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Recurrence of Palaearctic birds in the lower Senegal river valley

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Summary

From 1984 to 1993, numerous teams of European ringers carried out ringing studies in the Senegalese section of the lower Senegal river valley, mainly at the Parc National des Oiseaux du Djoudj. A total of 82468 birds was ringed and 1460 birds of 31 Palaearctic species were recaptured in the same general area ("recurrence") during at least one subsequent winter or passage period; 103 were retrapped in 3–5 different winters. Recurrence for seven species had not been proved in Africa before, and for 22 additional species, not in Senegal.

Résumé

De 1984 à 1993, de nombreuses équipes de bagueurs européens se sont succédées dans la partie sénégalaise de la basse vallée du fleuve Sénégal et plus principalement dans le Parc National des Oiseaux du Djoudj. La fidélité des oiseaux paléarctiques à leur zone d'hivernage ou de transit a été constatée pour 31 espèces dont sept nouvelles pour l'Afrique et 22 pour le Sénégal. Au total, 82468 oiseaux ont été bagués et ce phénomène a concerné 1460 d'entre eux dont 103 capturés de 3–5 hivers différents. Si le nombre de personnes intéressées est suffisant, une version française sera disponible au prix coûtant auprès d'A. Sauvage.

Introduction

It is well known that individuals of many Palaearctic migrants breed at the same location year after year; some also return to the same wintering grounds. In this paper, recurrence means that a bird was retrapped in the same area (although not necessarily

the exact site) in subsequent years. If a bird was retrapped at the exact same site, we refer to this as winter site fidelity: the latter is shown for several species with a sample of retraps from 1987–1991, for which we know where the birds were exactly ringed and retrapped (winter site fidelity is probably much more common than revealed by our data).

Recurrence was first discovered for several Palaearctic waders ringed in South Africa (Middlemiss 1961, 1962). Rowan (1964) also found that some Palaearctic passerines returned to their wintering sites in South Africa during subsequent years. Recurrence has since been recorded for some 52 species at their wintering areas in Africa (Tree 1965, 1966a, 1996b, Moreau 1972, Curry-Lindahl 1981, Jarry & Roux 1982, Yésou *et al.* 1995), and at transit areas in the Sahara (Moreau 1972). This faithfulness has also been shown on transit sites in Europe (Vansteenwegen 1978, OAG Münster 1984). Some Palaearctic migrants are also known to be faithful to their European wintering sites (Herrera & Rodriguez 1979, Finlayson 1980, Scebba & Lövei 1985, OAG Münster 1989, Eybert *et al.* 1989, Olioso 1993). Similarly some North American migrants regularly use the same wintering sites in Neotropical regions (Johnson *et al.* 1981, Blake & Loiselle 1992).

Prior to this study, a long term ringing programme had been carried out in Senegal from 1957 to 1977 by French researchers. Most of their ringing occurred at Djoudj and further inland at Richard-Toll (16°25'N, 15°42'W). Individuals of 11 of the 74 species that were caught at the two locations were recaptured during subsequent winters at the same site (Jarry & Roux 1982).

In this paper we present data on the recurrence of 31 Palaearctic species in the Senegal river delta from 1985 to 1993. We also compare our results with studies from other areas where the same phenomenon occurred. We have not included data on the recurrence of Collared Pratincole *Glareola pratincola* (a Spanish bird was controlled in Senegal in Mar 1969: Jarry & Larigauderie 1974) or Hoopoe *Upupa epops* as resident and Palaearctic migrant races could not be reliably separated.

Study sites

Parc National des Oiseaux du Djoudj, 16°10'N, 16°18'W, is *c.* 30 km from the coast and bordered by the Senegal River to the north. It comprises 16000 ha of seasonally flooded waterways. There are large areas of open water, reed-beds *Phragmites* and *Typha* spp., low sedge-beds *Carex* spp., Tamarisk *Tamarix senegalensis* scrub and smaller areas of trees of *Acacia nilotica* and *Prosopis juliflora*, *Salvadora Salvadoria persica* scrub and sandy plains interspersed with *Salicornia Salsola bariosma*. Numerous ringing sites were used at PNOD (Fig. 1: for years used see Appendix 1). Ringing occurred at Poste de Gainthe each winter from 1987 and more or less regularly at other sites.

Réserve de Faune de Guembeul, $15^{\circ}56'N$, $16^{\circ}28'W$ is 720 ha of shallow saline pools south of St Louis, c. 2 km from the coast.

Ross-Béthio, $16^{\circ}16'N$, $16^{\circ}08'W$, c. 8 km south-east of the PNOD boundary. Ringing occurred in two areas of shallow water close to rice-fields north of the town.

Other ringing sites included: the inundation zone of R. Djeuss near Tamach ($16^{\circ}07'N$, $16^{\circ}22'W$), reed-beds on the same river east of Ndigue ($16^{\circ}19'N$, $16^{\circ}20'W$), and rice-fields near Ndiongo ($16^{\circ}12'N$, $16^{\circ}14'W$). Ringing sites in the lower Senegal river valley are shown on Fig. 2.

