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Censuses of Anatidae in the central delta of the Niger and the Senegal delta—January 1972

FRANCIS ROUX

The central delta, or flood plain, of the Niger in Mali, and the Senegal delta within the states of Senegal and Mauritania, are two of the largest wetlands of tropical West Africa and constitute the principal wintering grounds of Palaearctic Anatidae in this part of the Continent.

The interest of the Senegal delta in this respect was recognized as early as 1958 (Roux, 1959); more or less complete waterfowl counts have been carried out quite regularly since the creation of the West Africa Survey within the International Waterfowl Research Bureau (I.W.R.B.) in 1966. However, no quantitative data had been assembled on the duck populations frequenting the central delta of the Niger, despite the fact that their abundance had been emphasized by Guichard (1947) and Duhart & Descamps (1963).

In January 1972 we carried out aerial surveys over these two large marshy complexes to census the Anatidae there. The rapid succession of the two operations, which fell within the period of the international counts of the I.W.R.B., permits a preliminary general view of the waterfowl distribution and their numerical status in their principal winter concentration areas in tropical West Africa.

I Central delta of the Niger

Geographical description

The central delta of the Niger lies between latitudes 13° and 17° North and longitudes 3° and 6° West. It is formed on the central course of the Niger, oriented here in a south-west–north-east direction, by the river overflowing into an immense alluvial plain almost without gradient (0·05 in 1,000). The spreading flood leads to the formation of a marshy area, about 100 km wide, to the south of Lake Debo. This lake, and its adjoining basins, Walado and Korientze, are only vast expansions of the river and act as regulators at the heart of the delta: the water is contained there by a barrage of 'dead' dunes, the Erg de Niafounke. To pass it, the Niger divides into three main arms, connected by multiple secondary branches. It only becomes one river again when it reaches Timbuktu. The region to the north of Lake Debo is characterized by lakes which extend on all sides of the water system in the whole Sahelian zone (dry thornbush savanna). This all constitutes a pseudo-lacustrine complex, 450 km long and over 200 km wide to the north of Lake Debo. Its area is nearly 80,000 sq. km. From south to north, five large areas can be distinguished:

(1) The upper delta. This is the region between the Niger and its right-hand tributary, the Bani, to their confluence at Mopti.
(2) The middle delta or Nigerian Mesopotamia. Bounded in the south by the course of the Niger from Diafarabe to Mopti, to the north by Lake Debo, it corresponds to the sector between the Niger and its left-hand branch, the Diaka. The lateral expansions on the east bank of the Niger below Mopti and on the west bank of the Diaka are included.
(3) The Erg de Niafounke. A mosaic of small and medium water areas between the dunes, drained by the branches of the Niger below Lake Debo.
(4) The series of lakes on the right bank. Depending on the eastern branches of the Niger below Lake Korientze.
(5) The series of lakes on the left bank. Includes the vast water areas fed by the western arm of the Niger, the Issa-Ber.

Hydrological conditions

The rainfall on the Guinea-Liberian massif results in the annual rising of the Niger and the Bani from July, the flood undergoing a considerable delay as a result of the spreading of the water in the plains and its storage in the basin of Lake Debo. The flood peaks at the beginning of October at Ke-Macina, where the river enters its central delta, and only at the end of December at Timbuktu, the exit from the delta area.

At the beginning of January, the southern plains, between the Niger and the Bani, are

drained and the water begins to withdraw from the northern areas.

In January 1972, this process was well advanced since the preceding flood had been exceptionally weak: 6·20 m at Mopti, whereas the average depth of the flood is 7 m. As a result, the flooded areas were considerably reduced from normal, not only in the upper delta but even on the edges of the middle delta and the large lakes of the north. The most distant of the lakes on the right bank had not even been reached by the flood.

These conditions, somewhat limiting the dispersal of the birds, helped the observations. On the other hand, they may have made the data atypical. However, there is nothing to prove that the total number of wintering Anatidae is affected by the extent of the flooded areas.

Dates and itineraries

The author arrived in Bamako on 30 December 1971 and reached Mopti on 3 January in one of the 'planes chartered for the surveys. There he met B. des Clers who had just come up the Niger from Gao by boat, after having visited the pools of Gossi and Douro, in the Gourma area, to the south of the bend of the Niger.

From 3 to 5 January, four reconnaissance flights of an average length of 4 hours were carried out from the Mopti-Sevare airfield. The tracks (see map, Figure 1) represent a total distance of 2,800 km.

For this first attempt, we did not hope to collect a complete figure for the number of Anatidae present in the delta; we only wanted to recognize the various habitats used for their concentration at this time of

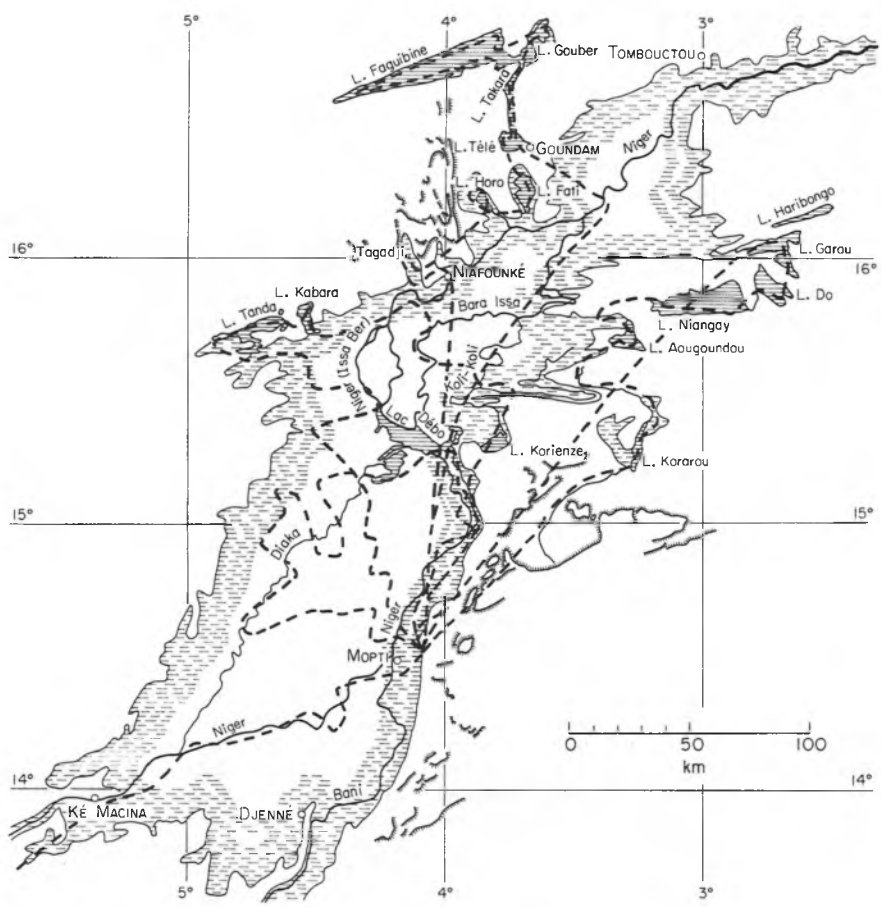


Figure 1. Central delta of the Niger. Shaded area, limits of flood zones; ---, tracks of observation flights, 3–5 January 1972.

year and to carry out a preliminary quantitative assessment of the wintering of Palaearctic populations.

Ignoring the upper delta, where there was only water in the shallows, the surveys were essentially north of the Mopti parallel (14°30′ N). They covered about a sixth of the middle delta, several sections of the Erg of Niafounke and all the lakes of the right and left banks of the river. Only the south and east shores of Lake Debo were surveyed; with the high floods of January, it is a real inland sea, and ducks primarily frequent pools and shallower lakes.

