THE DIET OF RUFFS AND BLACKTAILED GODWITS IN SENEGAL

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SUMMARY

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A study of the diet of Blacktailed Godwits *Limosa limosa* and Ruffs *Philomachus pugnax* by direct examination of stomach contents emphasizes the importance of rice, which accounted for over 80% of the items eaten. Rice was available at planting time in July–August and after the harvest in November–December. Thus fat deposition for migration, between January and April–May, is based on a rice diet (cultivated or wild rice). Very little animal matter was eaten. The choice of feeding ground will govern food choice among the available food. Birds which have eaten most are those which have found their preferred food.

RÉSUMÉ

L'étude du régime alimentaire des Barges à queue noire *Limosa limosa* et des Chevaliers combattants *Philomachus pugnax* par examen de contenus stomacaux montre l'importance du riz qui atteignait 80% de la nourriture ingérée. Le riz était disponible au moment des semis en Juillet–Aout et après la moisson qui avait lieu en Novembre–Décembre. Ainsi, l'accumulation de graisses pour la migration se fait sur une alimentation de riz (cultivé ou sauvage). Très peu de proies animales ont été trouvées. Le choix des terrains de gagnage influe sur le choix de la nourriture parmi les aliments disponibles. Les oiseaux qui ont mangé le plus sont ceux qui ont trouvé leur nourriture préférée.

INTRODUCTION

It is now appreciated that the non-breeding period constitutes the major part of the annual cycle in migrant birds. However, we still lack information on the conditions which these birds face on their wintering grounds (Weller & Batt 1988). This study of the diet of two common waders improves our knowledge of their activities on the wintering grounds.

Ruffs *Philomachus pugnax* breed, according to Urban *et al.* (1986) from, Scandinavia to eastern-most Siberia, with a few also in temperate central and western Europe. In winter their range is immense, extending from China and Japan to South Africa (Bannerman 1953). Cramp & Simmons (1983) wrote that the marked contraction of breeding range, especially in the south, in the last 200 years, is due mainly to drainage of wetlands. In the Senegal delta, at least 500 000 and at times more than one million birds may be present (Roux 1973). All Ruffs leave the Senegal delta before the breeding season.

Blacktailed Godwits *Limosa limosa* breed from western and central Europe to central and eastern Asia (Urban *et al.* 1986). According to Bannerman (1953), the European and west Siberian subspecies, nominate limosa, winters mainly in Africa. Some non-breeding birds stay during the summer in the Senegal delta. Glutz *et al.* (1977) wrote that Blacktailed Godwit populations have shown a marked increase, especially in the 20th century in north-west Europe, due mainly to its ability to adapt to man-made habitat changes, especially the creation of meadows, but they are now vulnerable to agricultural improvements such as drainage and earlier, rotary mowing. In the Senegal delta, the number of Blacktailed Godwits has been drastically reduced during the past 30 years, but it seems, according to Altenburg & Van der Kamp (1985), that more Blacktailed Godwits now winter further south than they did previously, particularly in the rice field areas of Guinea. From 125–140 000 Blacktailed Godwits winter each year near the Atlantic coast of west Africa.

The two species studied here are gregarious and diurnal, although they do fly and sometimes feed by night. Usually these birds have two peak feeding periods, in the morning and in the late afternoon (Tréca 1983, 1984). No detailed study has been made of the diet of Ruffs on their wintering grounds. They are said to feed on locally abundant foods: adult and larval chironomids in Sweden (Kallander 1977 in Cramp & Simmons 1983), southern Africa (Taylor 1964 in Cramp Simmons 1983) and Zambia (Mc Laren 1955 in Cramp & Simmons 1983). Guillou Debenay (1988) have also reported several kinds of abundant animal prey in Senegal.

Blacktailed Godwits feed chiefly on invertebrates although they are known to take some plant material in winter and on migration (Cramp & Simmons 1983). In the central delta of the Niger, Guichard (1947, in Cramp & Simmons (1983)) found only seeds of grasses and sedge *Cyperus esculentus* in Blacktailed Godwits' stomachs. In the same area, on 6 000 ha of rice fields, large flocks of Blacktailed Godwits were estimated to take 3–6 tons of seed per day (Roux 1973). In Guinea Bissau, Altenburg van der Kamp (1985) reported large amounts of rice and very little animal prey.

This study is based on the examination of numerous stomach contents of Blacktailed Godwits and Ruffs killed by hunters in the Senegal delta, an area where rice growing is expanding rapidly, but where numerous ponds and lakes still remain, representative of the natural ecosystem of the Senegal delta prior to large-scale irrigation (Fig 1). Our knowledge of the environment is still poor,

