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IS THE FULVOUS WHISTLING-DUCK A THREAT TO THE RICE CROP AT KIBIMBA SCHEME, EASTERN UGANDA?[1]

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Abstract. The effect of the Fulvous Whistling-Duck (*Dendrocygna bicolour*; FWD) on the crop at Kibimba rice scheme, eastern Uganda, was investigated using both field methods and diet composition. Data were collected from 31 plots of 4ha each established on newly-seeded fields. Three, 3x3m exclosures (experimental treatment) and non-enclosures (control treatment) were placed randomly in each plot. We counted the number of rice seeds and the number of FWDs in the plot on three consecutive days after seeding. The number of rice plants in the experimental treatments was then counted six weeks later. A significant difference in the number of FWDs existed across the three days which was not the case for the number of rice seeds. The number of rice plants did not vary between treatments. Rice (*Oryza sativa*) and grass weeds (*echinochloa* spp) contributed 50.5% and 16.3% of the overall diet in dry weight, respectively. Results of this study indicate that FWDs appear not to be a threat to the rice crop at Kibimba. On the other hand, the presence of weed seeds in the FWD diet suggests that these birds may perform an ecosystem service of controlling weeds on rice farms.
Key words: Fulvous Whistling-Duck, rice, Kibimba rice scheme, Uganda.

ES EL SUIRIRÍ BICOLOR UNA AMENAZA PARA LOS ARROZALES DEL PROGRAMA KIBIMBA EN UGANDA DEL ESTE?

Resumen. El efecto del suirirí bicolor (*Dendrocygna bicolor*) en los arrozales del Programa Kibimba, en el este de Uganda, fue investigado utilizando métodos de campo y estudios de la composición de la dieta. Los datos se colectaron en 31 parcelas de 4 ha cada una establecidas en campos recién sembrados. Tres recintos de exclusión de 3x3 m (tratamiento experimental) y recintos no-excluyentes (tratamiento de control) fueron situados aleatoriamente en cada parcela. Contamos el número de granos de arroz y el número de suiririís en la parcela durante tres días consecutivos tras la siembra. El número de plantas de arroz en los tratamientos experimentales fue contado seis semanas después. Encontramos una diferencia significativa en el número de suiririís entre los tres días, pero no así en el número de granos de arroz. El número de plantas de arroz no varió entre tratamientos. Granos de arroz (*Oryza sativa*) y semillas de malas hierbas (*Echinochloa spp.*)

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contribuyeron un 50.5% y 16.3% del peso seco total de la dieta, respectivamente. Los resultados de este Granos de arroz (*Oryza sativa*) y semillas de malas hierbas (Echinochloa spp.) contribuyeron un 50.5% y 16.3% del peso seco total de la dieta, respectivamente. Los resultados de este estudio indican que los suiririrís no parecen constituir una amenaza para el cultivo de arroz en Kibimba. Por otro lado, la presencia de semillas de hierbas en la dieta de los suiririrís sugiere que estas aves pueden realizar un servicio ambiental controlando las malas hierbas en arrozales.

Palabras clave: suiririrí bicolor, arroz, programa arrozales Kibimba, Uganda.

INTRODUCTION

Rice growing creates a mosaic of wetland habitats that have led to benefits for waterbirds in Uganda and elsewhere (Nachuha 2006). For example the Fulvous Whistling-Duck *Dendrocygna bicolour* (hereafter: FWD) during the past several decades extended its range and population size in close association to rice growing (Lynch 1943, Bolen and Rylander 1983, Carrol 1932, Meanley and Meanley 1959, Palmer 1976). As a result, this species is now considered a serious pest by farmers (Bomford 1988, Dallmier 1991, Bruzual and Bruzual 1983). However, opinions vary widely as reflected by the counter claim that FWDs benefit farmers by consuming weeds (Singleton 1951).