Equipment and methods

Maps of 1/200,000 and 1/1,000,000 of the National Geographical Institute were used, also binoculars, of little use in a 'plane, and a tape recorder. We were rarely able to use our cameras because of the light reflections on the cabin windows. Two 'planes were used: a low-winged Piper Cherokee and a high-winged Cessna 180. The latter, with a greater range and far superior visibility, was unfortunately only available for one operation, on 5 January; it allowed us to reach Lake Faguibine, the northern limit of our survey. Due to the lack of suitable fuel at Timbuktu, we had to return to Mopti-Sevare between each flight. Thus, flights over routes already surveyed were inevitable.

Except in transit, flights were made at less than 100 m above the ground, usually at between 30 and 80 m. From this altitude, the flocks of Anatidae are easily located up to 400 or 500 m away and even more if the emergent vegetation is scattered and the lighting favourable. Nevertheless, particularly in the middle delta, the pools are often covered with *Nymphaea* (wrongly called 'lotus' in the region) which greatly impedes detection and counting of the birds: we were sometimes directly above these sheets of *Nymphaea* before discovering that there were thousands of ducks there. The Palaearctic species regularly proved to be more abundant on this type of marsh than on the large areas of open water.

In counting birds from a 'plane there is difficulty in determining the species, and in estimating numbers, particularly in mixed flocks; so the numbers obtained are only approximate. However, in a region so vast and so difficult of access there is no other possible method for counting ducks than aerial observation.

It should be mentioned here that we had more than 100 hours experience of aerial counts of waterfowl on the French coasts; and a good knowledge of the endemic avifauna from several research missions in tropical Africa.

In wetlands which are too extensive to permit a direct exhaustive count of waterfowl, a general estimate of the populations can be obtained by multiplying the numbers observed on sample transects by a coefficient proportionate to the area of the zone considered. This method can give acceptable results in the case of uniform habitats and with knowledge of the distribution of the species according to the conditions of the habitat.

The central delta of the Niger appears to be a very complex mosaic of aquatic habitats and each habitat is very unequally occupied by Anatidae. The semi-permanent pools of the middle delta which, in January 1972, held the large majority of wintering *Anas*, are densely populated in one sector and practically deserted in another, just as favourable in appearance. Spur-winged Geese *Plectropterus gambensis* will concentrate in large numbers over a few hectares of floating vegetation, then be completely absent over dozens of sq. km. Often, we were struck by the sight of vast areas of completely unoccupied marsh. Here, the extent and variety of habitats lead to too much irregularity in the dispersal of the birds to justify numerical extrapolations.

Results

The totals in Table 1 are therefore only the numbers actually seen of each species in the various zones.

Of course, these figures only account for a fraction of the populations present in the central delta—very much less than a third and perhaps not even a tenth. However, being collected from almost all the range of the habitats of the delta, they show the proportion of the species in each zone and, considered as a whole, give good indications of the ratios of the dominant species.

They are not all comparable, however, for the Ferruginous Duck *Aythya nyroca*, the Pygmy Goose *Nettapus auritus* and the White-backed Duck *Thalassornis leuconotus* were very difficult to locate from the air and are largely under-estimated.

The Common Shoveler *Anas clypeata* poses a particular problem: although rarely recorded in Mali, it should nevertheless be better represented in the delta than appears

Table 1. Numbers of Anatidae counted in the central delta of the Niger, 3–5 January 1972 (rounded totals)

	Upper delta	Middle delta	Erg de Niafounke	Right bank lakes	Left bank lakes	Total
Garganey *Anas querquedula*	4,200	75,000	400	8,500	5,900	94,000
Pintail *Anas acuta*	1,400	9,500	180	2,350	13,300	27,000
Shoveler *Anas clypeata*		10				10
Pochard *Aythya ferina*					400	400
Ferruginous Duck *Aythya nyroca*					42	42
Fulvous Whistling Duck *Dendrocygna bicolor*		300				300
White-faced Whistling Duck *Dendrocygna viduata*	2,250	16,000	140	590	2,100	21,000
Egyptian Goose *Alopochen aegyptiaca*	1		1	800	830	1,600
Spur-winged Goose *Plectropterus gambensis*		1,450		3	49	1,500
Comb Duck *Sarkidiornis melanotos*		2,300		40	110	2,500
African Pygmy Goose *Nettapus auritus*		120	7	2	3	130
African White-backed Duck *Thalassornis leuconotus*		7				7
Totals	7,800	105,000	730	12,300	23,000	150,000

here. In the Senegal delta the species comprises 10–15 times as many female and male first winter birds than adult males. Yet the latter are more distinguishable from a plane than other *Anas* in the mixed flocks. Moreover, it is possible that the Shoveler, without being abundant, is localized in sectors which we did not survey.

Taken as a whole, the results emphasize the overwhelming majority of Palaearctic visitors. Resident species only provide 22% of the total. This enormous imbalance in favour of Eurasian migrants suffices to emphasize the importance of the central delta of the Niger as a wintering zone. It also stresses the impact which the migratory ducks have on the habitat, compared to the endemic species.

Palaearctic Anatidae

The great majority of Palaearctic visitors consisted of only two species, Garganey *Anas querquedula* and Pintail *A. acuta*, in agreement with the literature. These birds winter over the whole delta, from the southern fringe of the flooding to Lake Faguibine. Our counts showed very marked differences in the size of their concentrations according to the zones, differences undoubtedly linked just as much with the nature of the habitats as with the extent of the fall in water level. The most recently drained surfaces, which favour the feeding of granivorous surface-feeding ducks, had the densest concentrations.

This is apparent all along the valley of the Niger, at least up to Niamey: the data collected by B. des Clers from hunters in Gao indicate that the populations move down the water system, following the fall in the water level of the river, until the pre-nuptial migration leads them northwards.

Upper delta. We only explored a small part on the right bank of the Niger between Ke-Macina and Diafarabe, and towards the confluence with the Bani up to 30 km above Mopti. The water had receded from these plains nearly a month before and the remaining pools proved to be nearly all deserted. Only four concentration areas were located, holding 4,200 Garganey and 1,400 Pintail.

Middle delta. This was the main concentra-

tion area: 79% of the Garganey and 35% of the Pintail being counted in this zone. The two species occupied the same sort of habitat, small or medium pools—the largest do not exceed 3 km in diameter—which riddle the immense alluvial plain like the cells of a honeycomb.

Being in the most pronounced depression of the plain, these pools retain water during the greater part of the year, when not permanent. Amid the water sheet which still submerges the surrounding land in January, they are distinguished by being either free from vegetation or choked with *Nymphaea* sp. The *Anas* settle almost exclusively on these pools, avoiding the large flooded meadows where the wild rice *Oryza barthii* dominates, and the floating vegetation of 'bourgou', a very dense association of *Echinochloa stagnina* and *Panicum stagnium* which spreads extensively in the area surrounding Lake Debo.

This region of the delta is sprinkled with mounds which are never submerged—the *toggue*—on which villages are established; the majority are surrounded by rice fields. On the stubble fields there was a thin sheet of water, very favourable conditions for the feeding of the birds.

The profusion of resting grounds causes a very wide dispersal of the populations into flocks of very variable size, from several dozens to several thousands. Of 124 locations of Garganey surveyed, only three held more than 5,000 birds. Pintail were most often associated with flocks of Garganey. We nevertheless found some homogenous flocks, the largest comprised nearly 8,000 birds.

On the right bank of the Niger, between Mopti and Lake Debo, the flood plain is limited by the western spurs of the Bandiagara plateau, and its width does not exceed 15 km. Here, the rice fields are predominant and the semi-permanent pools are less numerous.

Surveyed several times—because it is situated on the direct route from Mopti to the north of the delta—this sector seemed relatively poorer in Palaearctic duck (8,200 Garganey, 350 Pintail). The road from Mopti to Gao which skirts its eastern border permits easy access. It is therefore the only part of the delta which observers of the West Africa Survey had previously been able to visit.

