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Use of Rice Fields by Birds in West Africa

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Abstract.—Rice fields in West Africa comprise mangrove swamp rice and rain-fed rice cultivations along the coast, rice fields in floodplains and river valleys, and inland irrigated cultivations. All these rice systems constitute important habitats for African and migratory Palaearctic waterbirds. Density counts reveal the presence of about 16 wetland-related birds per ha during the northern winter if the habitat is still damp or covered by water; this declines to about four birds/ha if the fields are dry. The coastal rice fields (South Senegal-Guinea-Conakry) harbour 1.17 million wetland-related birds during the northern winter, and the inland rice fields of Office du Niger (Mali) contain 730,000. In former floodplain areas, the high bird numbers in rice fields offer, to some degree, an ecological compensation for the loss of floodplains. In the Inner Niger Delta, for example, the construction of the Selingue Dam and the Office du Niger irrigation scheme resulted on average in the loss of 12% of the wintering waterbirds. However, the ecological loss is larger than these numbers suggest because most bird species in irrigated rice fields are common, while rare and endangered species are concentrated in the remaining West African floodplains that have not been converted to cultivated rice fields. *Received 1 August 2008, accepted 6 January 2010.*

Key words.—agriculture, bird densities, floodplains, man-made wetlands, rice fields, waterbirds, West Africa.

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African rice (*Oryza glaberrima*) was domesticated from wild rice (*Oryza barthii*) some 2,500 years ago, in what is today the Inner Niger Delta, Mali. However, Asian rice (*Oryza sativa*) has gradually replaced the local species in Africa, although crop failures in the Sahel occur more often in Asian rice. Africa hosts about 4% of the world's total area of rice cultivation, with over 90,000 km^2 planted in 2007 (International Rice Research Institute 2009). The largest area of cultivated rice is in Nigeria (30,000 km^2). Other major producers, in decreasing order of rice area, are Madagascar, Guinea, Egypt, Tanzania, Sierra Leone, Democratic Republic of the Congo, Mali, Côte d'Ivoire, Mozambique, Ghana, Liberia, Uganda, Chad, Senegal and Guinea Bissau. Small areas (<500 km^2) of rice are planted in various other countries. Rice cultivation throughout Africa has more than tripled in surface area since 1961, with major increases in Nigeria, Tanzania, Congo, Ghana and Uganda. Significant expansions of rice fields have occurred in sub-Saharan countries where Palaearctic migrant waterbirds spend the northern winter, and where the availability of wetlands could be critical for the survival of these migrants.

For coastal West Africa, Bos *et al.* (2006) estimated 1,128 km^2 of active rice cultivation in the coastal mangrove zone in 2000-2005. Earlier estimates from the region were higher but combined both cultivated and fallow fields. Van der Kamp *et al.* (2008) estimated that in the Casamance area of Senegal in 2007 about half of the total rice extent was actually in cultivation. During our own field work in the region in the 1980s we did not attempt to quantify how much of the land lay fallow or was abandoned, but we estimate that it was less than a quarter. Local declines in the exploited area may also have occurred. In contrast to the overall increase of rice cultivation in Africa, the area of rice in the coastal zone of southern Senegal and Guinea Bissau in the 1980s was probably twice as large as in the early 2000s. As elsewhere in Africa, people are leaving the countryside in favour of cities, and rural depopulation (e.g. in the northern half of the Inner Niger Delta; Zwarts and Kone 2005a), together with political instability since the early 1980s, reduced the labour force and cultivation in many coastal rice regions (Cormier-Salem 1999).

Here, we quantify the use of rice fields by waterbirds in West Africa, based on the sampling of bird densities in rice fields in Mali, Senegal, Guinea and Guinea-Bissau in 2004-2006. The increasing demand for rice cultivations in West Africa justifies the question regarding to what extent rice fields function as a substitute for natural wetlands, in particular the natural floodplains that are replaced by rice cultivations. The original data on which this review is based are from Wymenga *et al.* (2005), Bos *et al.* (2006) and Zwarts *et al.* (2009).