There is also contradictory evidence about the most vulnerable stage of the rice crop. Hasbrouck (1944) reported that FWDs were exceedingly injurious to rice when the broadcast planting method was used, and that they never touched the sprouted rice or the growing crop. Most damage occurred 3-5 days prior to germination (Currey 1984). However, levels of depredation from ducks vary and are often widespread, and this variability compounds the problems associated with distinguishing losses attributed to ducks and other predators. In light of these difficulties, detailed studies of duck depredations are still required to elucidate and determine the amount of damage caused. As agricultural damage by FWDs is a major concern, not only for farmers but for conservationists as well, the purpose of this study was to assess the effect of this species on the rice crop at the Kibimba Rice Scheme.

Rice also has been found to be the most important item in the diet of FWDs when they use rice paddies as feeding sites (Turnbull et al. 1989, Bruzual and Bruzual 1983, Dallmier 1991). Seeds of various rice field weed species occur in FWD diet as well (Hasbrouck 1944, Meanley and Meanley 1959, Landers and Johnson 1976). In Africa, the diet of FWDs has been documented in the context of a larger study on the damage caused by waterfowl generally to rice in the Senegal Delta (Treca 1986), and some aspects of FWD feeding behaviour have been studied in a flooded farm in South Africa (Clark 1978), at Lonchivar in Zambia (Douthwaite 1977) and at Lake Chilwa, Malawi (Schulten 1974). However, no such study exists in Uganda except for a distribution and abundance study (Arinaitwe 1992).

STUDY AREA AND METHODS

This study was conducted at Kibimba Rice Scheme, the larger of the two commercial growing areas in Uganda, and the only one where the broadcast method is used in the paddies. Kibimba Rice Scheme is located in eastern Uganda and is one of the Important Bird Areas supporting a high number of birds, particularly the FWD (Arinaitwe 1992). The FWD has been persecuted by the management of this scheme claiming that the species causes a lot of damage to the crop at different stages of its growth, but most especially after the broadcasting of the rice grains. Kibimba Rice Scheme is divided into blocks of varying sizes that are subdivided into plots of approximately 4ha by earth levees. Rice growing at this scheme involves broadcasting seeds on flooded fields (water depth ~ 6-10 cm) by a small agricultural aircraft. The fields are then gradually drained over a period of 3-4 days approximately.

The aim of this study was achieved by using both direct and indirect measures. The direct measure of FWD effect involved counting the number of rice seeds on three consecutive days after broadcasting while the indirect one involved counting the number of rice plants six weeks later.

From the onset, thirty-one 4ha plots that were ready for broadcasting were identified, upon which on the evening/morning of broadcasting we set up in each: three, 3x3 m exclosures that prevented consumption of rice seeds by birds (the experimental treatments), and three 3x3 m non-enclosures that allowed use (control). These exclosures were constructed using expanded metal with a mesh size of 1x1 cm supported by four pieces of wood (4x4 cm thick, 1.5 m tall). Four similar sized pieces of wood were used to demarcate the non-enclosures. We placed these experimental treatments randomly within the rice fields.

After setting up the experimental plots we estimated the number of rice seeds in the 4ha plots over the three days after broadcasting. To do this, we used a 0.25 m^2 metal frame that we threw 30 times daily in each plot, counting the number of rice seeds. This was to establish whether there was a decline in the number of rice seeds on the subsequent days after broadcasting. Counting of rice seeds was slightly obscured on the first day since the seeds were still under water (about 5 cm), but this was not a problem on the second and third day, as the plots were progressively drained.

Following the seeding, a total count of all FWDs using the plots, and the number foraging, was done for three consecutive days. Bird counts were done between 06:30-07:00 hrs for about 5-10 minutes depending on numbers. The birds were counted individually or in groups of five or ten if flocks were large. Water depth measurements were also taken at four randomly located points within each plot.

Data on the number of rice plants in the two treatments was collected after six weeks from the time of broadcasting. Using a 0.25 m^2 metal frame that we placed in a random location within each treatment, we counted the number of rice plants. This gave us three data points per treatment per plot and 93 data points for each treatment for the 31 plots. The entire data collection lasted a period of three months from December 2010 to February 2011.