Erg de Niafounke. On the north shore of Lakes Debo and Korientze a vast field of 'dead' dunes begins, pierced by three arms of the Niger: the Issa-Ber to the north-west; the Bara-Issa to the north; the Koli-Koli to the north-east. These dunes lie west-east and at high water the landscape is an alternation of flood corridors and long bands of emergent sand, dotted with *Hyphaene thebaïca*. This arrangement is repeated from Lake Debo to Dire with amazing regularity. Narrow strips of *cuscus* encompass the flooded shallows, the centre of which is often occupied by floating grasses of wild rice and *bourgou*.

There, the aquatic habitats are completely different from the plains of the 'living' delta, and seem much less valuable for Anatidae. Some twenty pools were surveyed in the Bara-Issa and Koli-Koli systems, producing a total of 400 Garganey and 180 Pintail.

Nevertheless, there are in this region more than a hundred water areas of the same type, some, to the north-west of Lake Niangaye, being 15–20 km long. Duhart & Descamps (1963) reported Garganey and Pintail to be extremely abundant there in winter. The populations must vary, here as elsewhere, between sectors, and in relation to the phenomena of flooding and draining in the rest of the delta.

Series of lakes on the right bank. Flowing from Lake Korientze, the Koli-Koli despatches branches to the east which feed several large lakes. These are, from south to north, Lakes Korarou, Aougoundou, Niangaye, Do, Garou and Haribongo. The hydrological regime of these lakes is mixed as is that of certain lakes on the left bank. They are filled partly by their own ground water and partly by the rising of the river. This only reaches the further lakes in years of heavy rainfall. In January 1972, Lake Niangaye was only flooded for two-thirds of its area (about 400 sq. km), Lake Garou one-third; Lake Haribongo was completely dry.

Apart from Lakes Korarou and Aougoundou which hold floating vegetation and reed-beds of *Typha australis*, these water surfaces are practically devoid of marshy vegetation. Their gently-sloping banks let the shallow water expose vast shores of bare mud sprinkled with puddles: the aspect is that of intertidal mud-flats. Old fields of millet, cultivated in the rainy season, occupy the wet fringe; on the circumference extends the Sahelian savanna, greatly degraded by cattle.

The exploration of these lakes proved to be disappointing as regards Palaearctic duck: 7,000 *Anas*, 6,300 of them assembled at the western tip of Lake Niangaye, the

others distributed only on Lakes Korarou and Garou. Pintail account for a third of these figures.

It is doubtful whether the birds can feed on these water areas, but only in the flooded habitats to the west. Moreover, substantial concentrations were noted on the pools which mark the channels joining Lakes Korarou and Aougoundou and which, with their rich carpet of *Nymphaea*, are reminiscent of the basins of the middle delta; for instance, 3,200 Garganey on the Bella Bambi pool. Such ponds, of which only a few were surveyed, could therefore between them hold many more ducks than the large lakes to which they are connected.

Series of lakes on the left bank. The Issa-Ber on its left bank feeds a series of pools and large lakes which are, from south to north, Lakes Kabara and Tanda, Tagadji pool, Lakes Oro, Fati, Tele, Takara, Gouber and Faguibine, the last three being fed through the agency of Lake Tele. Each of these water areas seems to have its own ecological characteristics, varying according to its depth and the nature of the substrate.

The largest, Lake Faguibine, 75 km long, has many points in common with Lake Chad, in particular its water likewise remains fresh. Situated on the outskirts of or outside the plains flooded by the Niger, these lakes are closely surrounded by predesert habitats with thorn-bushes and *Euphorbia* or by palm groves of *Hyphaene thebaïca*. Their value for migratory waterfowl seems to depend above all on the richness of their marsh vegetation and the extent of their drainable fringe.

Of the 19,700 Palaearctic ducks counted over the whole of these lakes (say 16% of the total) there were 15,200 on Lake Oro alone. In contrast, we only saw twenty-five on Lake Fati, 200 on the lakes system of Tele, Takara and Gouber and scarcely 1,200 on the 180 km of shore of Lake Faguibine. The dominant species was the Pintail, with 10,800 at Lake Oro, 950 at Lake Tanda and 1,200 distributed on Lake Kabara and some connected pools. On Lake Tele, partly covered with *Nymphaea*, the majority of the Ferruginous Duck in our Table were counted, and on Lake Faguibine all the Pochard *Aythya ferina*.

Lake Faguibine, in the shape of a square, directs a corner towards the west where the depth of the water falls, allowing the development of a submerged plant similar to *Potamogeton*, which we did not see anywhere else. The Pochard were concentrated here, as well as other Anatidae. It is an uncommon winter visitor but no doubt regular in Chad (Vielliard, 1972b), in the north of Nigeria and in the Senegal delta. Pochard had not been recorded before in Mali. Our observations established that the species does not hesitate to cross the middle of the Sahara.

Ethiopian Anatidae

As was to be expected, the White-faced Whistling Duck *Dendrocygna viduata* proved to be by far the most abundant of the Ethiopian Anatidae of the central delta of the Niger (77% of their total population).

In January 1972, 85% of the birds were in the middle delta, 10% on the lakes on the left bank, mainly at Lake Oro and Tagadji pool, the rest spread on the pools of the lakes of the right bank and in the Erg de Niafounke.

This distribution is very comparable to that of Garganey and the two species are very often seen at the same places. Nevertheless, the *Dendrocygna* like to rest standing in compact groups, which leads them more to frequent the banks of pools, wet rice fields and above all the sand banks and puddles of the lower bed of the river where the Palaearctic Anatidae are hardly found: we counted 1,800 White-faced Whistling Duck on 35 km of the course of the Niger above Mopti, as against seventy Garganey and one Egyptian Goose *Alopochen aegyptiaca*.

As a result of this habit, it is certain that the censuses carried out principally over the flood plains and lake complexes give a poor idea of the quantity of *Dendrocygna* in relation to the other Anatidae in the whole of the delta. A more extensive survey of the lower bed of the river and of its main arms would have raised the number of White-faced Whistling Duck without significantly altering that of the other species.

At the roosts, the flocks did not reach the size of the *Anas* concentrations: at only four of the seventy-three concentration points located were more than 1,000 birds counted, at nine more than 500.

The Fulvous Whistling Duck *D. bicolor* only appeared in the active delta in extremely small contingents (300). Although some undoubtedly escaped our attention among flocks of the White-faced species, it must be admitted that they are very uncommon in the delta at this time of year.

The distribution of Comb Duck *Sarkidiornis melanotos* and Spur-winged Geese

in January is centred even more on the middle delta than that of White-faced Whistling Duck: only 6% of the first species and barely 4% of the second were counted outside this region. These two large Anatidae, however, do not frequent the same localities. The Comb Duck primarily frequents the semi-permanent pools, the wet rice fields and the grassy embankments bordering the secondary rivers, while the domain of the Spur-winged Goose is the floating vegetation of wild rice and *bourgou* which is predominant over the deep flood. The depth of water on this recumbent vegetation also confines the species to places where the birds can move by wading without having to swim. Along the lower course of the Diaka and the south shore of Lake Debo we surveyed nearly 50 km of floating vegetation in deeper water without noticing one Spur-winged Goose (or other Anatidae, except some Pygmy Geese *Nettapus auritus*).

Nevertheless, the population of Spur-winged Geese is largely scattered and its census laborious: the 1,500 observed had to be counted in pairs, or families or small loose groups of several dozen individuals. One still does not have a definite idea of when they breed on the middle Niger. The indications of Duhart and Descamps suggest that eggs are laid from September to February. At the beginning of January one should therefore be able to find families with young at all stages of development. In fact, we did not see any chicks. However, as the 'plane passed, while a number of birds took flight, others were content to open their wings or run without taking flight, as if they were incapable of doing so: non-flying juveniles? adults in moult?—it was irritating not to be able to make sure.

