				
1170	Merja Bargha	5	2	4		5													
1270	Merja Boukka*	4	2	2		2													
3035	Embouchure de l'Wad Cherrat	1	2							1			1						
3130	Daya d'Al Jadida*	2	2	1											1				
5153	Embouchure de l'wad Bou Issafène	1	2					1	1										
5155	Plage Blanche	1	2					1	1										
5160	Embouchure de l'wad Dr'a	3	2		3				3										
1010	Plan d'eau de l'wad Mlalah	4	1								1								
1020	Merja Sidi Qacem	4	1										3						
1025	Côte Sidi Qacem-Rouadi	1	1					1											
1060	Merja Hawwara	5	1				1												
1081	Mlalah du Bas Tahaddart	4	1											1					
1160	Dayas Zarafa et Mhibess*	4	1			2													
1300	Merja de Sidi Bou Ghaba	5	1			1													
1320	Plan d'eau de Dwiya	4	1			2													
2010	Sebkha Bou Areg	4	1		3														
3020	Embouchure de l'wad Bou Regreg	4	1	2															
3032	Plage de Skhirate	4	1							4									
3090	Daya de Tamaris-plage	1	1	1															
3215	Plage de Beddouza	1	1				1												
3250	Plan d'eau de Safi	3	1	1															
3270	Sebkha Zima	4	1	3															
5130	Embouchure de l'wad Massa	5	1	3															
5157	Embouchure de l'wad Awrewra	1	1					1											
5200	Embouchure de l'wad Chbeyka	5	1						2										

Sites of National importance not monitored in 1991–95

3260 Sehb El Mejnoun

1250 Merja Dawra

*Sites partly or totally lost



Table 6. Priority sites for monitoring waders in Morocco in winter.

Site Codes	Site Names	Number of censuses (1983-90)	Number of censuses (1991-95)	Average count 1983-90	Average count 1991-95	% site count / national count (1991-95)	Cumulative % (site count / national count)	Ramsar Crit. 3a (number of winters)	Ramsar Crit. 3b	Ramsar Crit. 3c (number of species)	Crit. 3c (potential cases)	Crit. Nat. Imp. (number of species)
Priority 1a (SII)												
1240	Merja Zerga	8	5	15803	66235	46.28	46.28	4		7		12
5280	Baie d'Ad-Dakhla	1	2	9382	31076	21.72	68.00	2		5	2	12
3210	Lagunes de Sidi Moussa-Walidia	8	5	3972	9961	6.96	74.96		*	1	4	11
5250	Lagune de Khnifiss	4	5	4547	6227	4.35	79.31		*		2	11
3140	Côte Al Jadida-Jorf Lasfar	1	3	325	2160	1.51	80.82			1	1	8
1140	Marais du bas Loukkos ¹	7	5	3476	2700	1.89	82.71			1		6
5155	Plage Blanche	0	1	0	3355	2.34	85.05			1		2
Priority 1b (SPII)												
3120	Baie d'Azemmour-Al Jadida	6	5	259	1937	1.35	1.35				2	8
1130	Embouchure de l'wad Loukkos	4	5	474	854	0.60	1.95				1	5
1350	Barrage d'Al Qansera	6	4	262	1438	1.00	2.96				1	4
3170	Dayet Al Fahs	6	5	627	864	0.60	3.56				1	3
1081	Mlalah du Bas Tahaddart	0	4	0	480	0.34	3.89				1	1
Priority 2 (SNI for 2 species or more)												
5120	Embouchure de l'wad Souss	8	5	207	1670	1.17	1.17					8
5290	Baie de Cintra	0	2	0	1033	0.72	1.89					4
3031	Embouchure de l'wad Yquem	0	4	0	913	0.64	2.53					4
1280	Embouchure de l'wad Sebou	4	3	279	668	0.47	2.99					4
5270	Wad As-Saqia Al Hamra à La'youn	4	2	466	602	0.42	3.41					3
1030	Marais de l'wad Smir	8	5	234	291	0.20	3.62					3
5153	Embouchure de l'wad Bou Issafène	0	1	0	867	0.61	4.22					2
5160	Embouchure de l'wad Dr'a	2	3	32	852	0.60	4.82					2
1100	Merja des Wlad Khallouf	8	5	297	828	0.58	5.40					2
1070	Embouchure de l'wad Martil	0	4	0	366	0.26	5.65					2
3035	Embouchure de l'Wad Cherrat	0	1	0	303	0.21	5.86					2
1150	Merja des Wlad Skher	2	5	206	258	0.18	6.05					2
1170	Merja Bargha	2	5	1	201	0.14	6.19					2
Priority 3 (SNI for 1 species)												
2010	Sebkha Bou Areg	6	4	389	769	0.54	0.54					1
5157	Embouchure de l'wad Awrewra	0	1	0	460	0.32	0.86					1
1025	Côte Sidi Qacem-Rouadi	0	1	0	365	0.26	1.11					1
1010	Plan d'eau de l'wad Mlalah	2	4	184	333	0.23	1.35					1
5200	Embouchure de l'wad Chbeyka	5	5	4	312	0.22	1.56					1
3032	Plage de Skhirate	0	4	0	264	0.18	1.75					1
3215	Plage de Beddouza	0	1	0	229	0.16	1.91					1
1020	Merja Sidi Qacem	2	4	55	201	0.14	2.05					1
1060	Merja Hawwara	1	5	274	175	0.12	2.17					1
5130	Embouchure de l'wad Massa	8	5	102	163	0.11	2.29					1
1320	Plans d'eau de Dwiya	8	4	322	151	0.11	2.39					1
3270	Sebkha Zima	8	4	239	150	0.10	2.50					1
5260	Port et plage de Tarfaya	1	1	864	100	0.07	2.57					1
1300	Merja de Sidi Bou Ghaba	8	5	46	89	0.06	2.63					1
3090	Daya de Tamaris-plage	2	1	0	78	0.05	2.68					1
3250	Plan d'eau de Safi	2	3	38	57	0.04	2.72					1
3020	Embouchure de l'wad Bou Regreg	1	4	55	56	0.04	2.76					1
Sites of national or international importance not monitored in 1991-95												
3260	Sehb El Mejnoun	4	0	2285	0	0.00	0.00				1	
1250	Merja Dawra	4	0	767	0	0.00	0.00				1	
Sites of national importance wholly or partly lost												
1270	Merja Boukka	3	4	1440	727	0.51	0.51					2
3130	Daya d'Al Jadida	4	2	3	141	0.10	0.61					2
1160	Dayas Zarafa et Mhibess	1	4	412	40	0.03	0.64					1



