

# Nestling provisioning by male and female Yellow-breasted Chats: no relationships between morphology and parental care

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**ABSTRACT.** In birds, males and females may benefit by choosing mates based on morphological characteristics correlated with their ability to provide parental care. Our objective was to examine possible relationships between morphological characteristics and the provisioning behavior of male and female Yellow-breasted Chats (*Icteria virens*). No differences were found in the provisioning behavior of male and female Yellow-breasted Chats. Adult chats provisioned nestlings at higher rates and delivered more biomass at first nests than during later nesting attempts. This indicates that, later in the breeding season, nestling chats may require less energy, perhaps because warmer temperatures lower thermoregulatory costs. No correlations, either positive or negative, between chat morphological characteristics (mass, eye stripe length, tail length, wing chord, tarsus length, and plumage color) and provisioning behavior were noted. Thus, these results do not provide support for either the honest advertisement hypothesis (that predicts a positive relationship between quality and parental care) or the differential allocation hypothesis (that predicts a negative relationship). If mate choice among chats is based on future parental care, the absence of such correlations suggests that characteristics other than those examined in this study may be used by chats. Alternatively, chats may not base mate choice decisions on future parental care, but rather on other features such as territory quality.

**SINOPSIS.** Machos y hembras de *Icteria virens* como proveedores: no hay relación entre la morfología y el cuidado parental

Entre las aves tanto las hembras como los machos pueden beneficiarse seleccionando como pareja características morfológicas que puedan estar asociadas con la habilidad de estos para proveer cuidado parental. El objetivo de este estudio fue examinar la posible relación entre características morfológicas y la conducta de llevar comida al nido en ambos sexos de *Icteria virens*. No se encontraron diferencias significativas en la conducta de llevar comida al nido entre los sexos. Los adultos llevan más comida al nido y de mejor calidad a su primera camada que a las producidas posteriormente. Esto puede ser un indicativo, que tarde en la época de reproducción, los pichones requieran de menor cantidad de artículos que provean energía, posiblemente a temperaturas ambientales más altas y al bajo costo de termoregular. No se encontraron correlaciones positivas y negativas, entre características morfológicas de la especie estudiadas y la conducta de llevar comida al nido. Estos resultados no proveen apoyo a la hipótesis que predice una correlación positiva entre calidad del canto y cuidado parental, tampoco a la hipótesis nula que predice una correlación negativa. Si la selección de parejas entre individuos de la especie estudiada se basa en el cuidado parental que estos puedan proveer, la ausencia de dicha correlación sugiere que otras características que no fueron incluidas en este estudio son utilizadas por estas aves. Las aves muy bien pudieran usar como criterio de selección otros atributos como la calidad del territorio a ser utilizado para criar.

*Key words:* *Icteria virens*, morphology, provisioning, ultraviolet reflectance, Yellow-breasted Chat

Morphological traits such as plumage quality may provide information to prospective mates about an individual's future parental care. However, two hypotheses predict different relationships between such traits and parental care. The good-parent hypothesis (Hoelzer 1989) predicts that condition-dependent morphological cues are honest signals and reliably reflect the ability of an individual to provide parental care. For

example, male Northern Cardinals (*Cardinalis cardinalis*) with brighter breast plumage were preferred as mates by females (Linville et al. 1998), and brightly colored males also fed nestlings at higher rates (Filliater and Breitwisch 1997).

Alternatively, the differential allocation hypothesis proposes that attractive or high-quality individuals will provide less parental care because mates are willing to increase their contributions to keep their partners (Burley 1986). Among House Finches (*Carpodacus mexicanus*), for example, males with more elaborate or red-

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der plumage provide little or no parental care compared to less elaborate or duller males (Duckworth et al. 2003).

Typically, both male and female Yellow-breasted Chats (*Icteria virens*) provision nestlings (Schadd and Ritchison 1998). However, observations at nests also indicate that levels of provisioning by male and female chats vary among individuals and within pairs (Schadd and Ritchison 1998). Chats possess yellow to orange throat and breast plumage, and recent analysis has revealed that these feathers reflect strongly in the ultraviolet (Mays et al. 2004). Plumage reflecting in the ultraviolet has been found to serve as an important sexual signal in other species of birds (Andersson and Amundsen 1997; Johnsen et al. 1998; Siitari et al. 2002). Our objective was to examine possible relationships between variation in morphology among Yellow-breasted Chats, including throat and breast plumage, and levels of parental care.

### METHODS

Yellow-breasted Chats were studied from late April to early August 1998–1999 at the Central Kentucky Wildlife Management Area (CKWMA), located 17 km southeast of Richmond, Madison County, Kentucky. Chats were captured by placing mist nets in known territories or by luring them into nets using playback of chat songs. Captured chats were uniquely banded with a numbered aluminum band plus three colored-plastic bands. Yellow bands were not used. For each chat, we also determined mass, tail and tarsus length, wing chord length, and eye stripe (the white eye stripe above the right eye) length. In addition, feathers were collected from each chat. Three feathers were collected from each of three regions of the breast along a medial line: gular, or throat, region, upper breast (from the center of the yellow breast plumage), and lower breast (just above where the yellow breast plumage meets the white plumage of the belly).

After pairing, nests were located by observing the behavior of chats and searching likely sites. Nests with 3–8 d old young were generally videotaped with camcorders placed 1–2 m away. Because our study area was open to the public and we did not want to draw attention to nests, camcorders were only in place during taping sessions. Although chat behavior did not appear

to be influenced by the presence of the camcorders (Schadd and Ritchison 1998), we cannot, in the absence of any attempt to habituate chats to the camcorder's presence, be certain that there was no such influence.