Quite different is the distribution of the Egyptian Goose. They concentrate on the muddy banks of certain large lakes of the north: Tanda, Kabara, Tagadji pool on the left bank, Lake Niangaye on the right bank. Apart from these localities, we only saw seven birds. The area therefore seems distinctly more northern; perhaps it is confined to the Sahelian zone.

With Pygmy Geese the aerial counts are quite deceptive: besides being scattered in pairs or small groups, the birds can only usually be spotted if they take flight as the 'plane reaches them; many must have escaped us. However, 110 of the 132 individuals noted were on the pools of *Nymphaea* and the floating vegetation of the middle delta.

As for the seven White-backed Duck, their observation confirms the presence of this duck in the central delta where it has only been recognized once before (Duhart & Descamps, 1963). In Mali, the distribution is not limited to the Niger valley: B. des Clers found about fifty individuals at the Gossi pool, in the Gourma, on 26 December.

Additional observations

It was not possible to count, in addition to the Anatidae, the populations of all the identifiable waterfowl from a 'plane in flight—only those of a particular faunistic interest.

Pelicans. We think we saw the large majority, if not all, of the population of White Pelicans *Pelecanus onocrotalus* in the delta: 3,500 at Lake Tanda, 700 at Lake Do, plus thirty-two individuals to the south of Lake Debo. Of the Pink-backed Pelicans *P. rufescens*, generally considered more common here, we only observed isolated birds or small groups—sixty in all.

In West Africa the two species breed from October to March. We therefore hoped to find some colonies and thus supply the proof of nesting in the central delta. This is highly probable at least for the Pink-backed Pelican, since young captive birds, presumed to be of this species, were seen in the Bozo fishing encampments (J. M. Thiollay, personal comunication).

The origin of the White Pelicans of the middle Niger would be much more interesting to establish, since no breeding site is known nearer than 1,300 km to the west (Senegal delta and the Banc d'Arguin archipelago, Mauritanian coast) or 1,800 km to the east-south-east (Wase-Rock, East Nigeria, Kapsiki region, North Cameroon) (Naurois, 1969; Dragesco, 1971).

The Long-tailed Cormorant *Phalacrocorax africanus*, the only Cormorant of the central delta, is widespread in tens of thousands. Breeding was taking place in January: two small colonies were located at Tagadji pool and on the left bank of the Issa-Ber. African Darters *Anhinga rufa* were extremely abundant, above all in the middle delta. A hundred birds were sitting on their nests in a colony of Great White Egret *Egretta alba*.

Herons. The Great White Egret is the most evident species, present everywhere in very large numbers except on the bare banks of the large peripheral lakes where Grey Herons *Ardea cinerea* are commoner (hun-

dreds at Lake Korarou, Niangaye, Tele, Faguibine). In the middle delta three large colonies of Great White Egrets were located, one of them of more than 1,500 pairs on a wooded pool near Diaka. Another large mixed heronry is on an island of the Niger below Mopti. Buff-backed Herons *Bubulcus ibis*, Squacco Herons *Ardeola ralloides*, much more numerous that the Little Egret *Egretta garzetta*, each has enormous populations. The same is no doubt true of the Night Heron *Nycticorax nycticorax*; by day its populations, grouped in the shelter of the trees, are impossible to count, but its roosts in the thorny thickets in the middle of the flooded plains, each held hundreds of birds. The Purple Heron *Ardea purpurea* and the Grey Heron are probably the only herons solely represented here by Palaearctic visitors. They are more common in the zones of floating vegetation. The Goliath Heron *A.goliath* seems to be rare; only four were seen, at Lake Niangaye. Other species of Ardeidae were only seen or determined sporadically.

Storks, Ibises, Spoonbills, Flamingos and Cranes. For White Storks *Ciconia ciconia* the central delta of the Niger is an important wintering area, a number ringed in Western Europe and Morocco being recovered. During the cyclical swarming of the African migratory locust *Locusta migratoria*, of which the delta forms the breeding area, massive concentrations of White Storks are attracted by the acridids. However, we only saw 140, beside Lakes Tanda and Oro.

Ignoring the endemic Ciconiidae as well as the Sacred Ibis *Threskiornis aethiopicus*, we counted 1,650 Glossy Ibis *Plegadis falcinellus*, 1,400 of them on the plains and wet rice fields of the middle delta. This must be but a fraction of the actual numbers. Some nests of this ibis were found in the north-west of the delta, near Lake Fati, in March 1960 (Morel & Morel, 1961). The only other known breeding site in Africa north of the Equator is the Nile delta. Nevertheless, the majority of the Glossy Ibis of Mali must be of Palaearctic origin, like those which winter in the Senegal delta and the Chad basin.

Our only observation of spoonbills is that of a group of 140 African Spoonbills *Platalea alba* on a rocky islet in Lake Do.

There are no reports of Flamingos in the central delta of the Niger, nor in the other regions of Mali, and our surveys only confirmed their absence. The Lesser Flamingo *Phoeniconaias minor* might be found there if movements occur between the colonies of Kenya and that in the Mauritania sector of the Senegal delta (Naurois, 1965c). This hypothesis seems better founded since small flocks of Lesser Flamingos were observed to the north of Lake Chad (Vielliard, 1972a).

Crowned Cranes *Balearica pavonina* occur in pairs more often than in flocks and only 245 were counted, 115 of them grouped on a shore of Lake Niangaye.

Waders. To identify these birds from a 'plane is only possible for a minority of species, and all precise counting is deceptive. We tried to census only Black-tailed Godwits *Limosa limosa* and Ruff *Philomachus pugnax*, very gregarious species and easy to recognize. The totals—21,000 Black-tailed Godwits and 110,000 Ruff—indicate at the very most the quantitative relationship between these species. Their populations in the whole of the delta must be hundreds of thousands for the first, and millions for the second.

The muddy shores of the large lakes offer roosts for the Ruffs where there may be imposing flocks (50,000 at Lake Gouber). The sand banks of the Niger at low water played the same role. However, on the pastureland—above all the drained meadows and the stubble of the rice fields—the populations become impossible to ascertain because of their extremely wide dispersal.

The Black-tailed Godwits also depend on the rice fields for their food. In the delta the cultivation of floating rice is practised: this involves endemic varieties which regulate their growth according to the depth of the water cover, just like *Oryza barthii*. The Godwits are mainly on the fields before the harvest when the drainage holds the rice in a few centimetres of water. It is then that they appropriate large parts of the crop: over the 6,000 hectares of the rice growing perimeter of Mopti it is estimated that they take 3 to 6 tons a day. Supposing that the daily requirements of a Black-tailed Godwit were 50 g of seeds (wet weight), the minimum number of birds feeding on the rice fields of Mopti would then amount to 600,000. In fact, it is probable that a large proportion of the loss attributed to the Godwits is due to other avian species, in particular to the Anatidae which must come to feed at night. We only put forward these figures to give a better idea of the abundance of the Godwit.

The Black-winged Stilt *Himantopus himantopus* is equally widespread, scattered

along all the water areas. On the sandy shores of Lake Faguibine we distinguished other Palaearctic waders (Greenshank *Tringa nebularia*, Spotted Redshank *T. erythropus*, *Calidris* sp. and *Charadrius* sp.). On the course of the Niger the Pratincole *Glareola pratincola* was noticeable for the size of its flocks at rest on the sand banks.

Gulls and Terns. There was only one previous mention of the Lesser Black-backed Gull *Larus fuscus* (Guichard, 1947). However, it was not rare on the large lakes of the left bank (Tanda, Faguibine, Gouber, over 150). It goes up the Niger to Bamako, where a juvenile ringed in Great Britain was recovered. On Lake Faguibine we caused the flight of a dozen Black-headed Gulls *L.ridibundus* or Slender-billed Gulls *L. genei*. Black-headed Gulls are more likely, having already been recognized once in the central delta (Paludan, 1936) and recently recorded at Lake Chad (Lévêque, 1969).