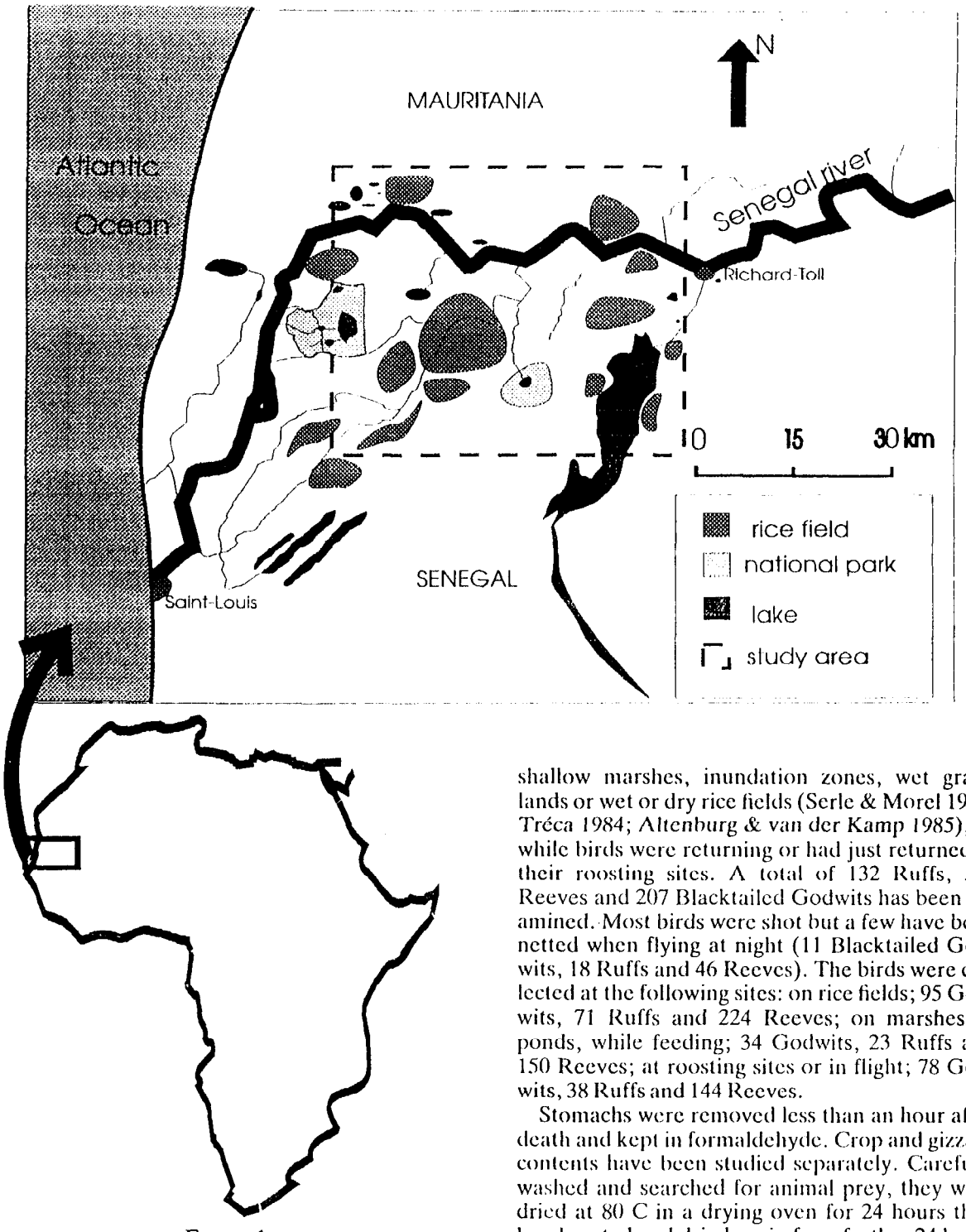

FIGURE 1

Map of the study area in the Senegal delta.

particularly regarding the food available to the birds. These diet studies are essential to assess the birds' food preferences and to control damage to rice crops (Tréca 1989), with a view to better management of the environment and protection of the bird species.

METHODS

Samples were collected between 1972 and 1979, either directly on the different feeding grounds: shallow marshes, inundation zones, wet grasslands or wet or dry rice fields (Serle & Morel 1979; Tréca 1984; Altenburg & van der Kamp 1985), or while birds were returning or had just returned to their roosting sites. A total of 132 Ruffs, 518 Reeves and 207 Blacktailed Godwits has been examined. Most birds were shot but a few have been netted when flying at night (11 Blacktailed Godwits, 18 Ruffs and 46 Reeves). The birds were collected at the following sites: on rice fields; 95 Godwits, 71 Ruffs and 224 Reeves; on marshes or ponds, while feeding; 34 Godwits, 23 Ruffs and 150 Reeves; at roosting sites or in flight; 78 Godwits, 38 Ruffs and 144 Reeves.

Stomachs were removed less than an hour after death and kept in formaldehyde. Crop and gizzard contents have been studied separately. Carefully washed and searched for animal prey, they were dried at 80 C in a drying oven for 24 hours then hand-sorted and dried again for a further 24 hours at 80 C. Seeds and other plant material have usually been identified to species. For analysis, some seeds have been grouped by family or in a category called "other seeds". Only well-identifiable items have been taken into account for the diet studies and weighed. Fine or coarse fragments hardly identifiable serve only for the calculation of the quantity of food eaten (Tréca 1990).

Since animal prey were scarce, stomach contents analysis has been done by weighing dried items. This method is often used instead of the volume method when seeds are far more numerous than animal remains (e.g. Tamisier 1971; Owen 1972; Sugden 1973; Schricke 1983).

Presupposing that the significant difference in size between Ruffs and Reeves would lead to differences in feeding behaviour and diet, males and females have been separated in the tables. Figure 2 shows that differences between the two sexes do exist but that they are statistically significant only in some food categories and only in some seasons.

Field observations during this study were useful to determine the source of food of these birds. For example, rice found in stomachs may have been eaten on seedlings or picked up on the ground after harvest and not taken from standing ears (Tréca 1984, Altenburg & Van der Kamp 1985).