FARMING PRACTICES

In West Africa (Fig. 1), farming practices differ depending on the availability of fresh water. Mangrove swamp rice, in the tidal zone, and lowland rain-fed rice cultivations are found along the coast from southern Senegal to the south where rainfall is abundant. To the north, with less and more unpredictable rainfall, rice is grown in floodplains and river valleys. In the valleys, flood recession cultures are practised. Large irrigation schemes have been set up in inland depressions and drained floodplains. The annual production of these different rice farming systems varies, depending on management and physical constraints. In coastal West Africa the annual yield amounts to 1-2 t/ha, compared with 4-6 t/ha in the inland irrigated areas where rice is grown on a larger scale. While the costs of traditional rice growing are limited to manpower, the costs of the modern irrigation systems are high, due to the construction and maintenance of the irrigation schemes. These costs, however, are partly hidden because the infrastructure for large-scale irrigated rice is heavily subsidised. Nevertheless, rice imported from Asia is cheaper than locally grown rice, and Sahel countries safeguard their own farmers through import taxes, with the aim of achieving food-security and keeping countries self-supporting. The large-scale irrigation schemes in West Africa, constructed in the second half of the 20th century, often have been detrimental to natural floodplains. The large irrigation scheme of Office du Niger in Mali annually takes so much water that the flooded area of the Inner Niger Delta, just downstream, is reduced by some 300 km^2. Floodplains in the Logone Valley, Cameroon, and the Senegal Delta have been embanked and converted into irrigated land. Although much natural wetland habitat has been lost due to water diversions, irrigated areas and reservoirs might be considered artificial wetlands, offering some compensation for the loss of floodplains. Small-scale irrigation schemes that reclaimed the coastal mangrove belt between Gambia and Sierra Leone store the rainwater in embanked areas, and farmers have to control salt- and freshwater levels, as well as soil acidity and salinity.

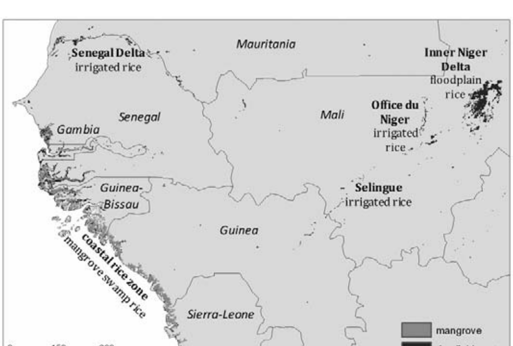

Figure 1. Bird density in rice fields was measured in five areas: the coastal rice fields between Gambia and Guinea, the rice fields on the floodplains of the Inner Niger Delta, and in the irrigated rice fields in the Senegal Delta, near Lake Selingue, and in the area of Office du Niger.

On the floodplains, farmers use a rice variety that is well adapted to grow during rising water associated with seasonal flooding. The plants can grow 3-4 cm a day and thus keep up with the rising water level during the flood. The stems may eventually be 5 m tall, and after about three months of flooding, the rice can be harvested during receding water. Much can go awry in such a system. If there is no rain before the flood, the seed does not germinate before the area is covered by water. If there has been sufficient rain for rice to sprout, the rice still needs water to grow, meaning that the flood must arrive within two weeks of the last rains. If the flood is low, the yield will be poor. If there has been enough rain, but the flood is higher than expected, production will be low. If the growing of rice has been successful, the ripening grain must be protected later on against seed-eating birds. Production of

65,000 t of rice is necessary to feed all 800,000 people in the Inner Niger Delta, but this level was not reached in four years between 1987 and 2002 (Zwarts and Kone 2005b). To enhance rice production, dykes and sluices have been built to stem the receding water, but floods were not as high as anticipated in most years and the embanked areas were only partly flooded between 1970 and 2005. The total surface area cultivated for rice in the Inner Niger Delta has increased from 160 km^2 in 1920 to 3,400 km^2 around 1990, of which 140 km^2 is actively irrigated (Zwarts and Kone 2005b).

