
Habitat selection, diet and interspecific associations of the rufous-tailed weaver and Fischer's lovebird

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Abstract

We investigated habitat selection and diets of two co-occurring endemic bird species (rufous-tailed weaver, *Histurgops ruficauda*, Fischer's lovebird, *Agapornis fischeri*) and four other species with which they associated in mixed feeding flocks (red-billed buffalo weaver, *Bubalornis niger*, white-headed buffalo weaver, *Dinemellia dinemellii*, superb starling, *Lamprotornis superbus*, and Hildebrandt's starling, *Lamprotornis hildebrandti*) during the dry season in Serengeti National Park Tanzania. Mixed species flocks could facilitate food acquisition and/or act as anti-predator mechanisms. Five of the six species selected grassland habitat over Acacia habitat along transects. Analysis of species association, using Cole's coefficient of association, showed that both rufous-tailed weavers and superb starlings co-occurred with red-billed buffalo weavers. Superb starlings were negatively associated with Fischer's lovebird, Hildebrandt's starling and white-headed buffalo weavers. Diet analysis revealed that the rufous-tailed weaver, white-headed buffalo weaver, and red-billed buffalo weaver were generalists eating both insects and seeds, whereas Fischer's lovebird and superb starling were specialists, selecting only seeds and insects respectively. These data offer some support for the hypothesis that mixed species flocks facilitate mutual food searching.

Key words: diet, habitat, Serengeti birds, species association

Résumé

Nous avons étudié le régime alimentaire et la sélection de l'habitat de deux espèces d'oiseaux endémiques (Histurgopse à queue rouge *Histurgops ruficauda*, Inséparable de Fischer, *Agapornis fischeri*), qui cohabitent dans le Parc

National de Serengeti, en Tanzanie, et de quatre autres espèces avec lesquelles ils s'associent en bandes mixtes (Alecto à bec rouge *Bubalornis niger*, Alecto à tête blanche *Dinemellia dinemellii*, Choucador superbe *Lamprotornis superbus* et Choucador de Hildebrandt *Lamprotornis hildebrandti*) pendant la saison sèche. Le fait de constituer des bandes mixtes peut faciliter l'acquisition de nourriture et/ou agir comme un mécanisme anti-prédateur. Cinq des six espèces ont choisi un habitat de savane herbeuse plutôt qu'un habitat à acacias le long des transects. L'analyse de l'association des espèces, en utilisant le coefficient d'association de Cole, montre que l'histurgopse à queue rouge et le choucador superbe cohabitent avec l'alecto à bec rouge. Le choucador superbe était négativement lié à l'inséparable de Fischer, le choucador de Hildebrandt et l'alecto à tête blanche. L'analyse du régime alimentaire a révélé que l'histurgopse à queue rouge, l'alecto à bec rouge, et l'alecto à tête blanche étaient des oiseaux généralistes qui mangent des insectes et des graines alors que l'inséparable de Fischer et le choucador superbe étaient spécialisés et ne mangeaient, respectivement, que des graines et que des insectes. Ces données viennent conforter quelque peu l'hypothèse selon laquelle des bandes d'oiseaux mixtes facilitent la recherche mutuelle de nourriture.

Introduction

Fischer's lovebird *Agapornis fischeri* and the rufous-tailed weaver *Histurgops ruficauda* coexist in the Serengeti region of Tanzania. The former is potentially threatened by the trade in aviary birds (Moyer, 1995), and both are endemic to the Serengeti region (Stevenson & Fanshawe, 2002). Little is known about either species. However, both species occur in the same habitats over a similar restricted range and they have been observed to share nests (Turner &

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Pitman, 1964). To conserve and manage these species, it is necessary to understand their habitat requirements and any interdependence.

Species may associate in mixed-species flocks because of mutual benefits such as increased foraging success (Murton, 1971; Krebs, 1973; Powell, 1985; Latta & Wunderle, 1996) or predator avoidance (Slotow & Paxinos, 1997). However, sometimes only one species benefits from co-existence (Connel, 1983; Kossenko & Fry, 1998). Fischer's lovebird roosts in the nests of the rufous-tailed weaver (Turner & Pitman, 1964), but it is not clear whether the rufous-tailed weaver gains any advantage from this association with Fischer's lovebird.

