

FORAGING PATTERNS OF MALE AND FEMALE SCISSOR-TAILED FLYCATCHERS

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Abstract.—Male and female Scissor-tailed Flycatchers (*Tyrannus forficatus*) exhibited sexually dimorphic foraging patterns during the breeding season. Males foraged from higher perches and were less successful in catching prey. Females were more likely to forage on the ground and were more affected by windy conditions. Three hypotheses that may explain these differences (competition, morphology and breeding constraints) are discussed.

PATRONES DE FORRAJE O EN INDIVIDUOS DE AMBOS SEXOS DE *TYRANNUS FORFICATUS*

Sinopsis.—Durante la época de reproducción la hembra y el macho de *Tyrannus forficatus* exhiben dimorfismo en sus patrones de forrajeo. Los machos forrajean desde perchas más altas y son menos exitosos en capturar presas. Las hembras son más propensas a buscar su alimento en los suelos y su forrajeo puede ser afectado por el viento. Se discuten tres hipótesis (competencia, aspectos morfológicos y limitaciones reproductivas) que podrían explicar las diferencias en los patrones de forrajeo.

Intersexual differences in foraging patterns may occur for a number of reasons (Selander 1966). First, species in which males and females forage predominantly or exclusively within breeding territories may differ in their spatial or temporal patterns of food acquisition to reduce competition. Second, morphological differences between the sexes, due for example to sexually selected characters, may result in different modes and/or success rates of foraging for males and females. Third, breeding and nesting activities may constrain both sexes to foraging in certain areas and/or at certain times. As yet, however, few studies have examined foraging strategies of males and females during this period.

Scissor-tailed Flycatchers (*Tyrannus forficatus*) are aerial insectivores that forage almost exclusively in their territories during the breeding season. If food is temporally or spatially limiting, it should be advantageous for males and females to separate their foraging activities to avoid competition. In addition, this species is unusual among the North American tyrannid flycatchers in that the male's tail is approximately 30-40% longer than the female's. While tail morphology has received little attention with respect to its effect on flight dynamics, it has been suggested that tails may be an adaptation to stabilize pitch (King and King 1979), and that an increase in tail length should result in decreased agility during flight (Evans and Thomas 1992). Therefore, foraging differences might also occur because these elongated tails subject males to certain foraging constraints not imposed on females. The purpose of this study was to quantify and compare foraging patterns of male and female Scissor-tailed Flycatchers and, if differences exist, discuss them in relation to the above three hypotheses.

METHODS

This study took place in and around Georgetown, Texas, between 12 May and 20 Jun. 1990. Pairs of unmarked scissortails were identified initially by repeated observations at one location. Most data concerning the feeding patterns of each individual were collected in 30-min periods between 0700 and 1200 hours by an observer sitting approximately 50 m from the bird. In some cases, focal birds flew out of sight before the observation period ended, whereas later in the season, more extensive observations were collected over a longer period (up to 2 h). All data were collected prior to eggs hatching.

During each 30-min period, I noted percent cloud cover, temperature (taken at the end of the observation period at each location) and wind speed (estimated by averaging six measurements taken over 1 min with a hand-held anemeter). For each foraging trip, I noted initial perch height, angle to the horizon (-90 , -60 , -30 , 0 , 30 , 60 , 90°), distance (0–1, 1–3, 3–5, 5–10, >10 m), and whether the bird was successful in capturing the prey. The sally was assumed to be successful if the focal individual was seen catching the prey or if the individual, after returning to a perch, was seen swallowing the prey. It is possible, however, that I underestimated the success rate as many small prey items could have been caught and swallowed unnoticed while the individual was flying.

It is unlikely that successive foraging trips by the same individual are independent events. Thus, instead of comparisons based on the total number of feeding trips by males and females, I have aggregated all trips during one observation period for each individual (hereafter termed a foraging bout), effectively treating each bout as one weighted observation. In cases where the same individual was observed on different days, foraging bouts were assumed to be independent. I felt that this was valid as differences in weather variables and prey distribution would likely necessitate different foraging patterns. This method allows use of all foraging observations but reduces the sample size to that corresponding to the number of feeding bouts, thus making statistical analysis more conservative than if each feeding trip was analyzed as a separate event.

RESULTS

I observed 65 foraging bouts by Scissor-tailed Flycatchers (39 by males, 26 by females) consisting of a total of 436 foraging trips (average number per bout \pm SD, female: 5.3 ± 4.2 , male: 7.6 ± 9.3).