Relative Abundance indicates the percentage (by dry weight) of each component found in the stomach contents, and Encounter Frequency the number of times that a particular food type was found. As a bird may have eaten several different foods, the sum of all Encounter Frequencies may be more than 100%. The total of all Encounter Frequencies can be adjusted to 100% using a correction factor, and these corrected frequencies are called Specific Contributions, a term used by botanists. Thus the direct comparison between Relative Abundance (RA) and Specific Contributions (SC) will give an idea of the birds' selection of preferred foods. But since the actual availability of food is unknown, it would be only a rough guide to the birds' preferences. Assuming that Specific Contributions are close (but only to a certain extent) to the food availability in the field, ratios close to 1 mean a food type eaten in proportions not too different to its availability on the feeding grounds.

RESULTS

Plant food

Table 1 shows that the diet of the three birds studied contains few plant species, and cultivated or wild rice accounts for more than 80% of the total annual food intake for Blacktailed Godwits, Ruffs and Reeves. Other foods are mainly Cyperaceae tubers for Blacktailed Godwits and grass seeds for Ruffs and Reeves. Reeves took (by percentage) less cultivated rice. This suggests segregation of the sexes on the feeding grounds, which is not evident from field observations.

Comparison in Table 1 between Relative Abundance and Encounter Frequencies shows that only half the birds have eaten cultivated rice, but for Godwits and Ruffs, the amount of cultivated rice in the stomachs is high (about 70%). On the other hand Reeves, which have also fed in rice fields, have eaten less of it.

As for the Cyperaceae tubers, they are not often encountered but largely eaten by Godwits, the reason being that the birds have to adopt a special behaviour to find these tubers low in the mud. The Godwit uses its long sensitive beak to find these tubers, whereas other seeds are located visually. Thus only a few Godwits have eaten these tubers (3,4%) but they have eaten a lot of them (12%).

Small seeds such as wild grasses or water lily seeds are abundant in places where Godwits, Ruffs and Reeves feed. These small seeds are sometimes eaten by birds which find them, but in small quantities. This shows that the birds' preferences are for large seeds such as rice.

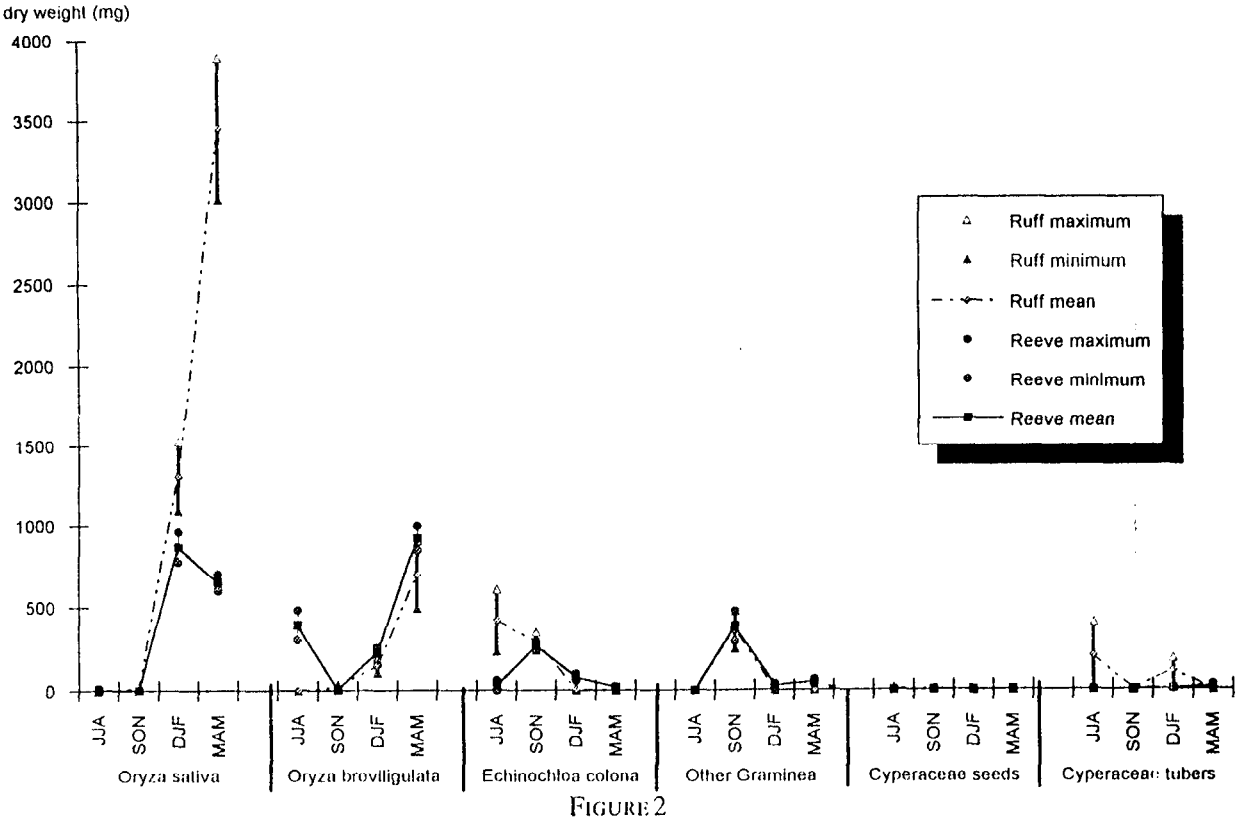

FIGURE 2

Seasonal differences in diet between Ruffs and Reeves for the main food items showing means, ranges and standard deviations.