This study of Fischer's lovebird and rufous-tailed weavers was aimed to understand habitat selection and diet as potential mechanisms for coexistence and niche separation. Because these two species were often found in mixed feeding flocks with several other species, we also documented the habitat and diet characteristics of these other species. The associated species comprised the red-billed buffalo weaver *Bubalornis niger*, white-headed buffalo weaver *Dinemellia dinemelli*, superb starling *Lamprotornis superbus* and Hildebrandt's starling *Lamprotornis hildebrandti*. We hypothesized that the species could co-occur away from the roosts for two reasons.

First, they may associate because they eat similar foods and facilitate finding food. This hypothesis would predict that species would select similar habitats, eat similar foods and associate in mixed groups. Additionally, species may co-occur as an anti-predator defence mechanism through safety in numbers (Jullien & Clobert, 2000). This idea would predict that species would associate in mixed species groups in the same habitat but not necessarily have the same diet.

The general habitat and geographic range of Fischer's lovebird has been described by Moreau (1945, 1948) as arid woodland dominated by *Acacia* and *Commiphora* species in northern Tanzania, whereas the rufous-tailed weaver has been reported to prefer open grassland (Turner & Pitman, 1964). The range of both species is centred on the Serengeti-Mara ecosystem.

Materials and methods

Study area

The Serengeti-Mara ecosystem is situated between 1°15'–3°17'S latitude and 33°50'–35°20'E longitude, and is part

of the high interior plateau of Eastern Africa. The 25,000 km² ecosystem is defined by the boundaries of the wildebeest migration (Sinclair & Norton-Griths, 1979; Sinclair & Arcese, 1995) and is made up of several different conservation units. The Serengeti National Park is bordered by the Maswa Game Reserve to the South, the Ngorongoro Conservation Area to the southeast, Loliondo Game Controlled Area to the northeast, Maasai Mara National Reserve in the north and the Ikorongo–Grumeti Game Reserve in the west. The elevation varies from 1162 m at Speke's Gulf of Lake Victoria to 1860 m in the northeast (Sinclair & Norton-Griffiths, 1979; McNaughton & Campbell, 1991).

The soils in the eastern park are of recent volcanic origin. In the west, central and northern Serengeti, the soils in the upper parts of the drainage systems are sandy loams with heavy clays below (Anderson & Talbot, 1965). Vegetation in the park is determined by soils and rainfall. There is a strong gradient in the total annual rainfall from the southeast (500 mm) to the northwest (1100 mm) (Norton-Griffiths, Herlocker & Pennyquick, 1975; Sinclair, 1995). Associated with this gradient is a change in vegetation from the open grasslands of the southern Serengeti plains to the woodlands of the central and northern parts of the region. Nearly two-thirds of the park is bush or woodland (Bell, 1971; Herlocker, 1976). On the plains, grasses are alkaline tolerant and there are many small dicots. The woodlands start near Seronera and are dominated by *Acacia* species except for a small region in the northwest where *Terminalia–Combretum* takes over (Herlocker, 1976).

Habitat selection

We established a 95-km road transect through a range of habitats to determine habitat selection by the six bird species. Transects were measured five times per month from July to December 2001 from Seronera (central Serengeti) to Kirawira (in the western corridor of Serengeti). Transects alternated in direction on different days.

Habitat use and availability data were collected simultaneously. For each bird sighting, we recorded species, number of individuals, perpendicular distance of birds from the transect, macro habitat type and distance to woodland edge. Habitat availability was recorded systematically at intervals of 1 km. The first systematic point was chosen randomly within the first kilometre from the start of the transect using a random number table. Subsequent sample

points were 1 km apart as measured by vehicle odometer. At each systematic location, we recorded the date, transect direction, starting location, odometer reading, time, macro habitat type, and grass and tree/bush greenness. Transects were conducted in the morning from 06.15 to 11.00 hours. Habitats were classified as one of six types on the basis of physiognomic features and dominant tree species when present:

1. Open grassland (mbuga): This habitat was devoid of trees except for an occasional *Acacia* or *Balanites* adult and a few regenerating *Acacia*. The grass layer was dominated by *Themeda triandra*. Open grasslands occurred on poorly drained soils and were usually located between riverine thickets or forest in valleys and woodlands on ridge tops.
2. *Acacia tortilis*: This tree species grows from 9 to 14 m in height and was characterized by a wide, umbrella shaped crown, which may reach 21 m in diameter (Herlocker, 1976). It occurs on various sites from ridge tops, gently sloping valley sides to alluvial benches beside major streams. The grass species form a mix of *T. triandra*, *Pennisetum mezianum* and *Digitaria macroblephora*.
3. *Acacia robusta*: This habitat comprises extensive regenerating stands of young *A. robusta* trees about 20 years old with a few large, widely scattered adult trees at least 80 years old. This habitat type extends from ridge tops to midway down the slopes where grasslands start, but it sometimes reaches the valley bottom.
4. *Acacia senegal*: This habitat occurs mainly on ridge tops in shallow stony soils. Trees grow from 3 to 5 m high. The grass layer within the stand is dominated by *P. mezianum* and *Sporobolus pyramidalis*.
5. *Acacia drepanolobium*: This habitat occurs on poorly drained soils in valley bottoms, and foot slopes at the base of rock hills. The tree grows 1 to 8 m in height and is most closely associated with *Balanites aegyptiaca* in the western corridor. The grass layer is dominated by *Dichrostachys macroblephara* and *P. mezianum*.
6. Others: This category comprised a number of rare habitats along the transect. They include stands of the trees *Acacia gerrardii*, *Acacia mellifera*, *Acacia hockii*, *Acacia kirkii*, *Acacia sieberiana*, *Dichrostachys sp.*, *Commiphora sp.*, thickets comprised *Grewia*, *Cordia*, *Croton* and other shrubs, rocky hill sides and riverine forest.

Analysis of habitat selection data

Frequencies of observations in each of the habitat categories were tallied separately for each of the six bird

species' sightings and for the systematic habitat observations. The systematic sample (which always exceeded the bird species observations) was then adjusted downwards to the same sample size as that for the bird species observations. This gave the expected frequency distributions if bird species were randomly associated with habitat parameters.

Thus, the expected frequency of bird species observations in a habitat type (E_i) was calculated as:

$$E_i = O_i * (A_i/A_T),$$

where O_i is the sum of all bird species records for habitat i ; A_i is the availability of habitat i (i.e. the sum of systematic observations in habitat i); A_T is the sum of all available habitats (i.e. total systematic records of all habitat types).

Groups containing several birds of one species were considered as a single observation because individuals in a group are not statistically independent. Chi-squared (Pearson's) goodness of fit was used to test whether habitats were used in proportion to availability. The Bonferroni Z-test was used to determine which habitats were significantly selected or avoided. Confidence intervals were calculated to determine whether the expected proportion fell outside or within the confidence limits of the observed proportion.

Species associations

Each observation of a group of rufous-tailed weavers or Fischer's lovebirds was accompanied by observations of the five other bird species associated with these focal species. The frequency with which these two species were associated with the other species was scored from the total set of groups observed over all transects. Cole's Association Coefficients (Cole, 1949) were then computed for each of the six species associated with each of the other species.

Cole's coefficient was computed from the 2×2 matrix

		Species 1	
		+	-
Species 2	+	a	b
	-	c	d

where Species 2 is the focal species and Species 1 becomes each of the other species in turn. The Association Coefficients (C) were calculated from three alternate formulae depending on the relative values of the cells. Thus, positive association occurs if $ad > bc$, and the coefficient and its standard error is:

$$C_1 = (ad - bc)/(a + d)(b + d), \quad (1)$$

$$SE_{C_1} = \text{sqrt}[(a + c)(c + d)/(n(a + b)(b + d))] \quad (2)$$

Negative association occurs if $ad < bc$. When $a < d$ then

$$C_2 = (ad - bc)/(a + b)(a + c), \quad (3)$$

$$SE_{C_2} = \text{sqrt}[(b + d)(c + d)/(n(a + b)(a + c))] \quad (4)$$

and when $a > d$ then

$$C_3 = (ad - bc)/(b + d)(c + d), \quad (5)$$

$$SE_{C_3} = \text{sqrt}[(a + b)(a + c)/(n(b + d)(c + d))] \quad (6)$$

The advantages of these coefficients are that they do not assume bivariate normal distribution, they give a linear measure of magnitude of association, and they allow small samples of positive observations when there are large numbers of negative values (Cole, 1949). Significance levels were obtained from the chi-squared test.