Along the coast, rice polders are located in the tidal marshes and were reclaimed from mangrove habitat in the zone from Gambia to Sierra Leone. Rice is grown between August and January, but natural succession results in dense vegetation in the rainy season from May to October. Prior to planting, the vegetation is cleared from the fields and deposited on small dams surrounding the parcels. A part of the sod is used to improve the dams, and the remainder turned on the spot. The ditches are deepened and the mud is laid down on the ridges. As a result the ground is completely bare before the rice is planted. Subsequently ditches may need to be deepened and ridges reconstructed. Rice farmers use seedbeds to germinate the rice seed, and this prevents seed predation, e.g. by Black-tailed Godwits (*Limosa limosa*). Rice fields are encircled by low dams, some 30-50 cm wide. Abandoned rice fields in the tidal zone may transform back into mangrove or change into bare sand- and mudflats. Abandoned rice fields in the rain-fed zone above the high tide line may convert into shallow backwaters.

Irrigated rice needs a lot of water, therefore rice growing is an anomaly in the Sahel, where the climate is more suited to drought-resistant and heat-tolerant millet and sorghum, which have been grown there for centuries. Nevertheless, rice has become the staple food of people in the Sahel. The Office du Niger in Mali, the largest irrigation scheme in West Africa (740 km^2), annually produces 333,000 t of rice (data from 2001; Wymenga *et al.* 2005), which constitutes 40% of the country's rice production. The region is the rice granary of Mali with a more or less secured production, independent of rainfall and river flow, where 250,000 people make a living (Bonneval *et al.* 2002). The cost of this production is the extraction of water from the Niger River, reducing flows to the Inner Niger Delta and limiting profitable rice cultivation on the floodplains. Independent of the river discharge, Office du Niger takes 2.5 km^3 of water per year, which is equivalent to 6% of the annual flow in a wet year (1995) and as much as 16% in a dry year (1990). Due to upstream irrigation, the risk of crop failure in the Inner Niger Delta has increased, especially in dry years. The cultivated rice zone of Office du Niger has expanded, on average, by 2.3% annually between 1983 and 2001. Water use has remained stable over this period, but yields have trebled to 6 t/ha. Water use has declined from 45,000 l/kg rice in the mid-1980s to less than 10,000 l/kg in 2000. The development plan launched by Office du Niger in 1998 envisages a further expansion of at least 140-400 km^2 of irrigated rice fields by 2020 (Keita *et al.* 2002). Irrigation schemes are normally characterized by rectangular fields and straight canals, diverting water into smaller canals, and finally into irrigation ditches among rice parcels. However, the Office du Niger uses former river branches to direct water to the various irrigation schemes. These river branches have been turned into permanent wetlands, mainly covered by cattail (*Typha australis*) vegetation of varying density. Cattail also abounds along canals and ditches, while the shallow water is covered by water lilies (*Nymphea* sp.), Water Fern (*Azolla africana*), Knotweed (*Polygonum senegalense*) and recent invaders such as Water Hyacinth (*Eichhornia crassipes*) since the early 1990s and Kariba Weed (*Salvinia molesta*) since the late 1990s. The overall impression of this irrigation scheme is therefore more "natural" than that of many other schemes.

METHODS

Between 2002 and 2006, birds were studied in various regions of rice cultivation in West Africa: 1) the Inner Niger Delta; 2) the Office du Niger irrigation scheme (Wymenga *et al.* 2005); 3) the Selingue irrigation scheme in Mali (van der Kamp *et al.* 2005); 4) the Senegal Delta (Zwarts *et al.* 2009); and 5) in coastal rice fields in Gambia, southern Senegal, Guinea-Bissau and Guinea (Bos *et al.* 2006). To estimate bird numbers in rice fields we performed density counts, i.e. accurate bird counts in small plots of known size.

Only 6% of the rice field plots that we censused in the floodplains were dry in November, but the proportion gradually increased to 35% in January and 62% in February. This trend was similar in the coastal zone, although less marked: 6% in November, 16% in December, 32% in January and 38% in February. No such trend was visible in irrigated fields: between November and February 50% of the plots were dry (but only 24% in July). Deep water is rare in rice fields: less than 1% of the plots had depths greater than 80 cm, and only 3% had depths between 40-80 cm.