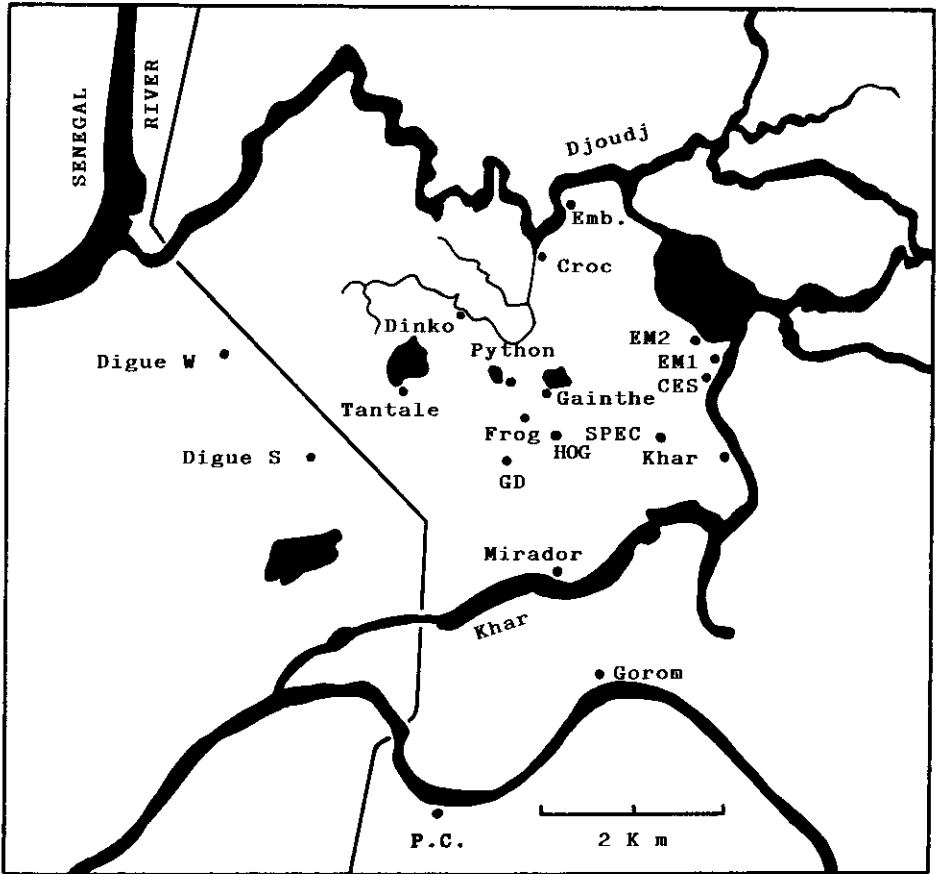


Figure 1. Ringing sites around Poste de Gainthe in Parc National des Oiseaux du Djoudj.

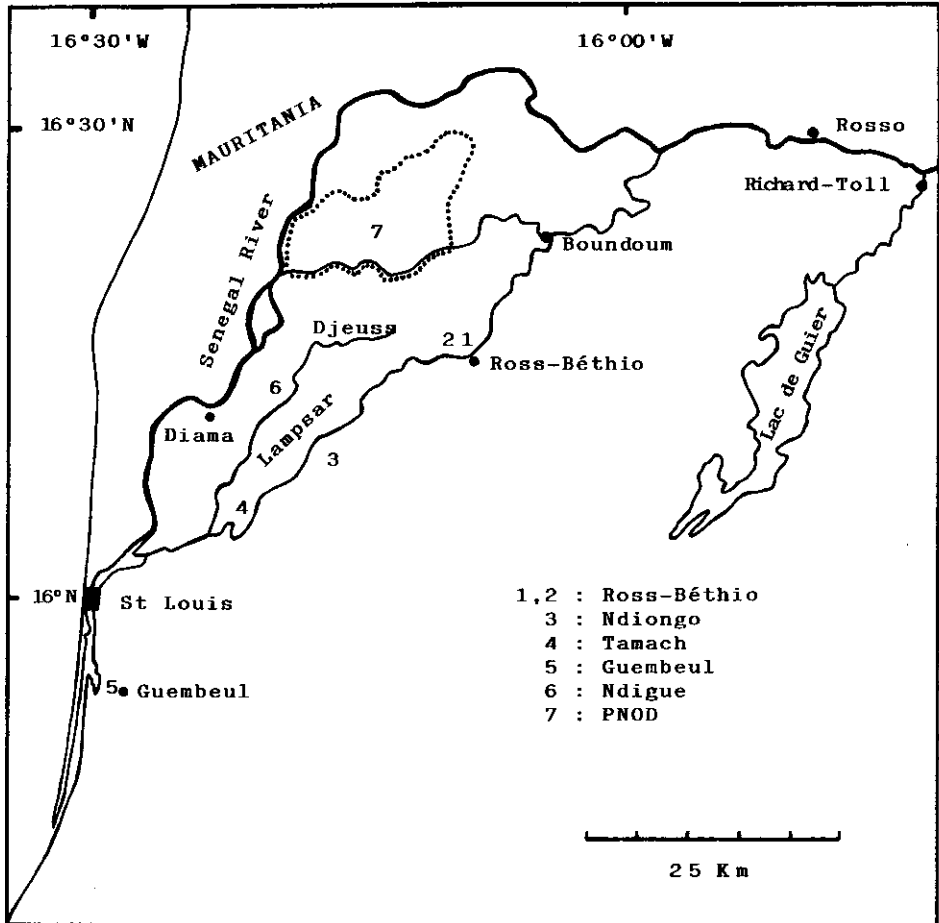


Figure 2. Ringing sites in the lower Senegal river valley.

Methods

The following abbreviations for participating organisations are used in this paper:

AVES: Société d'Etudes Ornithologiques a.s.b.l., Brussels;

CEEP: Conservatoire, Etude des Ecosystèmes de Provence;

CRBPO: Centre de Recherches sur la Biologie des Populations d'Oiseaux;

FIR: Fonds d'Intervention pour les Rapaces;

LPO: Ligue française pour la Protection des Oiseaux;

OAG: OAG Münster (Biologische Station Rieselfelder Münster, Germany);
 ORSTOM: Institut français de recherche scientifique pour le développement en coopération.

Information was collected over eight winters by various expedition groups carrying out ringing studies in the region. After a preliminary visit in 1984, researchers from OAG visited the area three times (1985, 1987–8) to dye-mark Ruff *Philomachus pugnax*. In 1987–8 the main objective of Dutch scientists (Rijksinstituut voor Natuurbeheer) was to dye-mark Black-tailed Godwits *Limosa limosa*; they were joined by French ringers (CRBPO-LPO-FIR). Other Palaearctic waders and passerines were also ringed at several sites in the lower Senegal river valley. Small teams of French ringers came to Parc National des Oiseaux du Djoudj (PNOD) on two consecutive winters in 1989–90 to ring mainly passerines; several British ringers were also present in 1990. The period of ringing by the groups above varied from one to three months duration. From 1990 to 1993, over 500 participants from 25 countries under the auspices of the International Ornithological Expeditions carried out a large scale ringing programme at Djoudj during three consecutive winters. The locations and numbers of birds ringed by the different groups are given in Appendix 1.

Birds were caught with mist-nets. Passerines were netted in areas of reed and sedge, wet and dry tamarisk scrub, salvadora scrub and in belts of acacia trees; waders were caught in and around shallow pools and in harvested rice-fields. Some of the ringing sites were re-used in subsequent years although not all of the nets were placed in the same positions. A flexible approach was used to maximize catch rates. French (CRBPO) rings were applied and location, date, time, species, sex, age and biometrics were noted.

For some species, the data are few and they are simply summarized. For others, the data are numerous and in order to maximize the amount of information presented, the results are tabulated as in the following example:

Sylvia cantillans Subalpine Warbler (1997, 137, 6.8%).