Diet

Individual birds (seventeen rufous-tailed weavers, ten Fischer's lovebirds, ten white-headed buffalo weavers, twelve superb starlings and thirteen red-billed buffalo weavers) were captured with mist-nets to obtain a sample of the crop contents. Out of consideration for the welfare of the individual birds, we attempted to minimize sample size and increase extent of sampling areas. Therefore, these birds were captured in different locations spread evenly across the study area. Additionally, we limited the study to the dry season, therefore, all sampling was performed during the month of July and August. We were unable to obtain samples for Hildebrandt's starlings. A saturated solution of apomorphine was applied on the bird's eyes to stimulate regurgitation (Schluter, 1988). This method has no adverse effect on the birds, which were released after being kept for an hour in a dark bag. This apomorphine method was successful for Fischer's lovebirds and superb starlings, but not for rufous-tailed weavers, white-headed buffalo weavers and red-billed buffalo weavers. For these three species, gizzard content was collected and preserved in alcohol. Food samples were separated in the laboratory

into three major food types: insects, seeds and other vegetation. The absolute volume and the percentage volume of each food type were calculated for each bird species. Diets of the five species were compared using analysis of variance. Tukey's multiple comparison method was used for pair-wise comparison between species (SAS Institute, Inc., 1985).

Results

Habitat selection

There were 309 observations of rufous-tailed weavers, 240 of Fischer's lovebirds, 401 of white-headed buffalo weavers, 1516 of superb starlings, 106 of Hildebrandt's starlings and 379 of red-billed buffalo weavers. There were 2595 systematic records of habitat availability. Only the white-headed buffalo used habitat in proportion to that available along transects (Table 1, Fig. 1). All other species selected grassland and avoided *Acacia* habitat. Overall, rufous-tailed weavers and Fischer's lovebirds selected similar habitats. Furthermore, these species selected similar habitats to red-billed buffalo weaver, superb starling and Hildebrandt's starling. While *Acacia drepanolobium*, *A. robusta* and *A. senegal* were avoided by most of the five species, *A. tortilis* was neither selected nor avoided by any of the six species. No other habitats were preferred by any of the bird species.

Bird species associations

Observations of all bird groups were summed over the time period of study along the transect, the total number of groups being 2950. The frequency with which each of the

Table 1 Frequency of available habitat

Habitat	Available observations	% Available
<i>Acacia robusta</i>	380	14.7
<i>Acacia drepanolobium</i>	273	10.5
<i>Acacia senegal</i>	176	6.8
<i>Acacia tortilis</i>	203	7.8
Grassland	1347	51.9
Others	214	8.3
Total	2593	100.0

The expected number of observations for each habitat was calculated from the frequency of available habitat.