COLLECTION OF DIET SAMPLES

Stomach contents analyses must be done before conclusions are reached concerning the economic importance of FWDs to agriculture (Rylander and Bolen 1980). To obtain information on the diet of the FWDs, we collected crop and gizzard contents from dead birds. Twenty-two birds were bought from hunters (local people) encountered in the field and supplemented by 31 birds killed after hitting power lines. The contents of 53 gizzards and 28 crops were each separately emptied into sample bottles containing 80% ethyl alcohol (Swanson and Bartonek 1970) for further analysis in the laboratory. During the laboratory analysis, the contents were rinsed over a 250µm mesh sieve and subsequently placed in clear water in a petri dish. With the aid of a microscope the contents were searched for food items. Food and grit were separated and placed on small filter papers. The materials were next oven dried to a constant weight at 65°C, left to cool and then weighed to obtain the dry weight (Swanson et al. 1974). The food was separated into the plant and animal foods for easier comparison with other studies in which foods were analyzed from gizzard and crop samples. Plant materials were easily identifiable to species level, which was not the case for animal material.

DATA ANALYSIS

Two separate analyses were done to determine if the number of rice seeds and FWDs varied across the three days after broadcasting. Numbers of rice seeds conformed to the normal distribution (One-Sample Klomogorov-Smirnov Test: $Z = 0.736$, $P = 0.650$, $n = 93$); therefore, these differences were tested using General Linear Mixed Models (GLMM) in Genstat version 3.0 (VSN Intl. 2003). Day was used as a fixed effect and the abundance of FWDs was used as a covariate in the analysis in which the number of rice seeds was used as the response variable. Plot was used as a random effect in all the analyses to control for pseudoreplication (Hulbert 1984). The numbers of rice plants in the experimental and control treatments also conformed to the normal distribution ($Z = 0.942$, $P = 0.338$, $n = 186$). A t-test for independent samples was used to compare the number of rice plants between treatments.

DIET COMPOSITION

Data on each item found in the crop, gizzard, and the total of both the crop and gizzard were expressed in two ways: 1) average % of dry weight = $\sum W_i/N$, where W_i = weight of the i^{th}

food item expressed as a percentage of the weight of all food items in the sample, and N = total weight of all food samples (Swanson *et al*. 1974); and 2) the occurrence of the food item i.e. in how many gizzards and crops the food item was found present.

RESULTS

VARIATION ACROSS THE THREE DAYS BEFORE GERMINATION

The abundance of FWDs on the rice scheme ranged from 0-556 individuals with an average of 84.9 ±107.2 SD birds. There was a significant relationship between the abundance of rice seeds and the total number of FWDs after controlling for differences in Day (Table 1). The number of FWDs increased with increasing numbers of rice seeds (Table 2). However, despite this relationship, the abundance of rice seeds did not vary significantly across the three days following broadcasting (Tables 1, 2). Although the number of rice seeds did not vary across the three days, the abundance of FWDs decreased significantly (Table 2, Figure 1). The student *t*-test results revealed that the number of rice plants did not vary between treatments six weeks later ($t_{(184)} = 0.824$, $P = 0.411$).

DIET COMPOSITION

A total of 53 adult birds were collected, 31 (57%) of which were from power line kills and 22 (43%) from hunters. The diet of these FWDs was composed of plant and animal matter. The percent dry weight of the food contents show that FWDs ate mostly plant material, with animal materials present in the diet of only a few individuals. Rice constituted almost half of the total dry weight (57.4%) of the diet, and was present in all the gizzards (Table 3). Seeds of *Echinochloa* spp were the most abundant in the diet (Table 3). Other plant seeds included sorghum (*Sorghum* spp.), which was present in very small quantities. No other plant structures other than seeds were found in the gizzards or crops, although some studies have shown that FWDs feed on plant shoots and leaves. Animal

TABLE 1. General Linear Mixed Models of number of rice seeds and FWDs across the three days before germination. Two separate models are given.