Year retrapped:		87–8	Mar 89	Jan–Apr 90–1	91–2	92–3	% retrapped	
Retraps from	n ringed			90				
Jan–Feb 87	30	1		1	1(1)		3.3	
87–8	112		1(1)	2(2)	3(2)	2(2)	6.2	
Mar 89	56			3(3)	1(1)	2(2)	8.9	
Jan–Apr 90	177				5(4)	3(1)	3(3)	4.5
90–1	399					33(30)	10(10)	10.0
91–2	1223						75(75)	6.1
92–3	1263							-
% retraps		0.9	1.7	3.3	2.4	3.2	6.5	

Retraps after: 1 year 118/1997 (5.9%); 2 years 16/774 (2.1%); 3 years 9/375 (2.4%); 4 years 3/198 (1.5%); 5 years 1/142 (0.7%). Birds caught in 3 different winters, 6; 4 different winters, 1; 5 different winters, 1.

The numbers in brackets after the name of the species (1997: 137, 6.8%) are the total number of ringed birds able to provide retraps (birds ringed in the last winter 1992–3 are not included), the number of different individuals which were retrapped, and the percentage retrapped.

In the main part of the table, the figures in parentheses indicate the number of individuals which were retrapped for the last time in that year, *e.g.* in 1990–1, three birds from 1987–8 were retrapped, of which two were caught for the last time in that year and one was caught again the following year. Among the 30 birds ringed in 1987, the same bird was retrapped in 1987–8, 1990, 1990–1 and 1991–2. The right hand column shows the % retrapped: 1 individual of 30 represents 3.3%.

The bottom row of the table gives the yearly percentages of retraps compared to the number of birds caught that year: in Jan–Apr 1990, 6 birds were retrapped and 177 others ringed (total 183) and the 6 retraps represent 3.3% of these 183 birds.

After each table, the percentages of birds retrapped after one, two, three and up to five years are also given; the data are number of retraps, number of ringed birds able to provide these retraps, and %: *e.g.* in 1992–3 only birds ringed in 1987 and 1987–8 (total of 142) may give retraps after five or more years. Details for birds caught in three, four or five different winters are also given.

Results

Ardeidae

Ixobrychus minutus Little Bittern (69: 5, 7%). Birds ringed: 1987, 1; 1987–8, 5; 1990–1, 21; 1991–2, 42; 1992–3, 23. All retraps of *I. m. minutus* were ringed the previous year: one (5%) retrapped 1991–2 and four (10%) in 1992–3. The latter high rate suggests that recurrence may be common. This is the first record of recurrence for this species. In 1992–3, the four retraps represent 15% of the 27 birds caught.

Charadriidae

Charadrius dubius Little Ringed Plover (186: 13, 7.0%). Birds ringed: 1987–8, 6; 1989, 1; 1990, 2; 1990–1, 94; 1991–2, 83; 1992–3, 140. The single bird ringed 1989 retrapped 1990–1; of the 94 birds ringed 1990–1, four retrapped 1991–2 and 6 (including 2 already retrapped previous year) in 1992–3 (11%); four ringed 1991–2 (5%), retrapped 1992–3. Retraps after one year 8/186 (4.3%); two years 7/103 (6.8%). Two birds caught in three different winters.

Charadrius hiaticula Ringed Plover (213: 4, 1.9%). Birds ringed: 1985, 4; 1987, 2; 1987–8, 38; 1990, 6; 1990–1, 80; 1991–2, 83; 1992–3, 109. Out of 80 birds ringed in 1990–1, two retrapped 1991–2 and another in 1992–3 (4%); one bird ringed 1991–2 (1.2%), retrapped 1992–3. Retraps after one year 3/213 (1.4%); two years 1/130 (0.8%). The percentage retraps was lower than in Kenya (Moreau 1972). The time spent ringing most waders was highly variable. Of the 38 ringed 1987–8, 32 were caught at Guembeul, a site that was never used again.

Scolopacidae

Calidris minuta Little Stint (1763: 26, 1.5%). Birds ringed: 1985, 40; 1987, 8; 1987–8, 238; 1989, 1; 1990, 70; 1990–1, 531; 1991–2, 875; 1992–3, 511. Two birds caught in 1990 were retrapped, one in 1990–1 and one in 1991–2 (3%); 11 birds ringed in 1990–1 were retrapped in 1991–2 and one in 1992–3 (2%); 12 birds ringed 1991–2 retrapped 1992–3 (1.4%). Retraps after one year 24/1763 (1.4%); two years 2/888 (0.2%). In 1985 and 1987 the Little Stints were mainly ringed at Ross-Béthio, and in 1987–8, 173 birds were ringed at Guembeul. In PNOD this species is very common and widespread around the “marigots” (stretches of water with mud-flats), which fluctuate in size and location every year. This might explain the low rate of recurrence. The percentage retraps is similar to that at Lake Nakuru (1.5%), a similar site in Kenya (“muddy shores with drying bordering pools”) from 1966–75 (Pearson 1987). The results from Magadi, another site in Kenya, with less variable water levels, gave higher recurrence (2.5%: this may include multiple retraps) (Pearson 1987), with birds retrapped after six, seven or even eight seasons.

Calidris ferruginea Curlew Sandpiper (336: 1, 0.30%). Birds ringed: 1985, 3; 1987–8, 102; 1990, 1; 1990–1, 142; 1991–2, 88; 1992–3, 41. Of the 102 birds ringed 1987–8, 89 were ringed at Guembeul. The recurrence rate was low, and surprisingly, the only retrap occurred in 1991–2 from the single bird ringed in 1990.

Philomachus pugnax Ruff (2144: 2, 0.09%). Birds ringed: 1985, 702; 1987, 1083; 1987–8, 192; 1990, 17; 1990–1, 88; 1991–2, 62; 1992–3, 47. Two birds were retrapped, both ringed 1985, retrapped 1987. Also, one bird ringed at Djeuss (16°05'N, 16°24'W) in Feb 1984 by P. Dugan (of 572 Ruffs ringed 1984 in Senegal: Jarry 1987) was retrapped at Ross-Béthio one year later. Two ringed at Ross-Béthio by P. Dugan (Feb and Mar 1984) were retrapped the following winter, one at the same site, another at Tamach; one dye-marked at Ross-Béthio 1987–8, was seen Dec 1988 at Maka (16°11'N, 16°23'W). Recurrence rate low, but apart from 1985–8, little effort was made to ring this species. Moreover, in 1985 and 1987, Ruffs were caught on roosts, mainly around Ross-Béthio on an area where thousands congregated; c. 80000 Ruffs were counted in Senegal Delta in 1987 (OAG Münster 1989). These roosts were very changeable and the probability of retrapping birds was very low; they were scarcely used as ringing sites in subsequent years. The recurrence rates found in Kenya (Moreau 1972) are higher, varying from 0.6% to 2.8% from 1966–9. If some Ruffs recur, others change their wintering area from one winter to another. Three ringed in Senegal were retrapped in Mali in subsequent winters: one ringed at Richard-Toll in Mar 1970, controlled (14°10'N, 4°20'W) in Feb 1971 (Jarry & Roux 1982); another ringed in Feb 1984, found dead (13°58'N, 5°30'W) in Mar 1985 (Jarry 1988); one ringed at Ross-Béthio in Feb 1985, found (14°55'N, 4°20'W) in Dec 1986 (Tréca 1993). Interestingly, c. 30% of adult colour-ringed Ruffs were faithful to their late summer transit site at Münster (OAG Münster 1984).