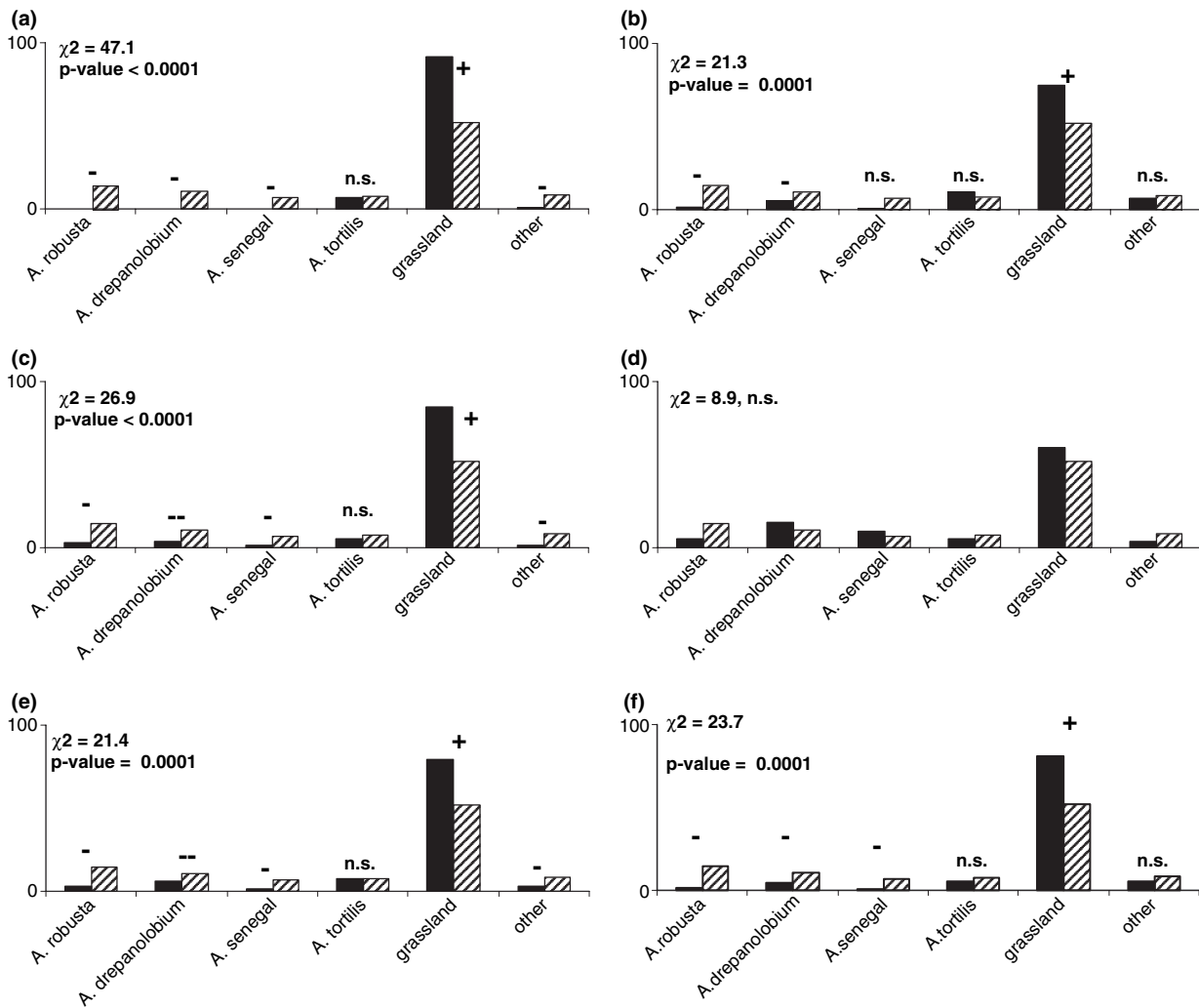


Fig 1 (a–f) Habitat use (%) and availability (%) of six bird species in the Serengeti ecosystem. Available habitat is represented by hatched bars and habitat use by bird species is represented by solid bars. Chi-squared (Pearson's) goodness of fit was used to test whether habitat was used in proportion to availability. Bonferroni Z-test determined selected or avoided habitats. Negative signs indicate avoided habitat and plus signs indicate selected habitat. Habitats that were not different from the random distribution are designated as 'n.s.' (not significant). (a) Rufous-tailed weaver, $n = 309$; (b) Fischer's lovebird, $n = 240$; (c) red-billed buffalo weaver, $n = 379$; (d) white-headed buffalo weaver, $n = 401$; (e) superb starling, $n = 1515$; and (f) Hildebrandt's starling, $n = 106$

six species was observed with each of the other species is presented in Table 2 with Cole's coefficient of association from Eqns (1) and (3).

There are two main groups of associations seen from these tables. There is a group of positively associated species. Both rufous-tailed weaver and superb starling are significantly associated with red-billed buffalo weaver. Conversely, there are three species (Fischer's lovebird, white-headed buffalo weaver and Hildebrandt's starling) that were negatively associated with superb starling. In

addition, there is also a negative association between rufous-tailed weaver and white-headed buffalo weaver. There was no association between rufous-tailed weaver and Fischer's lovebird during these daytime activities.

Diet

The rufous-tailed weavers, and white-headed buffalo weavers consumed both insects and seeds (Fig. 2), but more insects than seeds, and a trace of vegetation

Table 2 The number of observations of bird groups in which each species was observed with each of the five other species