Response variable	Explanatory variables			
	Model	Wald statistic	df	Chi^2 probability
1. Number of rice seeds	Fixed term			
	Day	0.24	2	0.775
	Total of FWDs in the plot	8.10	1	0.045
2. Number of FWDs	Fixed term			
	Day	135.72	2	<0.001
	Water depth	0.73	1	0.392

TABLE 2. Mean ± SD of abundance of rice seeds, FWDs and water depth on the three subsequent days after broadcasting.

	Days after broadcasting			
	Overall Mean ± SD	Day 1 Mean ± SD	Day 2 Mean ± SD	Day 3 Mean ± SD
Rice seeds	60.4 ± 24.6	60.9 ± 24.7	60.2 ± 25.0	60.1 ± 23.9
Total FWDs in the plot	83.8 ± 106.4	195.5 ± 113.7	58.1 ± 42.0	1.0 ± 1.83
Water depth (cm)	4.3 ± 2.3	6.4 ± 1.1	4.9 ± 0.8	1.5 ± 0.5

Sample size was 30 throws in 31 plots = 930 throws.

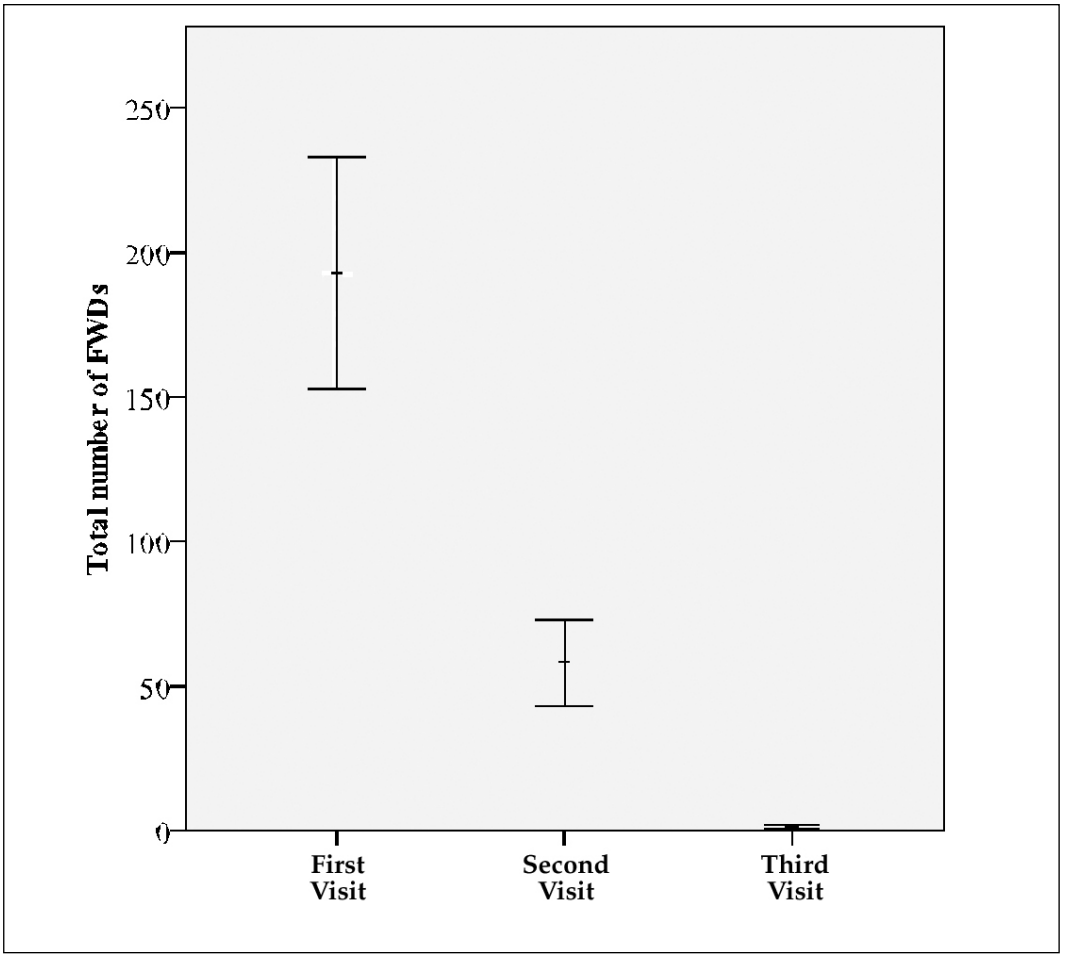

FIGURE 1. Variation in mean ± SE of FWDs across the three days after broadcasting.