Lymnocyptes minimus Jack Snipe (47: 1, 2%). Birds ringed: 1987, 20; 1987–8, 3; 1990–1, 12; 1991–2, 12; 1992–3, 3. One bird ringed 1990–1, retrapped 1991–2 (8%).

First record of recurrence for this species. It was (locally?) rather numerous in 1987 with 12 birds caught on 1 Feb at Gainthe.

Gallinago gallinago Common Snipe (118: 2, 1.7%). Birds ringed: 1985, 2; 1987, 20; 1987–8, 11; 1990, 3; 1990–1, 33; 1991–2, 49; 1992–3, 13. The only one caught in Mar 1989 was ringed in Jan 1988 (9%); one ringed 1990–1, retrapped 1991–2 (3%). The low recurrence rate is not surprising as there are numerous favourable sites for this species at PNOD.

Tringa stagnatilis Marsh Sandpiper (166: 3, 1.8%). Birds ringed: 1985, 24; 1987, 11; 1987–8, 6; 1990, 3; 1990–1, 41; 1991–2, 81; 1992–3, 35. One ringed 1990–1, retrapped 1991–2 (2%); two ringed 1991–2, retrapped 1992–3 (2%). The birds ringed in 1985 and 1987 were caught at Ross-Béthio. These results are similar to a rate of 1.9% from Kenya (Moreau 1972).

T. ochropus Green Sandpiper (47: 4, 8.5%). Birds ringed: 1987–8, 1; 1990, 1; 1990–1, 14; 1991–2, 31; 1992–3, 7. Of the 14 ringed in 1990–1, one retrapped following year and another one year later (14%); two ringed 1990–1, retrapped 1992–3 (6%). Retraps after: one year 3/47 (6%); two years 1/16 (6%). OAG Münster (1989) found that 56% of colour-ringed birds winter at the same sewage farms in Münster during subsequent years. Our rather high rate of recurrence compared to other waders supports this fidelity. The three retraps from 1992–3 represent 30% of the birds caught that winter.

T. glareola Wood Sandpiper (457: 14, 4.1%). Birds ringed: 1985, 3; 1987, 24; 1987–8, 33; 1990, 12; 1990–1, 130; 1991–2, 255; 1992–3, 113. One bird ringed 1987–8, retrapped 1992–3 (3%); of 12 ringed 1990, one retrapped 1991–2 and one 1992–3 (17%); of birds ringed 1990–1, four retrapped 1991–2 and three 1992–3 (5.4%); four ringed 1991–2 retrapped 1992–3 (1.6%). Retraps after: one year 8/457 (1.7%); two years 4/202 (2%); three years 1/72 (1.4%); five years 1/60 (1.7%). Sedentary in winter, with four retrapped 34–52 days after ringing, four after 64–83 days, one after 97 days, one after 118 days (1 Dec 1991 to 28 Mar 1992) and one after 160 days (7 Nov 1991 to 14 Apr 1992).

Actitis hypoleucos Common Sandpiper (65: 9, 14%). Birds ringed: 1987–8, 2; 1989, 1; 1990, 6; 1990–1, 18; 1991–2, 38; 1992–3, 66. Of birds ringed 1990, three retrapped 1990–1, and one of these again in 1991–2 (67%); of birds ringed 1990–1, three retrapped 1991–2 (24%); three ringed 1991–2, retrapped 1992–3 (8%). Retraps after: one year 9/65 (14%); two years 1/27 (4%). One bird caught in three different winters. Highest recurrence rate of any wader, even excluding multiple retraps. Fidelity to transit areas has been shown in Belgium (36 birds retrapped on the ringing site 1–3 years later during 1962–75: Vansteenwegen 1978) and Zambia (two ringed Aug–Sep 1964, retrapped 1965: Tree 1966b).

Otididae

Otus scops Scops Owl (6: 1, 17%). Birds ringed: 1991–2, 6; 1992–3, 8. All birds caught belonged to the Palearctic *O. s. scops*. Up to five were regularly seen in the same row of trees at Poste de Commandement during several different winters.

Picidae

Jynx torquilla Wryneck (43: 1, 2%). Birds ringed: 1987, 3; 1987–8, 4; 1989, 1; 1990, 3; 1990–1, 13; 1991–2, 19; 1992–3, 14. Three ringed in 1987 provided one retrap (33%) but none of the 40 ringed later was retrapped. Winter site fidelity: same bird caught three different winters, on same site (also retrapped 400 m away during second winter), retrapped after one and three years (67%). Recurrence has also been shown for this species in its Mediterranean wintering area (Scebba & Lövei 1985).

Hirundinidae

Riparia riparia Sand Martin (15081: 54, 0.36%). Birds ringed: 1987–8, 76; 1990, 527; 1990–1, 10102; 1991–2, 4376; 1992–3, 3494. One ringed 1987–8, retrapped 1990–1 (1%); of birds ringed 1990, five retrapped 1990–1, three 1991–2, one 1992–3, (1.7%); of 10102 birds ringed 1990–1, 18 retraps 1991–2 and 13 in 1992–3 (0.3%); 13 birds ringed 1991–2 retrapped 1992–3 (0.3%). Retraps after one year 36/15081 (0.2%); two years 16/10705 (0.1%); three years 2/603 (0.3%). From 1957–77, the 1743 ringed at Richard-Toll (Jarry & Roux 1982) provided only one recurrence (0.06%). Up to two million birds probably winter in and around PNOD (Rodwell *et al.* 1996). The birds were mainly ringed at roost sites, which are very numerous and changeable: *e.g.* in Feb 1991, several birds ringed earlier that winter at PNOD were retrapped on the river Djeuss, about 20 km south.

Motacillidae

Motacilla flava Yellow Wagtail (2758: 65, 2.36%).