TABLE 1
Relative Abundance, Encounter Frequencies and ratios RA/SC of plant food found in stomach contents of Blacktailed Godwits, Ruffs and Reeves (overall means)

		Relative Abundance			Encounter Frequencies			Ratios RA/SC		
		Godwits	Ruffs	Reeves	Godwits	Ruffs	Reeves	Godwits	Ruffs	Reeves
number of birds		207	132	518	207	132	518	207	132	518
total dry weights of items in all stomachs		217,85 g	225,17 g	621,53 g						
mean dry weight of stomach content/bird		1,05 g	1,71 g	1,20 g						
cultivated rie	*Oryza sativa*	71,17%	69,49%	42,70%	51,69%	54,55%	57,92%	1,56	2,57	1,48
wild rice	*Oryza breviligulata*	12,52%	11,73%	39,84%	25,60%	41,67%	53,47%	0,56	0,57	1,50
TOTAL RICE		83,68%	81,21%	82,54%						
wild Graminea	*Echinochloa colona*	0,25%	7,34%	6,95%	3,86%	46,21%	39,38%	0,07	0,32	0,35
	Panicum laetum	0,62%	7,75%	8,76%	3,86%	20,45%	19,31%	0,49	0,76	0,91
	other Graminea seeds	0,02%	0,05%	0,08%	1,45%	8,33%	6,76%	0,00	0,01	0,02
TOTAL GRAMINEA (without rice)		0,90%	15,14%	15,79%						
Nymphaeaceae	*Nymphea sp.*	1,63%	0,08%	0,56%	10,14%	6,06%	7,34%	0,18	0,03	1,15
Cyperaceae	seeds	0,02%	0,17%	0,08%	3,38%	9,85%	6,76%	0,01	0,03	0,02
	tubers	11,98%	2,99%	0,84%	3,38%	4,95%	1,93%	4,02	0,61	0,88
Gentianaceae	*Limnanthemum senegalense*	0,00%	0,00%	0,05%	0,97%	1,52%	2,21%	*	0,01	0,01
Other seeds		1,78%	0,40%	0,15%	9,18%	8,33%	5,79%	0,22	0,1	0,05
TOTAL		100,00%	100,00%	100,00%	115,53%	201,52%	200,97%			
Correction factor to calculate SC					1/1,1553	1/2,0152	1/2,0097			

* seeds eaten by less than 1% of Godwits, ratio non-calculated

Thus, as can be seen in Table 1, the RA/SC ratio is greater than 1 for cultivated rice in the three species. This ratio is also greater than 1 for wild rice and water-lily seeds in Reeves, which have sometimes different feeding grounds from Ruffs, and the ratio is far greater than one for Cyperaceae tubers in Blacktailed Godwits. These are the birds' preferred foods over the whole year.

However, each kind of food is not available in large quantities the whole year round. Figs 3 to 5 show the seasonal variations of vegetable items eaten by Blacktailed Godwits, Ruffs and Reeves respectively, by three month intervals. Since ploughing occurred in June, planting time was July–August and harvest time December–January, I have started the year in June. Figure 3

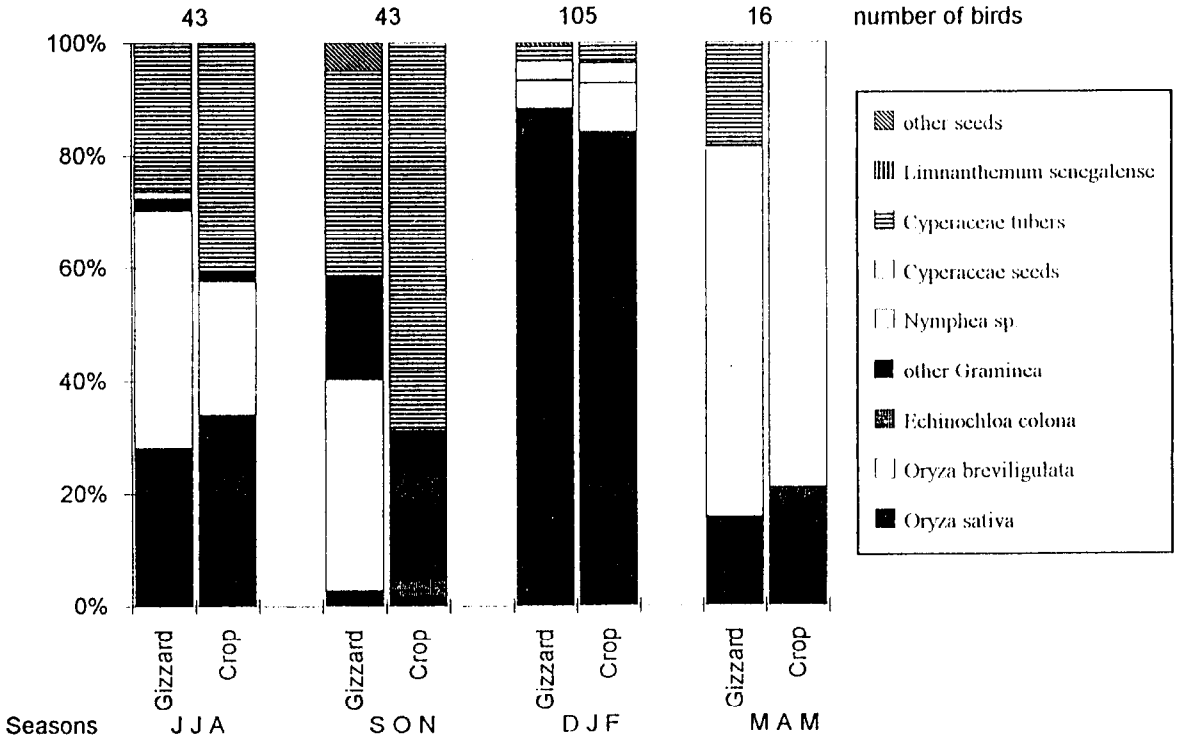

FIGURE 3
Seasonal variations in the relative abundance of vegetable items eaten by Blacktailed Godwits. Gizzard and crop contents are separated.