For logistical reasons we used stratified sampling, covering the series of dry to deeply inundated and bare to densely vegetated rice fields. Plot area averaged 2.99 ha, and was measured with a calibrated laser beam in an adapted binocular, calculated from GPS-readings, and wherever possible checked by foot. We recorded habitat type, vegetation height, vegetation density and water depth for each plot on pre-printed forms, and also the date, local time and coordinates. All wetland-related birds were counted as accurately as possible by walking through the plots while flushing birds. Distances between plots were large enough to avoid double counts. Altogether, 4,701 density counts have been conducted between November and February, with another 317 counts in irrigated rice fields during July. Census methods and stratification are described in more detail by Zwarts *et al.* (2009).

BIRD USE

Compared to floodplains and irrigated rice fields, coastal rice fields have lower bird densities but higher bird diversity (Table 1). Coastal rice fields are interspersed with fallow land, and adjoined by mangroves, vegetated upper tidal flats and ponds with aquatic vegetation. The mix of habitats attracts many more species (e.g. Sedge Warbler *Acrocephalus schoenobaenus*) than those typical of rice fields proper. Moreover, rice fields are used as high tide roosts by birds that feed on tidal flats during low tide (e.g. Whimbrel *Numenius phaeopus*, Curlew Sandpiper *Calidris ferruginea*); conversely, mangroves function as breeding and roosting sites for birds that feed in rice fields (e.g. Little Egret *Egretta garzetta*, African Spoonbill *Platalea alba*).

The densities given in Table 1 may be used to estimate the total numbers of birds present in the three rice field types. The irrigated rice fields in the Inner Niger Delta measure 140 km^2, and those on the floodplains 2,000 km^2 (Fig. 1). Given these multipliers, we estimate that the total number of Western Yellow Wagtails (*Motacilla flava*) inhabiting these rice fields varies between 460,000 when dry and 60,000 when wet. This difference between wet and dry conditions is much larger for the other species (Table 1). Given the gradual decline in the surface area of wet rice fields from 94% in November to 36% in February, a decline of bird numbers present on rice fields is to be expected. This is the reason why, in the dry season, waterbirds get progressively concentrated in bourgou fields, floating grassfields of *Echinochloa stagnina* and *Vossia cuspidata*, which remain covered by water for much longer than rice fields. The total numbers of birds calculated to be present in the 680 km^2 of irrigated rice fields in and around the Office du Niger and in the 1,120 km^2 of coastal rice fields amount to 0.73 and 1.16 million birds respectively (Table 2). These figures should be read with caution, however, as the density estimates are often associated with large standard errors (Table 1); hence, extrapolated population estimates will have broad confidence intervals associated with them. Our estimate of 76,000 Black-tailed Godwits, for example, is based on observations of birds in only 20 plots, with 99% of counts devoid of godwits. Estimates based on density counts are likely to be much more precise for species such as Western Yellow Wagtail that were scattered widely across the area, and which have more precise estimates of mean density (i.e. smaller standard errors).

When rice fields successively dry out in the course of the northern winter, Palaearctic waterbirds concentrate in the remaining wet areas before returning to the northern breeding grounds. For instance, densities of Western Cattle Egrets (*Bubulcus ibis*) and Squacco Herons (*Ardeola ralloides*) doubled between November and February. On the other hand, most Wood Sandpipers (*Tringa glareola*) left the rice fields in the course of their wintering period. The density of Western Yellow Wagtails, however, remained similar in wet rice fields between November and February.

Table 1. Average bird density per 1000 ha (± SE) in three types of rice fields, either wet (damp or covered by water) or dry, between November and February 2002-2006 (see also Fig. 2).