		Year retrapped: 87–8 Mar 89 Jan–Apr 90–1 91–2 92–3					% retrapped
Retraps from	n ringed						
Jan–Feb 87	3						0
87–8	25	3(2)	1	1(1)			12
Mar 89	7						0
Jan–Apr 90	114			1(1)	1	1(1)	2
90–1	380				17(11)	11(11)	5.8
91–2	2229					38(38)	1.7
92–3	6694						-
% retraps		0	30	1	0.5	0.8	0.7

Retraps after: one year 59/2758 (2.1%); two years 13/529 (2.4%); three years 2/149 (1.3%). Seven birds caught in three different winters, one in four. In 1987–8, the 25 birds ringed at or around the Poste de Gainthe (a daytime feeding area) provide a rather high rate of retrap (there or nearby); the one caught four winters in succession was three times on the same site, the fourth time 400 m away). Roosts found in 1990 were used for ringing mainly from 1991–2, when the number of birds ringed increased but percentage recurrence decreased, probably because Yellow Wagtails may use several different roosts (Moreau 1972). These rates are similar to those found in Nigeria (4.5% at Kano, 1.6% at Vom: Elgood 1982), where one bird was retrapped for seven seasons (Moreau 1972).

Motacilla alba White Wagtail (97: 10, 10%).

		Year retrapped: 87-8 Mar 89 Jan-Apr 90-1 91-2 92-3					% retrapped
Retraps from	n ringed	90					
Jan-Feb 87	1						0
87-8	6		1	1(1)			17
Mar 89	4		1	2(1)	1	1(1)	50
Jan-Apr 90	4						0
90-1	19				2(1)	1(1)	10
91-2	63					5(5)	8
92-3	167						
% retraps		0	0	33	14	4.5	4

Retraps after: one year 8/97 (8%); two years 4/34 (12%); three years 2/15 (13%); four years 1/11 (9%). The percentage is high, even after 4 years. Three birds caught in three different winters; one in four. The high retrap rate is partly due to anthropophily: birds were caught around the camp site at Gainthe. Out of four ringed Mar 1989, two recurred in subsequent years at exactly the same site (Gainthe): one wintered there during four different winters and one during three winters. Another, ringed Nov 1987 was retrapped on the same site in Jan 1990 and Mar 1991. Nevertheless, the following winter, the four ringed never provided any retrap. These birds probably breed in Iceland (Jarry & Roux 1982).

Anthus trivialis Tree Pipit (23: 1, 4.35%). Birds ringed: 1987, 1; 1987-8, 1; 1989, 1; 1990-1, 13; 1991-2, 7; 1992-3, 48. Not very numerous in Senegal Delta: most winter further south (Morel & Morel 1990, Rodwell *et al.* 1996, Sauvage & Rodwell in prep.). Only retrap: one ringed 9 Feb 1991, retrapped 30 Jan and 2 Feb 1993 (8%).

Laniidae

Lanius senator Woodchat Shrike (64: 4, 6.25%). Birds ringed: 1987, 1; 1987-8, 4; 1989, 1; 1990, 5; 1990-1, 26; 1991-2, 27; 1992-3, 51. One ringed 1989, retrapped 1992-3 (100%); two ringed 1990-1, retrapped 1991-2 (8%); one ringed 1991-2, retrapped 1992-3 (4%). Common in low densities around PNOD; all examined were *L. s. senator* (Rodwell *et al.* 1996).

Turdidae

Luscinia svecica Bluethroat (316: 22, 7.0%).

		Year retrapped: 87-8 Mar 89 Jan-Apr 90-1 91-2 92-3					% retrapped
Retraps from	n ringed	90					
Jan-Feb 87	2						0
87-8	27		1(1)	1(1)	1(1)		11
Mar 89	8		2(2)				25
Jan-Apr 90	46						0
90-1	110				8(5)	4(4)	8
91-2	123					8(8)	7
92-3	190						-
% retraps		0	0	6	0.9	6.8	5.9

Retraps after 1 year 18/316 (5.7%); 2 years 6/193 (3.1%); 3 years 1/83 (1.2%); 4 years 1/37 (3%). Three birds caught in three different winters. Winter site fidelity: three birds were retrapped on their same site and one 850 m away. In S France (Oliosio 1993) 12% of the Bluethroats recurred on a site where some birds winter but which is mainly a transit area. In Portugal, Eybert *et al.* (1989) have shown territoriality of the wintering birds connected with 16% fidelity to the wintering site.

Sylviidae

Locustella luscinioides Savi's Warbler (238: 8, 3.4%). Birds ringed: 1987, 1; 1987–8, 6; 1989, 11; 1990, 11; 1990–1, 92; 1991–2, 117; 1992–3, 143. All retraps occurred one year after ringing: four ringed 1990–1, retrapped 1991–2 (4%); four ringed 1991–2, retrapped 1992–3 (3%). This species is not easy to catch without tape luring and all retraps occurred with this method.

L. naevia Grasshopper Warbler (138: 1, 0.7%). Birds ringed: 1987, 6; 1987–8, 5; 1989, 1; 1990, 13; 1990–1, 52; 1991–2, 61; 1992–3, 172. First report of recurrence for this species, with one ringed on 1 Jan 91 retrapped on 27 Jan and 4 Feb 1991 and 27 Jan 92 (2%). Eight wintering birds were caught four or five times during the same winter, all with the following features: first caught 17 Dec to 20 Jan, duration in PNOD 31–95 days (max. one bird caught five times between 17 Dec and 22 Mar).

Acrocephalus schoenobaenus Sedge Warbler (4485: 166, 3.7%).

	Year retrapped:	87–8	Mar 89	Jan–Apr 90	90–1	91–2	92–3	% retrapped
Retraps from	n ringed			90				
Jan–Feb 87	38				1(1)			3
87–8	180		3(3)	3(1)	3(2)	1(1)	1(1)	4.4
Mar 89	35				2(2)			6
Jan–Apr 90	194				4(3)	3(3)	4(4)	5.1
90–1	1369					62(53)	26(26)	5.8
91–2	2666						66(66)	2.5
92–3	1360							-
% retraps		0	7.9	1.5	0.7	2.4	6.7	

Retraps after 1 year 135/4485 (3.01%); 2 years 34/1816 (1.87%); 3 years 7/447 (1.56%); 4 years 2/253 (0.79%); 5 years 1/218 (0.46%). Thirteen birds caught in three different winters. Winter site fidelity: of 12 birds, seven were always retrapped on the same site (including two spending three different winters in PNOD) and five within a maximum radius of 1.7 km. The 294 birds ringed in Senegal from 1957–77 did not provide any retraps. One ringed in Mar 1979 in Mali was retrapped on the same site in Apr 1982 (Jarry 1986). Recurrence in Nigeria and Uganda (Moreau 1972) was higher, respectively 4.5% and 8.5%. Our rather low rate of retrap was probably caused by nomadism within their wintering area, with the birds following the reed-beds and the tamarisk scrub along the shores of the drying pools.