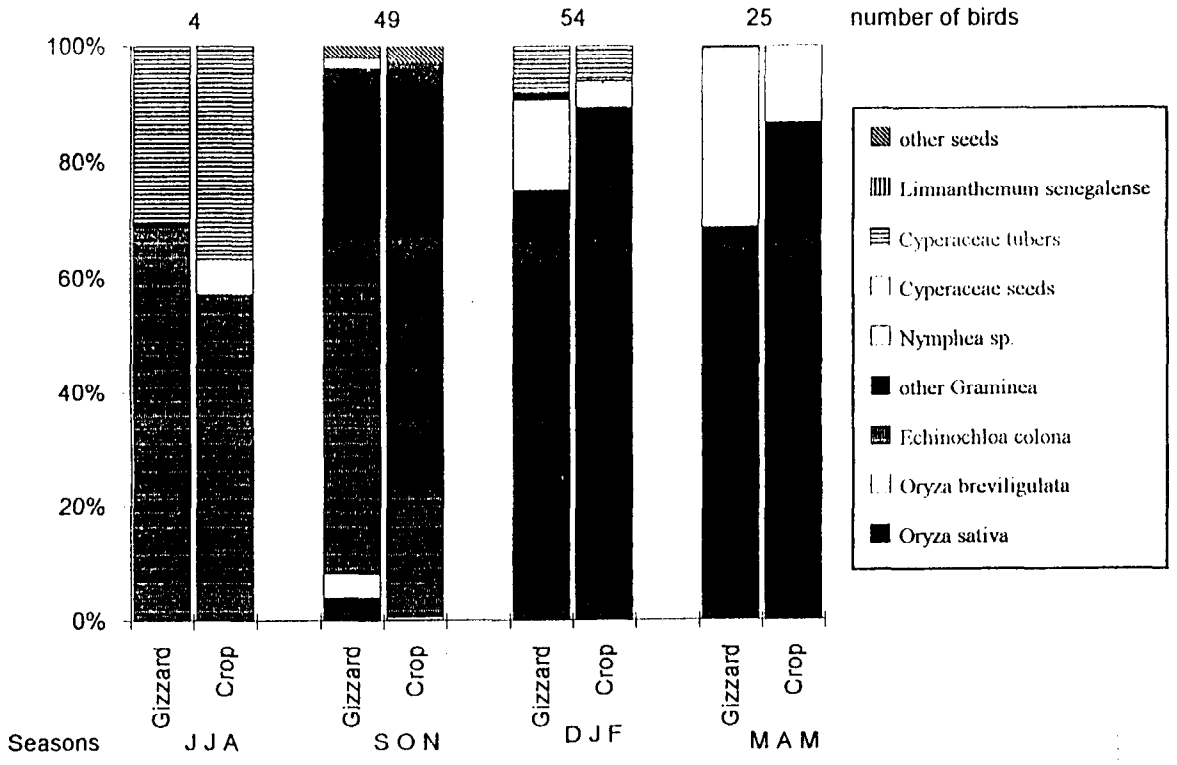

FIGURE 4

Seasonal variations in the relative abundance of vegetable items eaten by Ruffs' Gizzard and crop contents are separated.

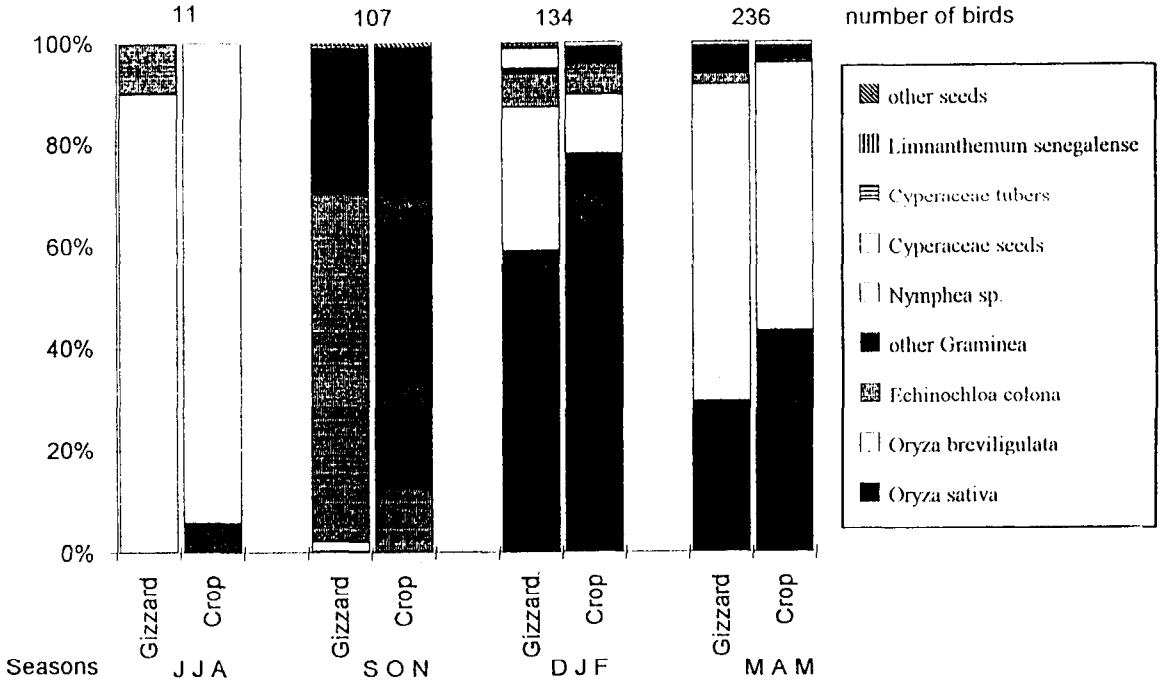

FIGURE 5

Seasonal variations in the relative abundance of vegetable items eaten by Reeves. Gizzard and crop contents are separated.