To determine if foraging patterns (perch height, sally distance, sally time (from perch departure to return), location (ground or air) and success rate) were influenced by air temperature, cloud cover or wind speed, I calculated Spearman correlation coefficients for each pair of variables (arc-sine transformations were used on percent of sallies to ground and percent success). If significant correlations were found among three or more variables, I further analyzed them to determine if effects were additive using partial regression analysis.

Air temperature was positively correlated with both sally distance (P

TABLE 1. Correlations between air temperature, percent cloud cover, windspeed, perch height, sally distance and sally time for male ($n = 39$) and female ($n = 26$) Scissor-tailed Flycatchers (see text for variable names).

		Females					
		PCHHT	DIST	TIME	TEMP	CLOUD	WIND
Males	PCHHT	—	0.501*	0.391*	-0.214	-0.475*	-0.419*
	DIST	0.541*	—	0.618*	-0.117	-0.363	-0.527*
	TIME	0.261	0.587*	—	0.131	0.060	-0.284
	TEMP	0.017	0.415*	0.529*	—	0.197	0.042
	CLOUD	-0.541*	0.072	0.034	0.530*	—	0.571*
	WIND	-0.095	-0.070	0.128	0.331*	0.165	—

* $P < 0.05$, two-tailed test.

= 0.009) and sally time ($P = 0.001$) for males but not females (Table 1). These latter two variables were, not surprisingly, strongly correlated in both sexes ($r = 0.585$, $P < 0.001$ for both sexes combined). Wind speed, on the other hand, was negatively correlated with perch height ($P = 0.035$) and sally distance ($P = 0.006$) for females but not males ($P = 0.565$ and $P = 0.673$, respectively). Cloud cover was associated with decreased perch height for both males ($P < 0.001$) and females ($P = 0.015$). There was no significant effect, however, of either windspeed or percent cloud cover on female perch height when the effect of the other was partialled out. Finally, percent cloud cover and windspeed were positively correlated with the percentage of sallies directed towards the ground for both sexes (cloud cover: $r = 0.306$, $P = 0.013$; wind speed: $r = 0.403$, $P = 0.001$). Again, however, the effects were not additive.

In addition to correlations with climatic variables, a strong positive correlation was found between perch height and sally distance for both males ($P < 0.001$) and females ($P = 0.009$). Success rate was negatively correlated with sally distance for males ($r = -0.318$, $P = 0.049$) although not females ($r = 0.111$, $P = 0.590$). No other measured variables reliably predicted foraging success for males, females, or both sexes combined.

In comparison to males, I found that females initiated foraging flights from significantly lower perches and were more successful at obtaining prey (Table 2). Unweighted data suggest that sally angles were similar for both males and females (Table 3; $\chi^2 = 8.60$, $P > 0.10$).

If tail length hinders foraging through its effect on flight dynamics, one might predict that potential differences between males and females would be more pronounced under windy conditions. I therefore compared mean values of all foraging variables for bouts occurring in winds greater and less than 2.5 m/s (Table 4). As suggested by correlations, female perch height and sally distance decreased in windier conditions while the percent of sallies to ground increased. No significant changes were found for male foraging patterns in the two conditions. This difference resulted in significant differences between males and females for each of these three variables under windy conditions that were not observed when conditions were calmer.

TABLE 2. Comparison of male and female Scissor-tailed Flycatcher foraging patterns. Probability levels calculated from *t*-tests on weighted means; arcsine transformations used for percentages.

	Male	Female	<i>P</i>
Perch height (m)	2.86 ± 1.89	1.62 ± 1.14	0.004
Sally distance*	3.04 ± 0.80	2.74 ± 0.79	0.145
Sally time (s)	5.82 ± 2.17	5.70 ± 3.12	0.855
% to ground	46.5 ± 30.7	61.1 ± 35.1	0.081
% successful	45.2 ± 25.5	62.4 ± 24.4	0.009

* Values are means of frequencies (see methods).

DISCUSSION

The results of this study suggest that foraging patterns of breeding male and female Scissor-tailed Flycatchers differ with respect to each other as well as under different weather conditions.

Warm air temperature, low cloud cover and calm conditions are all associated with an increase in the availability of flying insects (reviewed by Murphy 1987). In male scissortails longer sallies were positively correlated with air temperature. Leck (1971) suggested that favorable conditions (high visibility and insect activity), make long distance pursuits more energetically feasible. As cloud cover and/or wind speed increased, both sexes foraged from lower perches and directed more of their foraging sallies to the ground. In addition, females significantly shortened their sallies in high winds. Murphy (1987) also found that the proportion of perch-to-ground sallies by Eastern Kingbirds (*Tyrannus tyrannus*) increased under cloudy conditions and suggested that this reflected an adjustment in foraging tactics in accordance with insect distribution. Whereas foraging success did not correlate well with any weather condition in this study, Foreman (1978), examining a larger number of sallies, found that the foraging success of scissortails increased as it became warmer and decreased as cloud cover and wind speed increased.