Acrocephalus scirpaceus Reed Warbler (8583: 449, 5.23%).

Year retrapped: 87-8		Mar 89	Jan-Apr 90-1	91-2	92-3	% retrapped	
Retraps from	n	90					
ringed							
Jan-Feb 87	2					0	
87-8	50	1(1)	1	1(1)		4	
Mar 89	656		47(39)	24(21)	8(7)	5(5)	11.0
Jan-Apr 90	1060			37(31)	19(18)	24(24)	6.9
90-1	2253				98(84)	65(65)	6.6
91-2	4562					153(153)	3.3
92-3	4741						-
% retraps		0	0.1	4.3	2.6	2.7	4.9

Retraps after 1 year 336/8583 (3.91%); 2 years 109/4021 (2.71%); 3 years 32/1768 (1.81%); 4 years 6/708 (0.85%). 34 birds caught in three different winters. The rate of retrap became high (11%), four winters after a year with numerous birds ringed (Mar 1989). The numbers of Reed Warblers caught increased daily in mid-February, catches being more than twice the daily maximum of January 1991, 1992 and 1993. This happened when the first birds from the main part of the W European population, which winters from Sierra Leone to Cameroon (Cramp 1992) were reaching PNOD on their way back to their breeding grounds. In order to assess whether the retrapped birds were wintering in or migrating through PNOD, we assume that birds were definitely wintering when they were both ringed and retrapped before 10 Feb in different winters, and that they were probably wintering if they were caught before 10 Feb during one winter and later on another winter. On these criteria, of 415 birds retrapped in two winters, 47 (11%) were definitely wintering and 74 (18%) probably wintering (a total of 29%). Of 34 birds retrapped in three winters, three (9%) were definitely wintering and 9 (26%) probably wintering (total 35%). Birds caught later in February might also have been wintering, whereas those trapped in March and April (when the number of caught birds increased a lot) were probably mainly passage migrants (although some wintering birds were retrapped up to six times between Dec and Apr). Of the 415 birds retrapped in two winters and the 34 retrapped in three winters, 252 (61%) and 13 (38%) respectively were only caught after 20 Feb. Although, in early winter, the water level was often too high to allow us to net in the reed-beds, which might partly explain why most birds were ringed after mid-February, this is nevertheless the only species for which recurrence concerns (in such a large proportion) not only wintering but also (perhaps mainly) passage migrants. Transit site fidelity of birds ringed and retrapped in Mar-Apr ($n = 79$) is illustrated by the 41 retrapped on the same site, 30 retrapped on two sites only 650 m apart in the same reed-bed, and only eight retrapped on different sites.

A. arundinaceus Great Reed Warbler (69: 4, 6.80%). Birds ringed: 1987, 1; 1987-8, 3; 1990, 2; 1990-1, 13; 1991-2, 50; 1992-3, 10. One ringed 1990-1, retrapped 1991-2 (8%). Three ringed 1991-2 retrapped 1992-3 (6%) which represents 23.1%

of the birds caught that winter. The birds were caught in the reed-beds and our rate of recurrence was lower than previously described for Zaire (five retraps of 13 birds) and Uganda (three of 12) (Moreau 1972), but similar to rates in Zambia (six retraps of 72 ringed: Tree 1965, 1966a, 1966b) and Gabon (one caught three successive winters, of 16 ringed: Brosset & Erard 1986).

Hippolais pallida Olivaceous Warbler (302: 36, 11.9%).

Year retrapped:		87-8	Mar 89	Jan-Apr 90-1	91-2	92-3	% retrapped
Retraps from	n ringed	90					
Jan-Feb 87	5	1(1)					20
87-8	19		1(1)	1	2(2)		16
Mar 89	5			1(1)	1(1)		40
Jan-Apr 90	20			1(1)		1(1)	10
90-1	50				10(4)	7(7)	22
91-2	203					17(17)	8.4
92-3	91						-
% retraps		5	14	5	6	6.0	22

Retraps after 1 year 31/3021(0.26%); 2 years 8/95 (8%); 3 years 3/49 (6%); 4 years 2/29 (7%). Eight birds caught in three different winters. Winter site fidelity: in 1987-91, the six retraps occurred at the same ringing site. Out of 159 ringed at Richard-Toll from 1957-77, three recurred (1.9%) (Jarry & Roux 1982). We found a higher rate, almost 12% (more than 14.5% with multiple retraps); the rate was still high ($\geq 6\%$) after 3 and 4 years. The birds were caught mainly around the marsh of Poste de Gainthe, an area with *Acacia nilotica* and *Tamarix senegalensis* to which they were very faithful. From 28 Mar to 6 Apr 1994, seven were ringed and three retrapped from previous years (30% retraps).

Sylvia hortensis Orphean Warbler (125: 2, 1.6%). Birds ringed: 1987, 1; 1987-8, 1; 1990, 3; 1990-1, 45; 1991-2, 75; 1992-3, 147. Two birds were retrapped in 1992-3: one ringed 1990 (33%) and one 1991-2 (1%). Retraps after: one year 1/125 (0.8%); three years 1/5 (20%). Recurrence has not been previously described in Orphean Warblers. Rate was highly variable, with one retrap out of three ringed, one out of 75 and none of 45 in three successive years.

S. communis Whitethroat (205: 4, 2.0%). Birds ringed: 1987, 2; 1987-8, 1; 1989, 4; 1990, 4; 1990-1, 66; 1991-2, 128; 1992-3, 640. One ringed 1990-1, retrapped 1991-2 (2%); three ringed 1991-2, retrapped 1992-3 (2.3%). The low rate for this species, which is said to be very numerous in winter in NW Senegal (Morel & Morel 1990), may be because, up to 1990, suitable areas of scrub were rarely netted and Whitethroats were only abundant in PNOD in 1992-3. Nevertheless, from 28 Mar to 6 Apr 1994 the team caught 22 birds including two retrapped from the previous year. The rate of recurrence would probably be higher with ringing in more favourable habitats.