shows that cultivated rice is eaten when available, that is at planting time and during and after harvest. Also, when Godwits had eaten rice, they had eaten a lot of it. So the mean dry weight of stomach contents was heaviest in December–January–February: 1557 mg/bird, then 745 mg/bird in June–July–August, and lighter when no birds or very few birds had eaten cultivated rice: 424 mg/bird in March–April–May and 362 mg/bird only in September–October–November. It may well be that birds finding their most prefered food eat more than other birds.

Figure 4 shows that the Ruffs' diet is quite different from that of Blacktailed Godwits. Indeed, Ruffs eat a lot of cultivated rice at the time when it is very abundant on the ground, that is during harvest or just after. But 3 months later, Ruffs still eat a lot of cultivated rice. Thus rice which was no longer available in large quantities for Blacktailed Godwits is still available for Ruffs. At that time all the rice fields are very dry and although Blacktailed Godwits are able to pick up items on dry ground as I have seen sometimes, they prefer to forage on wet or watered grounds. On the other hand, Ruffs are very often seen feeding on dry rice fields. Figure 4 shows also that Ruffs don't feed on rice at planting time (July–August). The few birds examined, just back from their breeding grounds, had eaten grass seeds (*Echinochloa colona*) and Cyperaceae tubers.

At the same time (rainy season), Reeves also just back from their breeding grounds, unlike Ruffs, eat a lot of wild rice (more than 90% of their diet, see Figure 5). Later on, the diet of Reeves and Ruffs will be similar: Gramineae seeds in September–October–November, then cultivated and wild rice in December–January–February. Differences appear again in March–April–May when the Reeves diet is made of 55% wild rice instead of only 17% for Ruffs. At that time, Ruffs eat a lot of cultivated rice: mean = 3454 mg/Ruff against 657 mg/Reeve, (see Figure 2).

Animal prey

Throughout this study, no animal matter was found in Blacktailed Godwits' stomachs. They have then in the study area a purely vegetable diet. Ruffs and Reeves eat some animal matter, but the amount is negligible compared with the consumption of seeds (a mean of 1 to 3 small invertebrates per bird). Table 2 gives a complete list and numbers of all prey found in Ruffs' and Reeves' stomachs.

Grit

In the stomachs, there is always some grit which plays a role in crushing and grinding food. The variations of mean grit weight in the stomachs are very large, and individual variations even greater. But the differences between months are statistically significant (by variance analysis) only for Blacktailed Godwits $P(>F) = 0{,}0002$ and Reeves $P(>F) = 0{,}0043$ but not for Ruffs $P(>F) = 0{,}8222$. It is not easy to explain the variations in grit content between seasons.

Differences between gizzard and crop contents

The results so far have considered gut contents as a whole. The separation between crop and gizzard (see Figs 3 to 5) shows some interesting points. For example the number of food item categories is smaller in the crop than in the gizzard and proportionately, the food items that were defined as the preferred food such as cultivated rice are often more abundant in the crop than in the gizzard (Tréca 1990). Digestion rates don't seem to be the reason for such differences since it takes 4 to 6 hours to digest the whole gut content (Tréca 1984), whereas most of the birds were collected while feeding or just after the end of the feeding period, so that most of the plant material and sometimes prey were still intact. Different migration rates of seeds through the crop may induce a bias (Tamisier 1971), but there is no proof of such differential progress. This suggests that when arriving on the feeding grounds the birds begin to feed on whatever they find before focusing their attention on one or two seed species, the preferred food. Thus the Specific Contributions may reflect, to a certain extent, the availability of food items in the field.

Differences between birds according to the amount of food eaten

Some birds are heavier than others; some have full stomachs while others have eaten less, even at the end of the feeding time. The question is then whether the birds which have eaten more have filled their stomach with the same food as the birds which have eaten less. Reeves were separated into two groups: the first one, birds which have more than 10% of their food in their crop "birds that have eaten a lot" and the second one, "birds that have eaten less".

TABLE 2
LIST AND NUMBERS OF ANIMAL PREYS IN RUFFS' AND REEVES' STOMACH CONTENTS

	Ruffs	Reeves
number of birds examined	132	518
ARACHNIDS	5	
INSECTS		
Lepidoptera adult	1	
caterpillar	2	1
Diptera		
Muscoidae	27	1
Nematocera adult (?)	1	
Chironomidae larva	143	186
undetermined pupa	2	1
Coleoptera (several species)	146	209
Heteroptera Notonectidae	57	3
Corixidae		2
Hemiptera		2
Orthoptera	1	
Odonata		51
Hymenoptera		3
Undetermined insects' larvas	7	10
undetermined "worms"		14
GASTEROPODS	2	5
TOTAL	395	490
Mean number/bird	2,99	0,95