The possible relationship between sexual dimorphism in morphology and sex-specific foraging behaviors has been noted in many groups of birds. Bill dimensions and tail length in woodpeckers (Kilham 1965, Ligon 1968, Selander 1966, Short 1970), and body size in raptors (Safina 1984,

TABLE 3. Sally angle (0 = horizontal) for male and female Scissor-tailed flycatchers. Numbers in parentheses are percentages.

	Sally angle						
	+90	+60	+30	0	-30	-60	-90
Males	6 (2.0)	24 (8.1)	40 (13.4)	69 (23.1)	83 (27.9)	56 (18.8)	20 (6.7)
Females	0 (0.0)	5 (3.6)	14 (10.2)	34 (24.8)	48 (35.0)	24 (17.5)	12 (8.8)

TABLE 4. Relationship between wind speed and male and female foraging patterns.

Variable	Sex	Wind \leq 2.5 m/s		Wind $>$ 2.5 m/s
Perch height (m)	Male	2.84 \pm 2.26		2.88 \pm 1.51 ***
	Female	2.13 \pm 0.90	**	1.16 \pm 1.17
Sally distance	Male	2.91 \pm 0.77		3.14 \pm 0.84 ***
	Female	3.17 \pm 0.78	***	2.35 \pm 0.62
Sally time (s)	Male	5.49 \pm 2.36		6.14 \pm 1.96
	Female	6.54 \pm 4.04		5.02 \pm 1.99
% to ground	Male	39.2 \pm 32.8		53.7 \pm 27.4 **
	Female	42.8 \pm 31.9	**	75.8 \pm 31.1
% successful	Male	45.3 \pm 24.2 **		45.1 \pm 27.4
	Female	66.2 \pm 26.6		58.1 \pm 22.2

** 0.05 $>$ P $>$ 0.01. *** P $<$ 0.01.

Storer 1952, von Schantz and Nilsson 1981) are most often cited as characteristics that may be related to sex-specific foraging patterns. As often is the case, however, determining evolutionary cause and effect mechanisms is difficult. The following three possibilities were suggested by Selander (1966). First, differences in morphology between males and females of many species, especially with respect to bill morphology, may have evolved to reduce the degree of sexual overlap in resource exploitation. Second, separation of foraging activities by males and females, like that observed in Indigo Buntings (*Passerina cyanea*) (W. L. Thompson, in Selander 1966), may be unrelated to differences in morphology but is more likely the result of constraints imposed by breeding activities. Finally, sexual differences in foraging behavior might be a consequence of morphological differences resulting from sexual selection. As an example, Selander noted that male Great-tailed Grackles (*Quiscalus mexicanus*) may suffer reduced foraging efficiency because of their larger body size and increased tail length.

As predicted, male Scissor-tailed Flycatchers were generally less successful than females at capturing prey. While this may reflect a cost associated with increased tail length in this sex for reasons related to sexual selection, it is equally likely that intersexual differences were the result of constraints arising from reproductive duties. Male scissortails are primarily responsible for territory defense (Fitch 1950), and may have used higher perches to observe better territorial intruders or predators. This could explain why foraging sallies began from higher perches, and because sally distance for both males and females was positively correlated with perch height (possibly for reasons related to insect abundance), would also explain why male sally distances were longer. Females, being less constrained by territorial duties, could spend more time foraging from lower perches, direct more of their sallies to the ground, and could more

easily adjust their foraging tactics as wind speed increased. Few other studies have compared foraging by male and female flycatchers. Foreman (1978) also found that male scissortails engaged in longer flights than females but noted that both sexes had similar success rates in capturing prey. Davies (1977) suggested that male and female Spotted Flycatchers (*Muscicapa striata*) may separate foraging activities spatially and temporally, especially when feeding on large prey.

Whereas it is clear that foraging patterns of male and female Scissor-tailed Flycatchers differ during the breeding season, it is not yet possible to conclude why. Information on foraging strategies of related monomorphic species and an experimental study manipulating tail length in scissortails would be useful in teasing apart competition, morphology and breeding constraint hypotheses.

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