Species 1	<i>a</i>	<i>b</i>	Sp 1 alone <i>c</i>	Neither <i>d</i>	Cole's coefficient	Value	SE	<i>P</i> -value
	RTWE + Sp 1		RTWE alone					
Rufous-tailed weaver								
FILO	26	283	214	2427	C_1	0.01	0.02	n.s.
HIST	8	301	98	2543	C_2	-0.28	0.28	n.s.
SUST	166	143	1349	1292	C_1	0.05	0.05	n.s.
WHBW	25	284	376	2265	C_2	-0.41	0.14	<0.05
RBBW	85	224	294	2347	C_1	0.17	0.02	<0.05
	FILO + Sp 1		FILO alone					
Fischer's lovebird								
RTWE	26	214	283	2427	C_1	0.01	0.02	n.s.
HIST	6	234	100	2610	C_2	-0.30	0.32	n.s.
SUST	91	149	1424	1286	C_2	-0.26	0.06	<0.05
WHBW	28	212	373	2337	C_2	-0.14	0.16	n.s.
RBBW	34	206	345	2365	C_1	0.02	0.02	n.s.
	RBBW + Sp 1		RBBW alone					
Red-billed buffalo weaver								
RTWE	85	294	224	2347	C_1	0.13	0.02	<0.05
FILO	34	345	206	2365	C_1	0.01	0.01	n.s.
HIST	11	368	95	2476	C_2	-0.19	0.25	n.s.
SUST	227	152	1288	1283	C_1	0.18	0.05	<0.05
WHBW	56	323	345	2226	C_1	0.014	0.02	n.s.
	WHBW + Sp 1		WHBW alone					
White-headed buffalo weaver								
RTWE	25	376	284	2265	C_2	-0.41	0.14	<0.05
FILO	28	373	212	2337	C_2	-0.14	0.16	n.s.
HIST	12	389	94	2455	C_2	-0.17	0.24	n.s.
SUST	173	228	1342	1207	C_2	-0.16	0.05	<0.05
RBBW	56	345	323	2226	C_1	0.013	0.02	n.s.
	SUST + Sp 1		WHBW alone					
Superb starling								
RTWE	166	1349	143	1292	C_1	0.01	0.01	n.s.
FILO	91	1424	149	1286	C_2	-0.26	0.06	<0.05
HIST	39	1476	67	1368	C_2	-0.28	0.09	<0.05
WHBW	173	1342	228	1207	C_2	-0.16	0.05	<0.05
RBBW	227	1288	152	1283	C_1	0.025	0.01	<0.05
	HIST + Sp 1		WHBW alone					
Hildebrandt's starling								
RTWE	8	98	301	2543	C_2	-0.28	0.27	n.s.
FILO	6	100	234	2610	C_2	-0.30	0.32	n.s.
SUST	39	67	1476	1368	C_2	-0.28	0.09	<0.05
WHBW	12	94	389	2455	C_2	-0.17	0.24	n.s.
RBBW	11	95	368	2476	C_2	-0.19	0.24	n.s.

RTWE, rufous-tailed weaver; FILO, Fischer's lovebird; WHBW, white-headed buffalo weaver; SUST, superb starling; HIST, Hildebrandt's starling; RBBW, red-billed buffalo weaver.

Columns *a*–*d* describe the cells of the association matrix (see text), where '*a*' is the number of groups in which both species of a pair occur; '*b*' only the reference species occurs; '*c*' only the other species of the pair occur; and '*d*' neither of the two occur in the group.

In all cases, other species may also be present. The total number of groups in the study was 2950.

C_1 and C_2 refer to Eqns (1) and (3) (see text) and *P* is the probability that the value is different from zero.

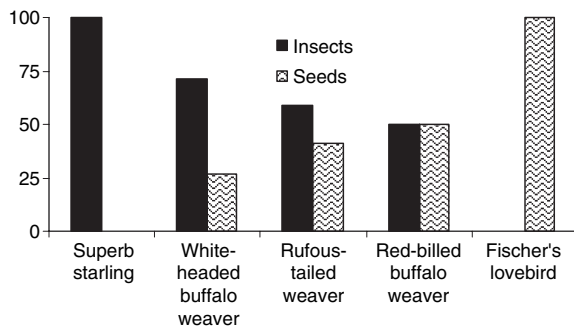


Fig 2 Per cent of volume of seeds and insects counted in the crop and stomach of five species of birds mist-netted in the Serengeti National Park, Tanzania. No diet samples were collected for Hildebrandt's starling

(Table 3). Red-billed buffalo weavers ate virtually equal amounts of insects and seeds (Fig. 2, Table 3). In contrast, Fischer's lovebirds ate almost entirely seeds with a trace of vegetation whereas superb starlings ate insects virtually exclusively.

There were significant differences in insect ($P = 0.017$, $F_{5,51} = 3.28$) and seed consumption ($P = 0.016$, $F_{5,51} = 3.35$) between bird species. The pair-wise comparisons showed that Fischer's lovebirds ate significantly fewer ($P < 0.05$) insects than white-headed buffalo weavers and rufous-tailed weavers. Fischer's lovebirds and rufous-tailed weavers ate significantly more seeds than superb starlings (Fig. 2).