S. cantillans Subalpine Warbler (1997: 136, 6.81%).

Year retrapped:		87-8	Mar	Jan-Apr	90-1	91-2	92-3	% retrapped
Retraps from	n ringed		89	90				
Jan-Feb 87	30	1		1	1	1(1)		3
87-8	112		1(1)	2(2)	3(2)	2(2)		6.2
Mar 89	56			3(3)	1	2(2)		8.9
Jan-Apr 90	177				5(4)	3(1)	3(3)	4.5
90-1	399					33(30)	10(10)	10.0
91-2	1223						75(75)	6.1
92-3	1263							-
% retraps		0.9	2	3.3	2.4	3.2	6.5	

Retraps after 1 year 118/1997 (5.9%); 2 years 16/774 (2.1%); 3 years 9/375 (2.4%); 4 years 3/198 (1.5%); 5 years 1/142 (0.7%). Six birds caught in three different winters, one in four, and one in five. Very common in vegetation around pools. One caught five different winters at the exact same site (marigot du Poste de Gainthe) and winter site fidelity was common, as shown with a sample of birds ringed 1987-90 at two pools c. 400 m apart, with a bare sandy area between them: out of 292 birds ringed at these sites, 19 were retrapped at the exact site of ringing and none at other sites (100% fidelity).

Phylloscopus collybita Chiffchaff (6992: 409, 5.85%).

Year retrapped:		87-8	Mar	Jan-Apr	90-1	91-2	92-3	% retrapped
Retraps from	n ringed		89	90				
Jan-Feb 87	72	3(3)						4
87-8	550		7(7)	8(7)	1	1(1)		2.7
Mar 89	45			5(5)	1(1)			13
Jan-Apr 90	526				10(7)	7(7)		2.7
90-1	1865					102(85)	49(49)	7.2
91-2	3934						237(237)	6.0
92-3	4065							-
% retraps		0.5	13	2.4	0.6	2.7	6.6	

Retraps after 1 year 364/6992 (5.21%); 2 years 65/3058 (2.12%); 3 years 1/1193 (0.08%); 4 years 1/667 (0.15%). Twenty birds caught in three different winters, one in five. From 1957-77, 415 Chiffchaffs ringed at Richard-Toll (Jarry & Roux 1982) provided five retraps (1.2%) with one bird recurring after five winters. In 1989, we were at PNOD in March only, when most of the birds had already left the area. With 409 birds recurring, among which 20 recurred a third winter, the results show that recurrence is normal for this species. Out of 1011 birds ringed 1987-90 on two pools described under Subalpine Warbler, 28 recurred at the exact ringing site and five at the other site, while four others recurred at two other sites 1 and 2.2 km away (76% fidelity). Nomadism was also shown, with colour-ringed birds seen on different sites inside the PNOD during the same winter or following winters.

P. bonelli Bonelli's Warbler (22: 2, 9%). Birds ringed: 1987–8, 1; 1990–1, 15; 1991–2, 6; 1992–3, 10. One ringed 1990–1, retrapped 1992–3 (6.7%), and one ringed 1991–2, retrapped 1992–3 (16.7%). Retraps after: one year 1/22 (5%); two years 1/16 (6%). This the first report of recurrence for this species.

Discussion

In Hawaii, Johnson *et al.* (1981) found that 81% of 37 colour-ringed Pacific Golden Plovers *Pluvialis fulva* returned to their wintering area, adding "each of the territorial birds reoccupied the same territory it had defended previously". This very high rate of recurrence was with conspicuously marked birds and would be hard to obtain for other species. It is higher than the rate for colour-ringed Ruffs and Green Sandpipers in Germany (OAG Münster 1989). In Costa Rica, during a five-year period from 1985–9 (Blake & Loiselle 1992), out of 1040 wintering migrants, 54 (6.19%) were retrapped in the following winters, including Wood Thrush *Hylocichla mustelina* (7.3%), Kentucky Warbler *Oporornis formosus* (7.7%) and Ovenbird *Seiurus aurocapillus* (10.7%). For the last species, more than half of the retraps were at the same net site.

It is difficult to compare our results with these, because of differences in analysis. Our rates were comparable for some passerines, despite changing aims during the study period (from ringing waders at first and then mainly passerines), the different periods during which we ringed in different winters, the different ringing effort in different years, the increase in number of ringing sites (from three in 1989 to more than ten), the abandonment of some sites, changes in the method used to attract birds (tape luring was used at first in 1990 for Sand Martins and commonly in 1991–3 for many passerines) and habitat differences from one year to another (mainly according to the level of water). In spite of these factors, owing to the great numbers ringed, the number of retraps reached 1460 birds and recurrence was ascertained for 31 species. For seven species (Little Bittern, Jack Snipe, Scops Owl, Bluethroat, Grasshopper Warbler, Orphean Warbler and Bonelli's Warbler) recurrence had not previously been reported in Africa. Recurrence has now been shown for 59 species wintering south of the Sahara. The results which were obtained for White Wagtails emphasize how long distance Palaearctic migrants are able to find their way to and from their breeding sites back to exactly the same winter site, year after year.

Among the numerous retraps, 98 birds recurred a third year on the site and a few others were present during four and five different winters in PNOD; Table 1 summarizes these multiple retraps.

Table 2 (which includes data from Middlemiss 1962, Rowan 1964, Tree 1965, 1966a, 1966b, Moreau 1972, Curry-Lindahl 1981, Jarry & Roux 1987, Pearson 1987 and Yésou *et al.* 1995) allows us to classify species according to their fidelity to their wintering area. For some species, with many individuals studied, recurrence seems to

be normal (*e.g.* Little Stint, Garden Warbler, Yellow Wagtail, Bluethroat, Reed Warbler, Sedge Warbler, Olivaceous Warbler, Subalpine Warbler and Chiffchaff).

Table 1. Multiple retraps in different years.

Number of different winters	2	3	4	5	Total
Little Ringed Plover	11	2			13
Common Sandpiper	8	1			9
Wryneck	0	1			1
Yellow Wagtail	57	7	1		65
White Wagtail	6	3	1		10
Bluethroat	19	3			22
Sedge Warbler	153	13			166
Reed Warbler	415	34			449
Olivaceous Warbler	28	8			36
Subalpine Warbler	128	6	1	1	136
Chiffchaff	388	20		1	409
Total	1213	98	3	2	1316

For other species the number of retraps is low because of the small number of ringed birds, but the rate of recurrence is high and recurrence is probably normal, *e.g.* Little Bittern, Little Ringed Plover, Green Sandpiper, Wood Sandpiper, Common Sandpiper, Scops Owl, White Wagtail, Woodchat Shrike, Savi's Warbler and Great Reed Warbler. Little Ringed Plover and Common Sandpiper are the only waders for which multiples retraps have been noted.

For Ruff, European Swallow in South Africa, and Sand Martin and Garganey in Senegal, the low rates of recurrence probably result from ringing birds in huge roosts with little chance of retrapping birds in subsequent years; recurrence might nevertheless be quite common but is difficult to demonstrate.