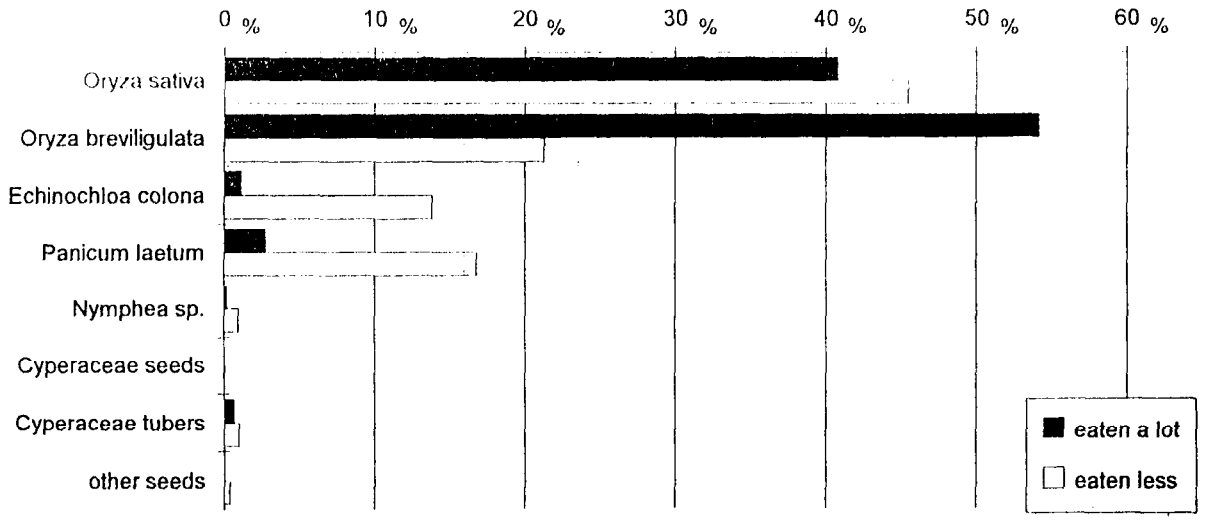

FIGURE 6

Comparison of relative abundance values between Reeves that have eaten a lot (more than 1/10th of food in the crop) and those that have eaten less.

Figure 6 shows the apparent differences between these two groups. Cultivated rice *Oryza sativa* percentages are quite similar between the two bird groups, but wild rice *Oryza breviligulata* percentages are very different, since the wild rice's proportion in the food of the birds which have eaten a lot is more than 50% compared with 21% for birds which have eaten less. Wild grasses which produce small seeds are almost absent from the diet of birds which have eaten a lot, but constitute 14–18% of the food of birds which have eaten less. Birds which have eaten a lot appear to be those which have found their preferred food and have gorged themselves on it. For Reeves, cultivated and wild rice are foods very much sought after, when available. The paddy grains' size also fills the stomach rapidly.

DISCUSSION

The northward migration to the breeding grounds occurs between March and May and is preceded by a weight increase (Pearson 1981; Treca 1993). It is then interesting to note that, in our study area, fat deposition for migration is based on rice only (Figures 3, 4 and 5). That is somewhat surprising knowing that in the western Europe the Blacktailed Godwits' diet is almost entirely animal matter (see also Glutz *et al.* 1977). Altenburg & Van der Kamp 1985 who have examined godwits' droppings in Guinea Bissau have also found that godwits which came into rice fields fed nearly exclusively on plant material, but that birds which went to mudflats took more invertebrate animals. We should not forget that part of the birds examined have already chosen the rice fields as feeding grounds (first level choice); the preferences shown by the birds for a certain food on the feeding ground is then a second level choice.

In other wintering areas, diets of Blacktailed Godwits and Ruffs may be different. Guillou & Debenay (1988) have found much animal matter in Ruffs' stomach contents on the Senegalese coast. According to Cramp & Simmons (1983) birds on passage or birds in their winter quarters feed on locally abundant food. Our observations of the daily rhythm show that Ruffs spend much less time foraging than they did 15 years ago (Tréca 1983). The reason is probably the increase in the number of rice fields which provide Ruffs with rice in abundance, after harvest.

For Blacktailed Godwits, outside the breeding period when the diet is primarily animal matter, Altenburg & Van der Kamp (1985) have found many rice grains in Guinea Bissau; Cramp & Simmons (1983) quote Guichard (1947) who found only Cyperacea and Graminea seeds in Blacktailed Godwit stomach contents from Mali in October. They also quote Dementiev & Gladkov (1951) who found oats in SSSR in September and Greenhalgh (1975) who on the other hand found many worms in Britain during the winter.

The RA/SC ratios give us an idea of the birds' preferences. Ratios far greater than 1 mean food collected in larger quantities than would have been concluded from the Specific Contributions alone. Birds which have found these seeds have crammed themselves. But it is not possible (see Hobbs 1982) to say that a particular food that reaches a ratio of 3 should be ranked above a food that has a ratio of only 2. On the other hand, ratios far smaller than 1 indicate food that birds can find on their feeding grounds but that they discard.

Cyperaceae seeds, although very common in the area even inside rice fields, are completely ignored, probably because of the small seed size since their calorific value (FAO 1968 and analysis by BRGM Dakar) is greater than that of culti-

vated rice (4,72 Cal/g vs 3,53 Cal/g). The same reason (size of seeds) may apply to wild grasses: *Echinochloa colona*, a grass very abundant in the flooded zones which matures and produces very large quantities of small seeds from August on, is eaten to some extent by Ruffs only when no other food is available in quantity. *Echinochloa colona* has a calorific value of 3,27 Cal/g. In October and to some extent in November, Ruffs eat also a lot of *Panicum laetum* seeds, a grass very abundant outside the flooded zones and which grows with the rains. This species seeds in October, and has a calorific value of 3,36 Cal/g. At that time and especially in October when no large seeds are available, Blacktailed Godwits look actively for tubers of Cyperaceae (calorific value 4,5 Cal/g).