	Floodplain		Irrigation		Coastal	
	Wet	Dry	Wet	Dry	Wet	Dry
Number of counts	112	31	598	560	2,332	718
Grey Heron *Ardea cinerea*	37 ± 23	0	15 ± 6	0	158 ± 62	42 ± 18
Black-headed Heron *Ardea melanocephala*	302 ± 292	0	3 ± 3	0	61 ± 20	30 ± 13
Purple Heron *Ardea purpurea*	31 ± 18	0	1 ± 1	2 ± 2	52 ± 14	12 ± 8
Squacco Heron *Ardeola ralloides*	60 ± 44	0	293 ± 85	6 ± 3	700 ± 109	212 ± 87
Western Cattle Egret *Bubulcus ibis*	3,060 ± 880	1,801 ± 1,558	2,613 ± 478	927 ± 220	1,421 ± 244	1,047 ± 226
Little Egret *Egretta garzetta*	40 ± 23	0	130 ± 49	0	630 ± 76	80 ± 30
Intermediate Egret *Egretta intermedia*	6 ± 6	0	258 ± 102	0	22 ± 7	6 ± 5
Western Great Egret *Ardea alba*	0	0	22 ± 18	0	189 ± 51	55 ± 31
Striated Heron *Butorides striata*	0	0	0	0	228 ± 138	17 ± 17
Hamerkop *Scopus umbretta*	0	0	62 ± 37	0	93 ± 21	30 ± 15
African Jacana *Actophilornis africanus*	131 ± 120	0	167 ± 102	0	181 ± 64	0
Black-winged Stilt *Himantopus himantopus*	513 ± 477	0	277 ± 86	0	186 ± 39	0
Spur-winged Lapwing *Vanellus spinosus*	384 ± 144	248 ± 232	1,652 ± 385	466 ± 80	742 ± 117	272 ± 64
African Wattled Lapwing *Vanellus senegallus*	12 ± 12	0	589 ± 150	83 ± 49	378 ± 96	429 ± 94
Little Stint *Calidris minuta*	658 ± 441	0	147 ± 81	2 ± 2	10 ± 5	0
Green Sandpiper *Tringa ochropus*	0	0	15 ± 8	0	70 ± 21	0
Wood Sandpiper *Tringa glareola*	937 ± 374	0	3,668 ± 832	1 ± 1	618 ± 81	6 ± 4
Common Greenshank *Tringa nebularia*	61 ± 60	0	61 ± 39	0	300 ± 57	15 ± 12
Ruff *Philomachus pugnax*	5,311 ± 2,707	0	182 ± 130	149 ± 149	226 ± 90	0
Spotted Redshank *Tringa erythropus*	60 ± 60	0	0	0	95 ± 44	0
Common Sandpiper *Actitis hypoleucos*	0	0	23 ± 10	1 ± 1	371 ± 39	34 ± 14
Crested Lark *Galerida cristata*	1,379 ± 379	104 ± 48	261 ± 147	429 ± 73	30 ± 11	16 ± 16
Western Yellow Wagtail *Motacilla flava*	2,409 ± 619	2,194 ± 2,094	8,784 ± 1,743	1,522 ± 244	2,767 ± 229	411 ± 96
Sedge Warbler *Acrocephalus schoenobaenus*	0	0	0	0	298 ± 152	0
Zitting Cisticola *Cisticola juncidis*	759 ± 400	1,273 ± 944	138 ± 43	218 ± 60	933 ± 104	764 ± 160
Other species	3,493	49	414	33	436	157
TOTAL	19,641	5,670	19,781	3,852	11,235	3,638

Table 2. Estimated total numbers of wetland-related birds present in the rice fields of Office du Niger and other irrigated rice schemes in the immediate surroundings (surface area: 680 km^2) and in coastal rice fields (surface area: 1120 km^2) in November-February. Estimates are based on extrapolations of mean densities from sampled areas to the entire area of rice within a region.