The Caspian Tern *Sterna caspia* and Gull-billed Tern *Gelochelidon nilotica* are very common, with imposing flocks on the banks of the river and the shores of the lakes. Ringing has proved the wintering on the middle Niger of a good number of the Caspian Terns originating from the Baltic coasts and it is known that the European populations of Gull-billed Terns regularly cross the Sahara. Nevertheless, it would not be impossible for local-bred birds to be mixed with the migrants. Both species breed on the coast of Mauritania and in the Senegal delta, Caspian Terns also nesting in Gambia, Portuguese Guinea and the maritime mouths of the Niger.

The *Chlidonias* sp. were not further identifiable in their winter plumage and we probably did not always distinguish them from Little Terns *Sterna albifrons* which, according to Paludan, breed here. The numerical dominance of the former is not in question, however, and their wintering population seems quite large.

Birds of prey. Without considering the resident species we noted the frequency of Marsh Harriers *Circus aeruginosus*, widely distributed mainly in the middle delta. The other remarkable Palaearctic bird of prey is the Osprey *Pandion haliaetus*: thirty-four on the shores of Lake Faguibine, plus about ten on other lakes and the course of the Niger. The Ospreys in the whole delta must comprise a large fraction of the nesting population of Europe.

Large mammals. Periodically flooded open habitats, divided by multiple water courses, are scarcely suitable for wild ungulates. However, certain species are adapted to them, such as the Reedbuck. In addition, the thorny Sahelian savanna, which surrounds the large lakes of the two banks of the Delta, is the habitat for Gazelles. We only saw two Reedbuck, one warthog and one hippopotamus in the course of our aerial surveys. Going up the Niger by boat from Gao to Mopti, B. des Clers encountered fifteen hippopotamus in all this stretch of nearly 800 km. In the desert region of the Gourma, which he crossed by car, only two small herds of gazelles were seen. Almost everywhere, on the other hand, mainly by the lakes, excessive numbers of livestock (cattle, goats, sheep) can be seen, the detrimental effect of which on the soil and the vegetation is very marked. In Mali the large animals, hunted without control and driven out by domestic pasturage, have become so depleted that its value for tourism seems inconceivable from now on.

In these conditions, it is the aquatic avifauna of the central delta which would assume a decisive role as a spectacular element for the development of nature tourism in Mali.

II Senegal delta

Geographical description

The Senegal delta lies between 16°40′ and 15°50′N. In contrast to typical deltas with several outlets, the Senegal has only one: a powerful coastal cordon contains the waters of the river in the interior and diverts their outlet towards the south.

The triangle formed by this 'barred' delta has as a base the coastal sector which extends from the Chott Boul, an old outlet blocked by sand for three centuries, 90 km to the present mouth south of Saint-Louis. Its apex is in the region of Richard Toll, 80 km from the coast.

The valley is crossed by a NE-SW depression occupied by two large areas of permanent water: the Lac de Guier in Senegal and Lake Rkiz in Mauritania. These lakes cover 300 and 100 sq. km respectively at maximum, and regulate the river's flow.

Below Richard Toll, a vast system of alluvial plains and decantation basins extends, flooded by the Senegal and by its tributaries on the left bank, the Gorom, Lampsar and Djeuss. On the right bank, in Mauritania, the water system is less complex, the majority of the branches being

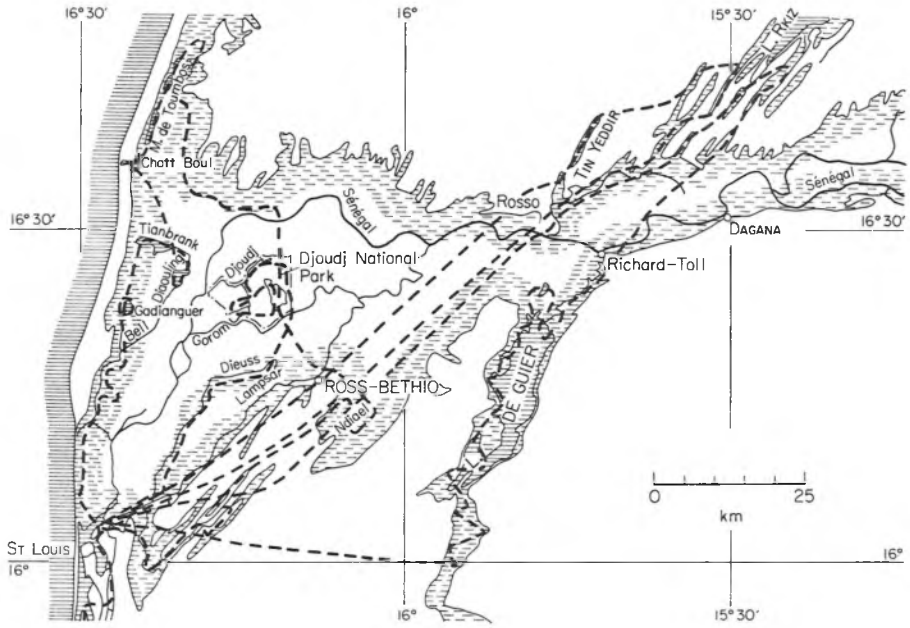


Figure 2. Delta of the Senegal. Shaded area, limits of flood zones; – – –, tracks of observation flights, 14–18 January, 1972.

'fossils'. However, the alluvial plains between the coastal cordon and the river are extended north by a series of depressions and *sebkras* running parallel to the coast for nearly 100 km: this is the Aftout-es-Sahel.

At the height of the flood, the whole of these regions used to be almost entirely under water; only the delta embankments and some outlines of the dunes showed through. Since 1963, rice-growing management works, protected by a network of dykes and barrages have prevented vast areas on the left bank, in the territory of Senegal, from flooding. Among the zones thus drained, the basin of Ndiaël, covering some 15,000 hectares to the west of the Lac de Guier, was one most favourable for the concentration of Palaearctic waterfowl (Roux, 1959). Today, these are essentially concentrated in the Djoudj depression, the largest decantation basin of the delta remaining in its natural state. Eleven thousand hectares of this basin, between the 'bend' of the river and the Gorom, were declared a National Park in April 1971.

Hydrological conditions

The Senegal floods annually as the monsoon rains fall from May to October on the upper basin of the river, over 900 km from its mouth. However, because of the gentle slope, the flood only reaches the delta in September, reaching a maximum at the beginning of November. The Aftout-es-Sahel only floods when there is a strong flow. In 1971 it was very mediocre and by the middle of January 1972 the floods had been re-absorbed over nearly the whole of the delta. Besides the Lac de Guier and permanent water courses, the aquatic habitats in Senegal amounted to the Djoudj basin, some depressions, notably between the Lampsar and Djeuss near their confluence, and the tidal lagoons and mangroves near Saint-Louis.

In Mauritania also, there was only water in the most marked depressions: upstream in the 'dead' dunes between Lake Rkiz and the course of the river; downstream in the pools and Etangs de Gadianguer, de Diaouling, de Tianbrank, linked to the river by its principal right-hand branch. In the Aftout-es-Sahel, the southern basins—Chott Boul, Lagune des Toumbos—still held a little water. The *sebkras* more to the north were dry.

As a result the Anatidae were limited to a small number of well-defined water surfaces where they were concentrated in large flocks: ideal conditions for carrying out a

complete census. We were also served by our knowledge of the lay-out of the delta and the experience of A. Dupuy who, since 1968, had surveyed this region several times to locate and count the waterfowl concentrations there (Dupuy, 1968, 1971).