KEY-SITES FOR THE WINTER MONITORING OF WADERS

Forty-four wetlands identified as being of international and/or national importance constitute the national site network for the winter census of waders (Table 6). They are classified into three priority levels:

- **1st priority:** Sites of International Importance with two sub-levels, the first (1a) being Sites of International Importance and the second (1b) being Sites of Potential International Importance;
- **2nd priority:** Sites of National Importance for at least two species;
- **3rd priority:** Sites of National Importance for a single species.

A complete survey of this site network covers about 98% of the waders wintering in Morocco. The twelve sites of 1st priority support, on average, 89.0%, whereas those of 2nd priority support 6.2%. We consider that the 25 sites of priorities 1 and 2 could constitute the national network of *key-sites* for the international mid-winter census of waders. Occasionally (in wet winters), it will be necessary to add to this network the temporary sites of Sehb El Mejnoun and Merja Dawra.

Counts in the 16 sites of 3rd priority cover only 2.7% of the population, though they are useful for data on the nine species responsible for the national importance of these sites. Each of these species uses only 1–2 sites in this category. However, Black-winged Stilt reaches the 1% level of its national population at five sites of 3rd priority. Therefore the omission of such sites would lead to an underestimation of the national population of that species. However, some of these sites are of first priority for groups of birds other than waders so they will be covered anyway.

It is likely that this order of priority will vary from year to year, depending on autumn–winter rain. The flooding of some temporary wetlands, for example, is not regular, whereas an excess of water may be unfavourable to small waders in several estuarine sites.

In summary, an exhaustive census of waders in all the priority sites will require the counting of (1) the whole Atlantic margin of the country, (2) the Mediterranean coast between the cities of Tangier and Tétouan and nearby Nador, and (3) the two inland regions of Khémisset-Fès and Chema'ia-Sraghna.

Finally, the wetlands lost before 1991 or which were more important for waders before 1991–95, should not be completely neglected, particularly during rainy winters.

DISCUSSION

The censuses carried out during 1991–95 are considered to be the most reliable ever undertaken in Morocco. This was achieved mainly through the standardisation of counting techniques and almost total coverage of all important wader wintering sites.

Although it is likely that numbers were slightly underestimated during 1991–95, the size of this error will be negligible compared with the range of variation in numbers from year to year. It is therefore recommended that these results be utilised directly in any estimate of the biogeographic populations.

This study has confirmed the major importance of Morocco, especially of its Atlantic coast wetlands, for wintering waders. For twelve species, the country supports more than 1% of the relevant biogeographic populations and, for seven species, more than 4%. Three of these – Avocet, Ringed Plover and Kentish Plover – are represented by 8%, 14% and 30% respectively of their total number. The exceptionally high count of Kentish Plovers may be related to the fact that the Moroccan breeding population appears to be increasing.

The value of Morocco for waders is principally due to several estuarine and coastal wetlands the importance of which in the East-Atlantic flyway has now been established.

The assessment of wintering sites identified at least seven wetlands that meet one or more of the Ramsar criteria. Two of these are already listed under this convention, and the other five were recently proposed as protected areas (A.E.F.C.S. 1996). On the other hand, this assessment led to the selection of a relatively high number of priority sites for future monitoring under the International Waterfowl Census. However, the fact that 95% of the waders are usually concentrated in 25 wetlands allows consideration of these as key-sites for the winter monitoring of waders. Therefore, with these covered thoroughly, the main species will be adequately monitored without the necessity for an exhaustive census.

An aim of future monitoring is to improve the quality of the counts at the national level. One particular reason for this is to accumulate sufficient data to establish adequate management plans for wetlands in the national network of protected areas.

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