	Office du Niger	Coastal rice
Number of counts	716	3,051
Reed Cormorant *Microcarbo africanus*		2,927
Grey Heron *Ardea cinerea*	702	14,605
Black-headed Heron *Ardea melanocephala*		6,003
Purple Heron *Ardea purpurea*		4,839
Western Great Egret *Ardea alba*		17,632
Intermediate Egret *Egretta intermedia*	5,806	2,033
Little Egret *Egretta garzetta*	2,019	56,961
Western Cattle Egret *Bubulcus ibis*	84,295	149,257
Squacco Heron *Ardeola ralloides*	4,903	65,547
Striated Heron *Butorides striata*		20,012
Hamerkop *Scopus umbretta*	121	8,731
African Sacred Ibis *Threskiornis aethiopicus*		445
White-faced Whistling Duck *Dendrocygna viduata*		9,775
African Jacana *Actophilornis africanus*		15,490
Lesser Jacana *Microparra capensis*		506
Black-winged Stilt *Himantopus himantopus*	12,189	15,913
Collared Pratincole *Glareola pratincola*	7,163	1,527
Greater Painted Snipe *Rostratula benghalensis*		1,404
Spur-winged Lapwing *Vanellus spinosus*	87,336	70,684
African Wattled Lapwing *Vanellus senegallus*		43,684
White-crowned Lapwing *Vanellus albiceps*		3,746
Common Ringed Plover *Charadrius hiaticula*		4,270
Little Ringed Plover *Charadrius dubius*		1,632
Spotted Redshank *Tringa erythropus*		8,140
Marsh Sandpiper *Tringa stagnatilis*		1,336
Common Greenshank *Tringa nebularia*	1,137	26,109
Green Sandpiper *Tringa ochropus*	171	5,951
Wood Sandpiper *Tringa glareola*	82,082	53,105
Common Sandpiper *Actitis hypoleucos*		32,676
Common Snipe *Gallinago gallinago*	2,058	21,369
Little Stint *Calidris minuta*	2,198	855
Ruff *Philomachus pugnax*	189	19,382
Black-tailed Godwit *Limosa limosa*		76,008
Pied Kingfisher *Ceryle rudis*		7,961
Western Yellow Wagtail *Motacilla flava*	398,082	247,708
Red-throated Pipit *Anthus cervinus*		844
Plain-backed Pipit *Anthus leucophrys*		11,684
Yellow-throated Longclaw *Macronyx croceus*		5,552
Sedge Warbler *Acrocephalus schoenobaenus*		25,531
Savi's Warbler *Locustella luscinioides*		901
Bluethroat *Luscinia svecica*		931
Crested Lark *Galerida cristata*	27,155	3,000
Zitting Cisticola *Cisticola juncidis*	9,933	100,047
Prinia spp.	3,222	230
TOTAL	732,019	1,168,382

The concentration of waterbirds in the few remaining waterlogged areas can also be illustrated by comparing irrigated rice fields in November-February with those in July, at the end of the dry season. The density of African Jacanas (*Actophilornis africanus*), for instance, was 25 times higher in July than in winter (2.2 vs. 0.09 birds/ha). For most waterbirds, irrigated rice fields are among the very few wetland habitats available in the Sahel at the end of the dry season.

Significance for Birds

The high bird numbers in wet rice fields may indeed suggest an ecological compensation for the loss of floodplain wetlands; however, such a conclusion should be interpreted with caution. Most bird species in irrigated rice fields belong to common species, such as Western Cattle Egret, Spur-winged Lapwing (*Vanellus spinosus*) and Wood Sandpiper. Rare and endangered species, such as Glossy Ibis (*Plegadis falcinellus*), Purple Heron (*Ardea purpurea*), Garganey (*Anas querquedula*) and Ruff (*Philomachus pugnax*), which are common in West African floodplain areas, are rare in cultivated rice fields (Wymenga *et al.* 2005; Table 2). Floodplain loss also affects a much wider range of bird species. In the Inner Niger Delta, for example, the construction of the Selingue Dam and the Office du Niger irrigation scheme resulted in the loss of 12% of the wintering waterbirds. If the proposed Fomi Dam comes into existence this loss is expected to grow to 44%. The newly created, irrigation zones have compensated for only a tiny fraction of these losses (Wymenga *et al.* 2005: 217).