Dates and itineraries

We used an Alouette I helicopter and then a Piper Tripasser 'plane with high wings. A first reconnaissance on 14 January 1972 surveyed the Djoudj basin and flooded sectors on the left bank of the river, along the rivers Lampsar and Djeuss. On the morning of 17 January we explored the Mauritanian part of the river, on the right bank, downstream to the northern limit of the inundations in the Aftout-es-Sahel, at 16°47′N. In the afternoon we surveyed, on the left bank, the southern system of the delta to the east of Saint-Louis (zone of the three small lakes), the dry depression of the Ndiaël, the Lac de Guier and the region of Richard Toll. Finally, going upstream to the NE, we were unable to reach Lake Rkiz due to lack of fuel. On 18 January after having again tried in vain to reach this lake by direct flight from Saint-Louis, we completed the survey of the basins between the dunes situated in its southwest extension in Mauritania: Sekeirim, Sokam, Tou Kindji, Tin Yeddir and El Hofra. Then recrossing the whole delta by a NE-SW diagonal, we arrived above the brackish lagoons which mark the mouth of the Senegal below Saint-Louis. We inspected the succession of lakes along the coast to Cap Vert, on the way to Dakar.

These various routes covered 1,500 km, 1,100 km of which were effective surveys. In addition, on 15 and 16 January, we carried out counts on foot and by boat in the Djoudj National Park, verifying and complementing our aerial counts in this, the richest, sector of the delta.

Our observations therefore covered all the favourable areas for concentrations of Anatidae in the lower basin of the Senegal with the sole exception of Lake Rkiz.

Results

Table 2 gives the results of our counts for each species of Anatidae in the various sectors of the delta. The reservations expressed in the preceding chapter as to the accuracy of the numbers collected by aerial observation also apply here. However, the figures indicated for the Djoudj National Park combine the results of estimates by helicopter and counts on foot and by boat. It was only during ground observations that Green-winged Teal *Anas crecca*, Wigeon *A.penelope* and Fulvous Whistling Duck were noted. These species, mingled among concentrations of Garganey and White-faced Whistling Duck, completely escaped our attention in the helicopter.

Palaearctic Anatidae

We would emphasize the very great numerical superiority of Palaearctic visitors over the Ethiopian Anatidae. The quantitative relationship between these two categories is the same here as in the central delta of the Niger: 77% being Palaearctic ducks.

The population of January 1972, nearly 200,000, consisted almost exclusively of two species: 70% Garganey and 28% Pintail. The proportional representation of these species is here too the same as that in the central delta of the Niger.

Following our first investigations on the wintering of Palaearctic Anatidae in the Senegal delta, we wrote: 'The November population is not less than 150,000 individuals. At least two-thirds of it is composed of Garganey, the rest mainly comprising Pintail, then Shoveler, and in small numbers, Teal, Pochard and Ferruginous Duck' (Roux, 1959). Subsequent studies were to reveal the presence, rare if not occasional, of two other species, Marbled Teal *Marmaronetta angustirostris* and Tufted Duck *Aythya fuligula* (to which we now add Wigeon). However, in 12 years the contingent of wintering Anatidae has scarcely changed in number or composition, despite the losses of aquatic habitats suffered as a result of agricultural management since 1963.

The third fact which emerges from our results is the very marked localization of the concentrations. Three zones, comprising several water surfaces but each a well-defined entity, hold 95% of the populations. The most important is the Djoudj National Park which held 62% of the total, the large majority of the Garganey (68%), nearly half of the Pintail, virtually all the Shoveler and the whole populations of the three other species. These figures demonstrate the bio-ecological value of this National Park as a refuge for wintering Anatidae.

Djoudj National Park. Nowhere have we seen more spectacular concentrations of

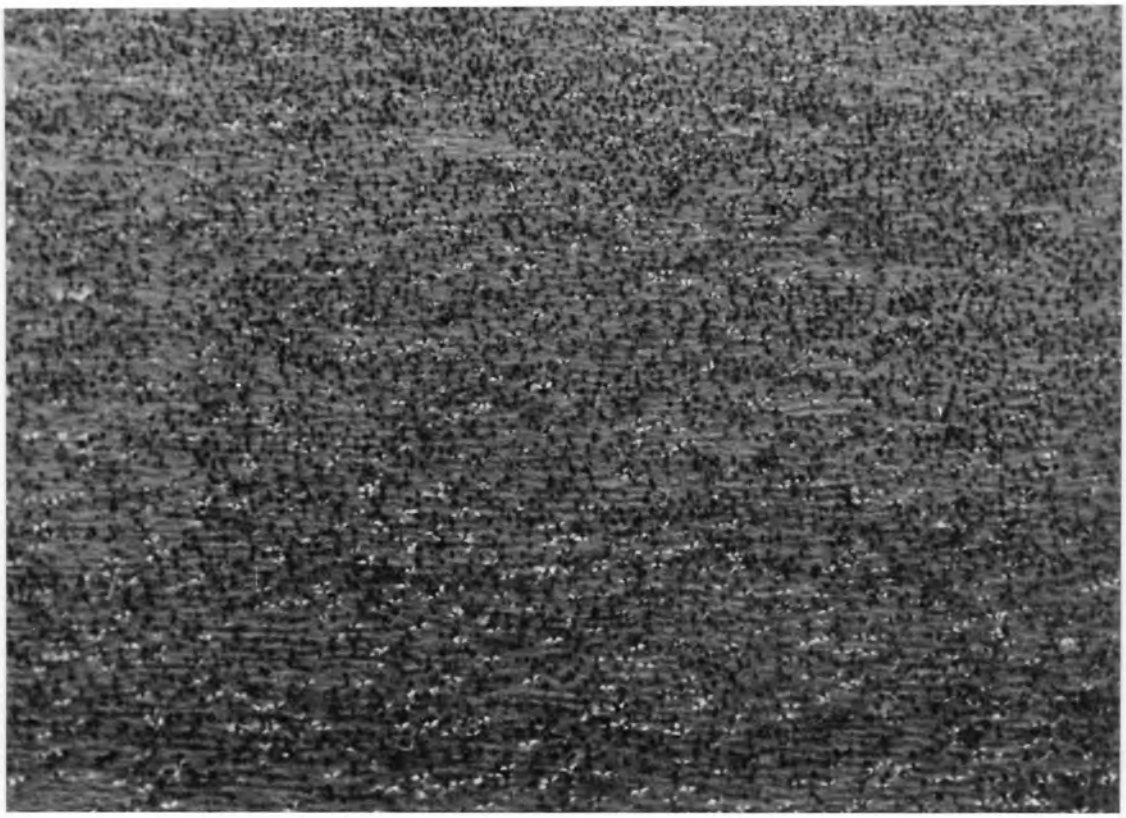
Table 2. Numbers of Anatidae counted in the Senegal delta, 14–18 January 1972 (rounded totals)

	Djoudj National Park	Confluence of Lampsar & Djeuss	Mauritanian delta	Lake Guier	Other areas	
Teal						
Anas crecca	500					500
Garganey						
Anas querquedula	95,000	38,000	240	1,620	1,600	135,000
Wigeon						
Anas penelope	1					1
Pintail						
Anas acuta	26,000	200	28,700	830	320	55,000
Shoveler						
Anas clypeata	2,000	40	215	30	29	2,300
Pochard						
Aythya ferina	420					420
Ferruginous Duck						
Aythya nyroca	230				3	230
Fulvous Whistling Duck						
Dendrocygna bicolor	400					400
White-faced Whistling Duck						
Dendrocygna viduata	35,000	6,300	500	510	680	43,000
Egyptian Goose						
Alopochen aegyptiaca	250					250
Spur-winged Goose						
Plectropterus gambensis	750			410	11	1,170
Comb Duck						
Sarkidiornis melanotos	650				40	690
African Pygmy Goose						
Nettapus auritus	4	4		60	39	110
Totals	160,000	45,000	30,000	3,500	2,700	240,000

ducks. The aquatic habitats are of two kinds. The basin itself, a vast depression on salty soil with brackish water, dries by evaporation from May; in its centre there extends a lake of 4,000 hectares (ha), of uniform depth (less than a metre in January) bordered by meadows of *Vetiveria, Sporobolus, Oriza*, etc. The rivers draining the basin, Djoudj and Tieguel, are permanent fresh water, bordered by *Tamarix* and *Phragmites*. Barrages near their junction with the Senegal prevent the water held in the basin from returning to the river when its level falls. Thus, in January, the water level in the National Park was 70 cm higher than the level of the river. It is clear that such water management is biologically very important in a region where flood water is rapidly reabsorbed because of the dryness of the climate.