Discussion

This study has focused on the habitat selection and interspecific interactions of two bird species endemic to the Serengeti ecosystem, the rufous-tailed weaver and Fischer's lovebird. These species have a nesting associa-

tion (Turner & Pitman, 1964; E. Mwangamo, pers. observ.) and we examined whether they were closely associated with each other and four additional species that were often present with them in mixed feeding groups.

Analysis of habitat use indicated that five of the six species were significantly associated with open grassland and actively avoided *Acacia* habitat. Within the same grassland habitat, species associations were detected with Cole's coefficient, yet many did not differ from a random distribution. Of those that did have associations, we compare these results with the predictions set out in the introduction. The first hypothesis stated that foraging in mixed species groups would be of advantage if they helped each other in finding localized food resources (Murton, 1971; Krebs, 1973; Powell, 1985; Latta & Wunderle, 1996; Monkkonen, Forsman & Helle, 1996; Dolby & Grubb, 1998, 2000). Species may accept the cost of competition because the benefits of group foraging could exceed the cost of sharing resources (Cresswell, 1997).

This foraging hypothesis predicts that associated species should have similar diets. Our results show that the three species that were positively associated in mixed flocks in the same habitat (rufous-tailed weaver, red-billed buffalo weaver and superb starling) all ate substantial quantities of insects. These results, therefore, are consistent with the predictions of this foraging hypothesis. The hypothesis is also supported by the negative association between Fischer's lovebird and superb starling, two species that have completely different diets (superb starling is a pure insectivore whereas Fischer's lovebirds are pure granivores). Superb starling and Hildebrandt's starling occurred separately as might be expected through interspecific competition between these very similar congeneric species. No diet data were obtained for the Hildebrandt's starling.

Table 3 The mean number, standard error and per cent by volume of particles counted in the crop and stomach samples of five species of birds mist-netted in Serengeti National Park, Tanzania

Species	n	Mean seed	SE	%	Mean insect	SE	%	Mean vegetation	SE	%
RTWE	17	221.1	70.1	41.3	312.9	62.4	58.6	0.2	0.1	0.0
FILO	10	309.5	93.8	99.8	0.0	0.0	0.0	0.4	0.4	0.1
RBBW	13	215.1	35.9	49.8	216.5	10.3	50.2	0.0	0.0	0.0
WHBW	10	131.1	28.4	27.0	341.3	82.9	70.5	11.9	11.9	2.4
SUST	12	0.0	0.0	0.0	215.0	99.4	99.4	1.3	0.9	0.6

n, number of individuals of each species. RTWE, rufous-tailed weaver; FILO, Fischer's lovebird; WHBW, white-headed buffalo weaver; SUST, superb starling; HIST, Hildebrandt's starling; RBBW, red-billed buffalo weaver.

However, the negative associations among white-headed buffalo weaver and superb starling and the rufous-tailed weaver suggest a more complex explanation. The white-headed buffalo weaver was not associated with any particular habitat type and white-headed buffalo weaver was often found in woodlands where rufous-tailed weaver did not venture and superb starling occurred less frequently.

An alternative hypothesis suggests that species live in mixed flocks to avoid predators through group vigilance (Buskirk, 1976; Thiollay, 1999; Jullien & Clobert, 2000). This idea predicts that species with very different diets would have maximum benefit from group vigilance as they would also avoid competition for limited food resources in the dry season. Food, especially insects, is at lowest abundance in the dry season (Sinclair, 1978) and competition for foods is greatest. However, the close association of the red-billed buffalo weaver and rufous-tailed weaver that have very similar diets is not easily explained by this hypothesis. Identifying food items by species might further clarify these relationships. Diets may change during the year as new growth appears and birds begin reproducing. Relationships among these species may change, or be further illuminated by study in other seasons.

Fischer's lovebirds have no clear association with rufous-tailed weavers during the day but they do compete for the roosting nests of the rufous-tailed weavers (E. Mwangomo, pers. observ.). There is an indication, therefore, that Fischer's lovebirds are obtaining some benefit through this interspecific association, which may explain the range and habitat overlap of these two species. Our finding is of relevance to conservation as the two species need to be considered together for management purposes. The rufous-tailed weaver and Fischer's lovebird are endemic to the Serengeti ecosystem, if their co-occurrence is of ecological significance, then the Serengeti habitat will be important for the survival of Fischer's lovebirds which are facing illegal commercial exploitation outside protected areas.

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