The extent of West African mangroves has not declined much in recent decades, except in southern Senegal during the drought in the 1980s (Bos *et al.* 2006), but mangrove rice and tidal rice seem to be in decline, although trends differ throughout the region (e.g. Cormier-Salem 1999). The bird numbers estimated for the coastal rice fields (Table 2) are based upon a surface area of 1,120 km^2, which is probably half of the area available in the early 1980s. Large losses of available rice habitat would have dire consequences for migratory birds wintering in sub-Saharan coastal rice fields, such as West European Black-tailed Godwits (Zwarts *et al.* 2009). African species may suffer as well, for example Black Crowned Cranes (*Balearica pavonina*), which are still present in relatively large numbers (Beilfuss *et al.* 2007).

Apart from vegetation type, water level was the most important variable explaining variation in bird densities (Fig. 2). For example, herons and Little Egrets prefer a water depth of at least 20 cm, and Western Cattle Egrets avoid rice fields with more than 40 cm of water (Fig. 2A). Sedge Warblers were found in rice fields with shallow water, which is also the preferred habitat of Western Yellow Wagtails, but the latter species can also be observed in dry fields and in rice standing in deep water (Fig. 2B). Shorebirds typically

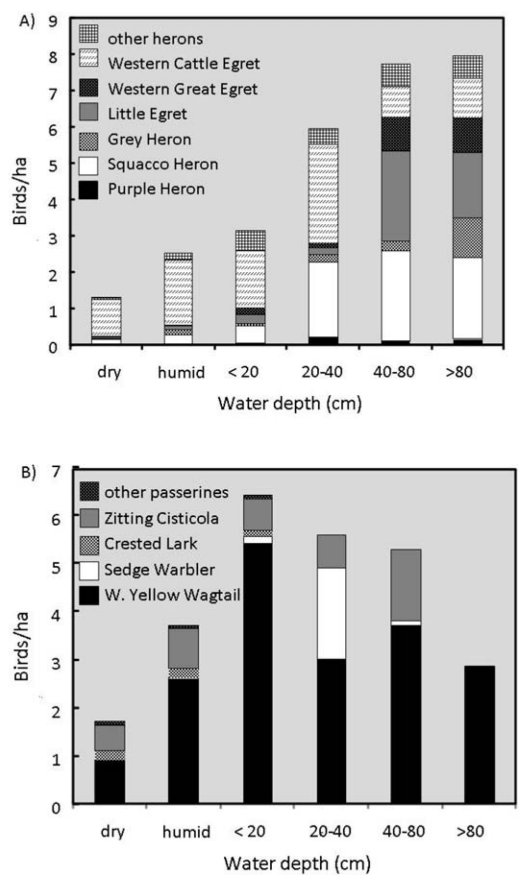

Figure 2. Average bird density of (A) herons and egrets and (B) passerines as a function of water depth in rice fields. Data collected in November-February 2002-2006, combined for floodplains, irrigation schemes and costal rice fields in Mali, Senegal, Guinea-Bissau and Guinea. Other herons: Black-headed Heron *Ardea melanocephala* (0.05/ha), Intermediate Egret *Egretta intermedia* (0.05/ha), Striated Heron *Butorides striata* (0.13/ha), Hamerkop *Scopus umbretta* (0.06/ha). Other passerines: Red-throated Pipit *Anthus cervinus*, Savi's Warbler *Locustella luscinioides*, Bluethroat *Luscinia svecica* and Prinia spp. (all 0.01/ha), and Yellow-throated Longclaw *Macronyx croceus* (0.03/ha).

reached their highest densities (4-6 birds/ha) in shallow water.

The density of waterbirds averaged eleven birds/ha in wet coastal rice fields, but only half as many in dry rice fields (Table 1). Such densities are in the same order of magnitude as those from floodplains and irrigated rice fields. The species composition was about the same in the various types of rice field, but densities varied relative to the presence or absence of water and the type of rice field. The most ubiquitous species across all types of rice field was the Western Yellow Wagtail. In coastal and irrigated rice fields, Western Yellow Wagtails were common in wet habitats, but scarce when rice fields had dried out. On the floodplains, however, Western Yellow Wagtails were common in dry rice fields as well. Here, the flies accompanying grazing cattle that use the fields after the harvest offer plenty of food for insectivores.

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