The concentrations occurred principally at the edge of the central lake and on one of the adjoining depressions, the Khar, where the depth of the water was lower. This depression, in the process of drying up, served as a refuge for almost 50,000 Garganey and 7,000 Pintail, as well as Teal. In the first warm hours of the day, the birds formed a compact and continuous flock 250-m long on the bank. Other flocks of Garganey, together with Pintail and Whistling Ducks, occupied the side arms of the permanent small lakes. The Shoveler were mainly found along these water courses, while the Pochard and Ferruginous Ducks were all spread over a series of small water areas separated by curtains of *Phragmites* and *Typha* to the north of the central lake.

Confluence of the Lampsar and the Djeuss. In the angle formed by these two rivers near their junction 15 km north-east of Saint-Louis, marshes encompassed by thick formations of *Typha*, are semi-permanent and partly covered with *Nymphaea*. They hold the other most important part (27%) of the population of Garganey of the delta, with a small number of Pintail, Shoveler and a good number of White-faced Tree Duck. An even more considerable population of Garganey has been seen there in January 1971 (Dupuy, 1971).



A. R. Dupuy

Figure 3. Concentration of Garganey *Anas querquedula* (*c.* 6,500 birds) at Djoudj National Park, Senegal delta, 19 January 1972.

Mauritanian delta. The alluvial plains downstream on the right bank of the Senegal are bounded to the west by the coastal cordon. Here, the proximity of the sea accentuates the salinity. In addition, the tide up the Senegal reaches, via the small rivers Tiallakt and Bell, the ill-defined depressions which spot the plains. As a result, the depressions are totally devoid of vegetation. The majority of these had little water in January, surrounded by vast expanses of bare mud.

These waters were almost exclusively populated by Pintail (52% of the whole population of the delta). However, a very distinct decrease was seen from south to north. Very abundant in the southern depressions, along the Tiallakt, the species was poorly represented on the large central etangs—Diaouling, Tianbrank—and absent to the north, on the Chott Boul and in the Aftout-es-Sahel. This distribution must be related to the habitats favourable to the feeding of the Pintail.

Lac de Guier. The large flocks of wintering Anatidae find refuge by day on this vast permanent lake when the other shallow waters dry up. It is also occupied when the rice fields of Richard Toll and those near Rosso, 15 km north of the lake, in Mauritania, are flooded. The irrigation of these rice fields from February procures new feeding grounds for the ducks just as the natural aquatic habitats are reduced and the feeding requirements of the birds are increasing as their pre-nuptial migration approaches.

On 17 January the lake held less than 2% of the whole population of the delta; but from 29 to 31 January we witnessed large flocks of Garganey—estimated at 15,000 birds—leaving at twilight and returning in the morning. At the same time a large reduction in the contingents at Djoudj occurred; we verified this on a last visit to the National Park on 1 February. This transfer of part of the populations of Djoudj to the Lac de Guier had already been observed in February 1971 (Roux, 1971).

Other zones. On the other aquatic habitats of the delta, Palaearctic Anatidae were few or non-existent. The saline lakes near the mouth of the river below Saint-Louis held none. Nevertheless, two other districts presented a certain interest. The region south-west of Lake Rkiz in Mauritania is an alternation of parallel north-east–south-west 'dead' dunes and inundation corridors bordered by forests of *Acacia nilotica*. The widest depressions—Tou Kindji, Tin Yed-

A. R. Dupuy

Figure 4. More than 450 White Pelicans *Pelecanus onocrotalus* in the National Park of Djoudj, Senegal, January 1972. The nearly unanimous reaction to the passing aircraft is striking.

dir, El Hofra—contain a rich floating vegetation of wild rice and water lilies. Although only holding 1,400 migratory ducks (1,050 of them Garganey), these pools can play a not unimportant role at the end of the season because they dry up late.

To the south of the delta, east of Saint-Louis, three long depressions were connected not long ago to the Ndiaël from which they received surplus water. Now they only receive the outflow of the small river of Ngalam, the last left-hand branch of the Senegal, which is insufficient to fill them completely when the flood is weak. On the only depression holding water we noted 520 Garganey. Some years previously, large concentrations of this species occurred in this zone (A. Dupuy, personal communication).

The coastal areas of the Cap Vert region. Mid-way between the mouth of the Senegal and Cap Vert, along the coast, from north to south, there is first of all a series of freshwater basins in the hollow of the dunes—the Niayes—then a series of more or less extensive lakes, some brackish and temporary, others saturated with salt and permanent, such as Lake Retba, the level of which is 2·40 m lower than that of the sea. The largest is Lake Tanma, a vast level depression filled by the rains from July–August and persisting in dry seasons according to the annual variations in rainfall. It had been dry for some weeks by the time of our survey. These lakes are famed for attracting numerous flamingos and the hunters of Dakar practise their sport there at the expense of the waterfowl.

In the Niayes, nearly all drained and converted for the cultivation of food, we only saw thirty White-faced Whistling Duck. In 1967 White-backed Duck were found there. More to the south, only two of the five existing water areas held Anatidae: the pool of Ndiarhol, with 370 Garganey, some Pintail and Shoveler; Lake Retba, with 200 Pintail and fifteen Shoveler. Black tailed Godwit (940), Ruff (3,000) and Avocet *Recurvirostra avosetta* (890) formed, with numerous Stilt, the majority of the waders present.

In autumn, when these lakes present vast areas of shallow water and when the post-nuptial migration is in full swing, they may be more important.

Ethiopian Anatidae

While the Palaearctic migrants had already been the subject of more or less complete

counts, until now there were no quantitative data available on the endemic Anatidae of the delta. We estimate that we counted virtually all of their population. In the middle of January, this amounted to nearly 46,000 individuals, say three times less than the migratory contingent. White-faced Whistling Ducks constituted 94% of this, the rest being provided mainly by Spur-winged Geese and Comb Ducks, then Fulvous Whistling Duck, Egyptian Geese and Pygmy Geese. The only other Ethiopian Anatidae recorded in Senegal is the White-backed Duck, known through rare observations and recoveries, two of them in the delta in 1963 and 1967 (G. Morel, 1972).

This population is remarkably similar in structure to that of the central delta of the Niger. The only appreciable differences here are the higher percentage of White-faced Tree Ducks and the smaller proportional quantity of Comb Ducks and Egyptian Geese. However, it is possible that, for the Whistling Duck, our figures include some of the birds dispersed at other periods along the valley of the Senegal. The species was incomparably less numerous in the delta during January 1971 (Dupuy, 1971). For the Pygmy Goose, the number only accounts for a fraction of its local population, the smaller water-lily marshes possibly sheltering some.

Table 2 gives the numerical distribution of each species in the different sectors of the delta. It spotlights the unique role of the Djoudj National Park, where 80% of the total was concentrated.

For the majority of these birds, as for the Palaearctic Anatidae, the Djoudj depression is mainly a day roost. It could not in fact satisfy the feeding requirements of such a quantity of ducks for a long time. At night they disperse to seek their food. To explain such a concentration we must mention, in particular, from the tranquillity which they enjoy in this area, free from all human activities; even traffic and grazing are forbidden.