For other species including Black-winged Stilt, Ringed Plover, Common Snipe, Jack Snipe, Curlew Sandpiper, Marsh Sandpiper, Wryneck, Redstart, Grasshopper Warbler, Orphean Warbler, Whitethroat and Bonelli's Warbler, recurrence was found but the sample was too small to know if it is a regular phenomenon.

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Table 2. Recurrence of species occurring in Senegal. Numbers in brackets are birds ringed (Senegal 1985–93, birds able to provide retraps; Senegal 1957–77, all birds ringed at Richard-Toll and/or PNOD; other data presumably all ringed birds). KCL means recurrence occurred in Africa, according to Curry-Lindahl (1981), but details lacking.

	Senegal 1985–93	Senegal 1957–77	Other African data
<i>Ixobrychus minutus</i> Little Bittern	5 (69)		
<i>Anas querquedula</i> Garganey	(71)	5 (626)	
<i>Himantopus himantopus</i> Black-winged Stilt	(27)		1 (?)
<i>Charadrius dubius</i> Little Ringed Plover	13 (186)		KCL
<i>C. hiaticula</i> Ringed Plover	4 (213)		2 (21)
<i>Calidris minuta</i> Little Stint	26 (1763)		305 (11547)
<i>C. ferruginea</i> Curlew Sandpiper	1 (336)		4 (?)
<i>Philomachus pugnax</i> Ruff	2 (2144)	3 (1088)	74(?)
<i>Lymnocyptes minimus</i> Jack Snipe	1 (47)		
<i>Gallinago gallinago</i> Common Snipe	2 (118)		2 (18)
<i>Tringa stagnatilis</i> Marsh Sandpiper	3 (166)		8 (>314)
<i>T. nebularia</i> Greenshank	(14)	1 (11)	KCL
<i>T. ochropus</i> Green Sandpiper	4 (47)		6 (?)
<i>T. glareola</i> Wood Sandpiper	14 (457)		8 (>95)
<i>Actitis hypoleucos</i> Common Sandpiper	9 (65)	1 (16)	3 (?)
<i>Otus scops</i> Scops Owl	1 (14)		
<i>Jynx torquilla</i> Wryneck	1 (43)		KCL
<i>Hirundo rustica</i> European Swallow	(192)		81 (>40500)
<i>Riparia riparia</i> Sand Martin	54 (15081)	1 (1743)	1 (?)
<i>Motacilla alba</i> White Wagtail	10 (97)	4 (502)	KCL
<i>M. flava</i> Yellow Wagtail	65 (2758)	1 (342)	952 (c.36000)
<i>Anthus trivialis</i> Tree Pipit	1 (23)		2 (107)
<i>Lanius senator</i> Woodchat Shrike	4 (64)		KCL
<i>Saxicola rubetra</i> Whinchat	(1)		1 (13)
<i>Phoenicurus phoenicurus</i> Redstart	(140)	2 (136)	3 (90)
<i>Luscinia megarhynchos</i> Nightingale	(9)		2 (195)
<i>L. suecica</i> Bluethroat	22 (316)		
<i>Locustella luscinioides</i> Savi's Warbler	8 (238)		KCL
<i>L. naevia</i> Grasshopper Warbler	1 (138)		
<i>Acrocephalus schoenobaenus</i> Sedge Warbler	166 (4485)		23 (?)
<i>A. scirpaceus</i> Reed Warbler	449 (8583)		17 (177)
<i>A. arundinaceus</i> Great Reed Warbler	4 (69)		15 (?)
<i>Hippolais pallida</i> Olivaceous Warbler	36 (302)	3 (159)	KCL
<i>Sylvia hortensis</i> Orphean Warbler	2 (125)		
<i>S. borin</i> Garden Warbler	(99)		17 (>197)
<i>S. communis</i> Whitethroat	4 (205)	1 (277)	1 (52)
<i>S. cantans</i> Subalpine Warbler	136 (1997)	2 (72)	2 (7)
<i>Phylloscopus collybita</i> Chiffchaff	409 (6992)	5 (415)	
<i>P. trochilus</i> Willow Warbler	(116)		4 (?)
<i>P. bonelli</i> Bonelli's Warbler	2 (22)		

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Appendix 1

Ringing sites and the years they were used from 1985 to 1993

Djoudj National Park

Gainthe (since 1987): pond of shallow water, flooded tamarisk scrub and acacia trees.

Frog (since 1987–8): pond of shallow water, flooded tamarisk scrub.

GD (1987–8): pools, flooded and dry tamarisk scrub.

Mirador Khar (1987–8, 1992–3) and Petit Mirador (1990–1): flooded tamarisk scrub. Other sites of flooded tamarisk scrub along the Khar and Gorom rivers (1990–1). P.C.: swamps (1987–8); acacia and other trees (1989–3). SPEC (1990–3): sandy plain with salicornia plants. HOG (1991–3): acacia and dry tamarisk scrub with a few salvadora bushes. Emb. (1989, 1989–90), Croc (1990–1), EM1, EM2, CES (1990–3): reed-beds. Dinko (1989–1, 1992–3): reed-beds and low sedge-beds. Grand Lac (1987, 1987–8, 1990): shallow water areas between Petit Marigot and Grand Marigot. Digue W, (1987–8), Tantale (1987–8), Digue S (1990–1): ponds of shallow water. Gorom (1990–94): mostly *Salvadora* bushes with some acacia and a few reed-beds. Python (1987–8, 1990–94): pool with tamarisk scrub and reed-beds.

Other sites
Tamach (1985); Ndiongo (1985); Ndigue (1990–1); Ross-Béthio (1985, 1987, 1987–8); Guembeul (1987–8).

Numbers of birds ringed from 1985 to 1993

1985: five ducks and 829 waders ringed, including 702 Ruffs (710 Ruffs dye-marked).

1987: 1090 Ruffs dye-marked, about 210 other waders and c. 160 Palaearctic passerines ringed (total 1548).

1987–8: 82 Black-tailed Godwits and 192 Ruffs dye-marked, 700 other waders ringed; most waders caught at Guembeul. About 1100 palaearctic passerines (550 Chiffchaffs) also caught. Total 2310 birds ringed.

1989: in Mar the pools were almost dry and 656 Reed Warblers were ringed in Reed-beds. Total 1308.

1990: 3064 birds were ringed, including 527 Sand Martins, 1060 Reed warblers, 526 Chiffchaffs and 108 waders.

1990–3: 497 Wood Sandpipers and 1917 Little Stints ringed (total 5230 waders). 17972 Sand Martins, 9303 Yellow Wagtails, 5395 Sedge Warblers, 11554 Reed Warblers, 2885 Subalpine Warblers and 9864 Chiffchaffs. Total 72303 birds ringed.