It is thus clear that the birds studied choose food items available in large quantities with which they can fill up their crop rapidly. Choice is apparently not based on the calorific values of food items. Rice is the preferred food and the extension of rice cultivation allows birds to spend less time feeding (Tréca 1992).

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REFERENCES

ALTENBURG, W. & VAN DER KAMP, J. 1985. Importance des zones humides de la Mauritanie du Sud, du Sénégal, de la Gambie et de la Guinée-Bissau pour la Barge à queue noire (*Limosa l. limosa*). UICN/WWF-projet 3096, CIPO-projet 9238. Fondation néerlandaise pour la Protection des Oiseaux. Rapport RIN 1985–1.

BANNERMAN, D.A. 1953. The birds of west and equatorial Africa. Vol. I. Edinburgh & London: Oliver and Boyd.

CRAMP, S. & SIMMONS, K.E.L. 1983. The birds of the Western Palearctic. Vol. II. Oxford: Oxford University Press.

FAO. 1968. Food composition table for use in Africa. Washington: U.S. Department of Health, Education and Welfare, Public Health Service.

GLUTZ VON BLOTZHEIM U.N., BAUER, K.M. & BEZZEL, E. 1977. Handbuch der Vögel Mitteleuropas. Band 7, Charadriiformes (2. Teil). Wiesbaden: Akademische Verlagsgesellschaft.

GUILLOU, J-J. & DEBENAY, J-P. 1988. Les tannes, marais ouverts de la côte sénégalaise, présentation du milieu et de l'avifaune. Régime alimentaire des limicoles nicheurs et paléarctiques. *Alauda* 56: 92–112.

HOBBS, N.T. 1982. Confidence intervals of food preference indices. *J. Wildl. Manage.* 46: 505–507.

OWEN, M. 1972. Some factors affecting food intake and selection in white-fronted geese. *J. Anim. Ecol.* 41: 79–92.

PEARSON, D.J. 1981. The wintering and moult of Ruffs *Philomachus pugnax* in the Kenyan Rift Valley. *Ibis* 123: 158–182.

ROUX, F. 1973. Recensement d'oiseaux aquatiques dans le delta du Sénégal. *Oiseau Rev. fr. Orn.* 43: 1–15.

SERLE, W. & MOREL, G.J. 1979. Guide des Oiseaux de l'Ouest Africain Neuchatel: Delachaux et Niestle.

SCHRICKE, V. 1983. Distribution spatio-temporelle des populations d'Anatidés en transit et en hivernage en baie du Mont Saint-Michel, en relation avec les activités humaines. Thèse de doctorat, Université de Rennes.

SUGDEN, L.G. 1973. Feeding ecology of Pintail, Gadwall, American Widgeon and Lesser Scaup ducklings in Southern Alberta. *Can. Wildl. Ser. Report* 24.

TAMISIER, A. 1971. Régime alimentaire des Sarcelles d'hiver, *Anas c. crecca L., en Camargue. Alauda* 39: 261–311.

TRÉCA, B. 1983. L'influence de la sécheresse sur le rythme nycthéméral des Chevaliers combattants *Philomachus pugnax* au Sénégal. *Malimbus* 5 (2): 73–77.

TRÉCA, B. 1984. La barge à queue noire (*Limosa limosa*) dans le delta du Sénégal: régime alimentaire, données biométriques, importance économique. *Oiseau Rev. fr. Orn.* 54: 247–262.

TRÉCA, B. 1989. Les risques de dégâts d'oiseaux sur les rizières sahéliennes. *In*: ELDIN, M. & MILLEVILLE, P. (Eds) Le risque en agriculture. Paris: ORSTOM.

TRÉCA, B. 1990. Régimes et préférences alimentaires d'Anatidés et de Scolopacidés dans le delta du Sénégal: étude de leurs capacités d'adaptation aux modifications du milieu. Exploitation des milieux cultivés. Thèse de doctorat en sciences de la Vie: Museum National d'Histoire Naturelle de Paris.

TRÉCA, B. 1992. Quelques exemples de possibilités d'adaptation aux aménagements hydro-agricoles chez les oiseaux d'eau, et leurs limites. *Oiseau Rev. fr. Orn.* 62: 335–344.

TRÉCA, B. 1993. Oiseaux d'eau et besoins énergétiques dans le delta du Sénégal. *Alauda* 61: 73–82.

URBAN, E.K., FRY, C.H. & KEITH, S. (EDS). 1986. The birds of Africa. Vol. II. London: Academic Press.

WELLER, M.K. & BAIT, B.D. 1988. Waterfowl in winter: past, present and future. *In*: WELLER, M.W. (ED.) Waterfowl in winter. Minneapolis: University of Minnesota Press.

ERRATA

In the paper: Syroechkovski, E.E. & Lappo, E.G. 1994. Migration phenology of waders (Charadrii) on the Taimyr Peninsula, northern Russia. *Ostrich* 65 (2): 181–190, the map illustrating the breeding range and movements of Bartailed Godwit and Ruff (Fig. 7, p 188) has been printed upside down. The editors wish to apologise to the authors, and to any readers who have been confused by the directions of movement implied by the present figure.

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