Apart from the Djoudj, principal places of concentration were the marshes at the confluence of the Lampsar and the Djeuss, an important refuge of White-faced Whistling Duck, and the shores of the Lac de Guier, the wild rice fields of which held a third of the population of the Spur-winged Goose.

Additional observations

The Cormorants and the Ardeidae. These were so numerous, they were ignored, as were the Laridae and the majority of the species of waders. Only the results concerning the species of greatest faunistic interest are shown in Table 3.

Pelicans (Figure 4). Perhaps the whole population of White Pelicans in Senegal was assembled in the Djoudj National Park: some 8,000 individuals, a part of which at least must try to breed there. Their colony, abandoned with the eggs destroyed, was discovered at the end of February at the edge of the Djoudj river; the fall in the water level had made the site accessible to the jackals (G. Jarry, personal communication). It was known that the species breeds in the region: during an aerial survey over the Aftout-es-Sahel in November 1958, we had located an islet occupied by a colony (Morel & Roux, 1962), later verified by R. de Naurois. However, nesting in the delta *sensu stricto* had not been established before. Since spring 1972, work has been carried out there to ensure that the breeding site remains continuously isolated by water.

The Pink-backed Pelican, in small numbers, only occupied the water courses of the Djoudj and the lagoons near the mouth of the river. Its nearest known breeding colony in Senegambia is situated near M'Bour, 200 km south of the delta (Naurois, 1965a).

Storks, Ibises, Spoonbills, Flamingos and Cranes. We did not see more than fourteen White Storks. The previous winter, in the same period, A. Dupuy (1971) saw less than a hundred. Twelve years before, the species was observed in considerable numbers in the delta (Morel & Roux, 1966). In the middle of January, those originating in North Africa may already have returned to their native land; we were to encounter dozens of them in the south of Morocco at the beginning of February. However, the contingent from the Rhineland countries, the wintering of which in Senegal is proved by over thirty ringing recoveries, still remains in its winter quarters. There, too, its decline is only too evident.

In contrast, we made a fortunate discovery of sixteen Black Storks *Ciconia nigra*, fourteen of them distributed in two groups to the south of Lake Rkiz. There were only three or four records in the west of tropical Africa, the most recent in 1923. It is the rarity of the species in its European breeding area which makes our discovery interesting—now one of its wintering centres is known—probably that of the Iberian contingent (Roux & Dupuy, 1972).

Table 3. Waterfowl other than Anatidae counted in the Senegal delta, 14–18 January 1972 (rounded totals)

	Djoudj National Park	Confluence of Lampsar & Djeuss	Mauritanian delta	Lake Guier	Other areas	Total
White Pelican *Pelecanus onocrotalus*	8,000		530		10	8,500
Pink-backed Pelican *Pelecanus rufescens*	110				160	270
White Stork *Ciconia ciconia*	7		7			14
Black Stork *Ciconia nigra*	2				14	16
Glossy Ibis *Plegadis falcinellus*	150	900	70	30		1,150
Spoonbill *Platalea leucorodia*	750		100		100	950
Greater Flamingo *Phoenicopterus ruber*	170		4,350		150	4,700
Crowned Crane *Balearica pavonina*	260		3	15		280
Black-tailed Godwit *Limosa limosa*	4,500	1,500	1,500	1,800	1,200	10,500
Ruff *Philomachus pugnax*	500,000	1,600		700	1,400	500,000
Avocet *Recurvirostra avosetta*	1		2,230		850	3,100

The population of Glossy Ibises is very close to that which we found in November 1958, the depression of Ndiaël then held nearly all the population of the delta for the night. It is not impossible that they nest in Senegal—as in the central delta of the Niger—but we do not have any indications despite the very extensive investigations carried out for 15 years on the reproduction of the waterfowl of the lower Senegal (Morel & Morel, 1962; Naurois, 1965b, 1969). We believe these Ibises to be migratory and of Palaearctic origin.

Regarding the Spoonbills *Platalea leucorodia* this is less doubtful: the important colonies of the Banc d'Arguin on the coast of Mauritania are only 400 km away, and young which we ringed in June 1960 were recovered in the delta in the following winter. However, are Spanish and Dutch birds not added here to the Mauritanian ones? At the Banc d'Arguin in 1960, we found a Spoonbill ringed in the Netherlands; in March 1961, we observed two there wearing rings of a different type to ours: clip rings, like those issued by the Rijksmuseum of Leiden. Since they reach the Saharan coast, the Dutch Spoonbills may likewise spread to Senegal. However, our earlier observations and the more recent ones of A. Dupuy (1971) did not allow us to assume the presence of such a number of Spoonbills in winter. In the Djoudj, where they roost, their flocks were mixed with several dozens of African Spoonbills.

The brackish etangs of the Mauritanian delta, from the Gadianguer to the lagune des Toumbos in the Aftout-es-Sahel, held the main part of the population of the Greater Flamingo *Phoenicopterus ruber*. We did not see more in 1958. These birds probably come from the colonies of the Banc d'Arguin, where the species nests erratically, and also from those of the Camargue, as several ringing recoveries have proved. We closely followed by 'plane each flight of Flamingos: we were looking for first-year birds and above all for the Lesser Flamingo. However, the flocks only comprised 'adults' of the large species.

Since the discovery in July 1965 of a breeding colony of Lesser Flamingos in the Aftout-es-Sahel (Naurois, 1965c), they do not seem to have been seen again in this region. They were not there in January 1972, nor on the coastal lakes of Cap Vert. In the middle of the Lagune des Toumbos, we located the site of a colony of Flamingos, no doubt several years old; although very eroded, the nests still formed visible bumps on the surface.

Crowned Cranes are the only cranes

known in Mauritania and Senegambia. At twilight, the birds coming from the north and west converge towards the Djoudj depression where they roost. The order of their population in the delta then must not be very much greater than 300.

Waders. We refer the reader to our earlier publications for all information on the phenology of wintering and the numerical status of the Palaearctic waders in the Senegal delta (Roux, 1959; Morel & Roux, 1966). We will only relate the original data concerning Black-tailed Godwit, Ruff and Avocet.

By day the Black-tailed Godwits disperse over the feeding sites and are difficult to check. They can only be counted at the places where they assemble, either for the night, or for bathing and resting in the day. We cannot therefore conclude that there was a decrease in the wintering population. This, however, would be quite likely, considering the reduction in aquatic habitats of the delta and very active shooting in the rice fields where they are considered harmful.

The Ruffs, on the other hand, remain extraordinarily abundant; on the edges of the depression of the Khar, in the Djoudj National Park, more than 500,000 assembled for the night. At the end of February, the same roost, transferred to the bank of the central lake, held nearly a million birds (G. Jarry, personal communication).

We had already observed Avocets wintering in the delta but always in a limited number. It was therefore a surprise to see such flocks of them on the Mauritanian etangs and the lagoons of the mouth of the river. Nearly 1,000 frequented the coastal lakes of Cap Vert and A. Dupuy (personal communication) was to see several hundreds of them in the delta of the Sine-Saloum in March. The wintering population on the west coast of Africa is therefore greater than was supposed—or than it was 10 years ago. Its increase could be related to the increase in the west European population. On the geographical origin of these wintering birds the only indication is the recovery in Basse Casamance of one ringed as a chick in Belgium.

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Summary

The central delta of the Niger was surveyed by air between 3 and 5 January 1972 and the Senegal delta from 14 to 18 January 1972. Details of the hydrological conditions are given. Attention was concentrated on the Anatidae, particularly those of Palaearctic origin. Useful information was also gained on many other types of waterfowl. Detailed lists of the birds counted are provided, together with assessments of their relative importance and the environmental features affecting their distribution.

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F. Roux, Co-ordinator of I.W.R.B. West African Survey, Laboratoire d'ornithologie, Museum National d'Histoire naturelle, 55 Rue de Buffon, 75 Paris 5.