TABLE 3. Percentage of plant and animal items found in the gizzard and crops of 53 FWDs.

	Gizzard (53)			Crop (28)			Total (crop+gizzard)		Occurrence	
Type of food	Total weight (g)	%	n	Total weight (g)	%	n	Total Weight (g)	%	Gizzards	Crops
Rice seeds	60.4	24.6	60.9	24.7	60.2	25.0	60.1	23.9	60.1	23.9
Echinochloa spp	24.7	16.3	53	13.1	23.1	53	37.8	18.2	44	25
Nymphae spp	0.5	0.3	3	0.2	0.4	1	0.7	0.3	3	1
Sorghum	0.4	0.3	6	0.6	1.2	3	1.0	0.5	4	3
Animal	0.1	0.1	4	0.1	0.2	2	0.2	0.1	6	3
Grit	49.5	32.5	53			0	49.5	23.7	53	0
Total (N)	151.9	100		56.7	100		208.6	100		

n = number of samples
N= as defined in the methods section.
Numbers in brackets show the number of gizzards and crops from which diet samples were collected

matter, composed of molluscs and insects, occurred in very small proportions.

DISCUSSION

VARIATION ACROSS THE THREE DAYS AFTER SEEDING

The number of rice seeds did not vary across the three days prior to germination. This indicates that FWDs do not have any effect on the rice crop at Kibimba Rice Scheme. However, there was a decline in the abundance of FWDs across the three days after rice broadcast and this decline is probably attributed to the declining water levels. The positive relationship between the number of rice seeds and the total number of FWDs implies that FWDS are attracted to the rice fields because of the presence of rice seeds. These results indicate that the presence of water was a primary cue in habitat use by FWDs, a finding in agreement with Bruzual and Bruzual (1983). No matter how abundant seeds were, they only became available when there was sufficient water to facilitate their consumption by FWDs.

FWDs were observed feeding in the whole plot including the control plots (non-enclosed areas). The lack of variation in the number of rice seeds across the three days before germination and rice plants between treatment effects could be probably attributed to the fact that the number of FWDs is small compared to the amount of rice broadcast to cause any significant effects.

RICE IN THE DIET OF FWDS

Although earlier results indicated that FWDs do not seem to have an impact on the rice crop, rice seeds dominated their diet (57.2%). There is a possibility that some specimens, especially those obtained from hunters, may have had bait (poisoned rice) in their gizzards/crops, which contributed to this relatively high proportion of rice in the diet.

WEEDS IN THE DIET OF FWDS

The presence of *Nymphae* spp in the diet of the birds indicates some foraging in natural wetland habitat. *Echinochloa* spp grass seeds were also abundant in the diet of ducks, although second to rice. *Echinochloa* spp are considered the most serious and widespread weeds at Kibimba Rice Scheme (Ishwar Singh, Plant breeder, Kibimba Rice Scheme, pers. comm.). The importance of this weed in the diet of FWDs in the different regions of the world indicates that FWDs may play a significant role in the control of this weed on rice schemes (Singleton 1951, Meanley and Meanley 1959, Bruzual and Bruzual 1983, Lynch 1943).

CONCLUSIONS

Although there was no significant evidence from this study that FWDs cause damage to the rice crop, the presence of rice in their diet indicates that FWDs may have a slight negative impact on the rice crop if their population is very high. The predation on economically important weeds, such as *Echinochloa* spp. by FWDs, can have a positive impact on the control of these undesirable weeds. Therefore, once farmers learn about this information, the persecution of these ducks may become less.

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