All taping was conducted between 06:00 to 12:00. Videotapes were subsequently viewed and, for each parental visit to a nest, we noted the number and size of prey items delivered. Prey were categorized as small (< adult bill length), medium (> adult bill length and up to  $2 \times$  bill length), or large (>  $2 \times$  bill length). Additionally, for nests where the date of hatching was known, nestling chats were weighed to the nearest 0.1 g on day 6 post-hatching.

Feathers collected from adult chats were measured for their spectral reflectance in the laboratory using an Oriel InstaSpec™ IV spectroscopic system (Oriel Instruments, Stratford, CT), consisting of a sighting optic with Nikon UV-transmissive macro-lens (105 mm), fixed image compact spectrograph (285–735 nm), and a capture board. Feathers were illuminated with a 250 watt stabilized Xenon-arc light source (CVI-Laser Corp.). Reflectance spectra (282–730 nm) were calculated relative to a white standard of Spectrolon™ (Labsphere Inc., North Sutton, NH).

Because nests were videotaped on more than one occasion, repeated-measures analysis of variance was used to examine the possible effects of sex, nesting attempt, and adult morphology on provisioning behavior. Spearman correlation coefficients were used to examine possible relationships between adult morphological characters and provisioning behavior. For these analyses, only those pairs in which both individuals were captured were used and, for pairs that were double-brooded, only one nest (chosen randomly) was used. To examine possible morphological differences between male and female chats, Wilcoxon tests were used. Sample sizes vary because plumage samples were collected during 1998 and 1999, while nests were videotaped only during the 1999 field season; nests in some territories where one or both adults had been captured could not be located and videotaped; and adults (usually the female) in some territories were not captured. All analyses were conducted using SAS (SAS Institute 1989). Values are presented as mean  $\pm$  1 SE.

## RESULTS

Chat nests ( $N = 40$  nests in 34 territories) were videotaped for 244 h ( $\bar{x} = 6.1$  hours per nest, range, 2–14 h) during the breeding season of 1999. Male and female chats visited nests at similar rates ( $F_{1,26} = 1.95$ ,  $P = 0.17$ ), with a rate of  $1.65 \pm 0.13$  visits/h for males and  $1.49 \pm 0.04$  for females. Similarly, we found no difference ( $F_{1,27} = 0.04$ ,  $P = 0.85$ ) between males ( $2.04 \pm 0.03$ ) and females ( $2.05 \pm 0.04$ ) in mean size of prey delivered to nestlings. Male and female chats also delivered the same number of prey to nestlings per visit ( $F_{1,27} = 1.76$ ,  $P = 0.2$ ), with  $1.49 \pm 0.04$  prey/visit for males and  $1.40 \pm 0.04$  for females. However, differences between males and females in the number of prey delivered per hour approached significance ( $F_{1,27} = 3.65$ ,  $P = 0.067$ ), with males delivering  $2.15 \pm 0.15$  prey/h and females  $1.67 \pm 0.12$ .

We found no differences in mean size of prey delivered, provisioning rate, or number of prey delivered per hour among nestlings of different age ( $P > 0.12$ ) or among different brood sizes ( $P > 0.23$ ; Schadd and Ritchison 1998). However, provisioning rates did vary with nesting attempt ( $F_{1,32} = 5.81$ ,  $P = 0.02$ ). Adult chats visited first nests ( $N = 22$  nests in 22 territories) of the season at a rate of  $1.79 \pm 0.14$  times/h, while later nests (second and third;  $N = 18$  nests in 17 territories) were visited  $1.26 \pm 0.11$ . The mean number of prey delivered per hour also differed with nesting attempt ( $F_{1,32} = 5.98$ ,  $P = 0.02$ ), with adults delivering  $2.16 \pm 0.14$  prey items/h at first nests and  $1.59 \pm 0.13$  at later nests. The mean number of prey per visit ( $F_{1,34} = 0.26$ ,  $P = 0.61$ ;  $1.47 \pm 0.04$  for later nests) and mean prey size ( $F_{1,34} = 0.13$ ,  $P = 0.72$ ;  $2.06 \pm 0.03$  for first nests and  $2.02 \pm 0.04$  for later nests) did not differ between first nests and later nests.

**Adult morphology.** For pairs ( $N = 12$ ) where both adult chats were captured and nests were videotaped, males ( $26.70 \pm 0.53$  g) and females ( $26.03 \pm 0.63$  g) did not differ in mass ( $Z = 0.93$ ,  $P = 0.36$ ). Similarly, males and females did not differ in tarsus length ( $Z = 1.13$ ,  $P = 0.26$ ;  $28.52 \pm 0.21$  mm,  $28.06 \pm 0.21$  mm, respectively), wing chord length ( $Z = 1.04$ ,  $P = 0.3$ ;  $76.08 \pm 0.43$  mm,  $74.95 \pm 0.72$  mm, respectively), or tail length ( $Z = 0.87$ ,  $P = 0.38$ ;  $76.63 \pm 0.63$  mm,  $74.67 \pm$

$1.08$  mm, respectively). However, male chats did have longer eye stripes than females ( $Z = 3.01$ ,  $P = 0.003$ ;  $17.51 \pm 0.32$  mm,  $15.86 \pm 0.32$  mm, respectively).

The breast plumage of male ( $N = 72$ ) and female ( $N = 43$ ) Yellow-breasted Chats was compared spectrographically. Male chats had a significantly greater reflectance in the ultraviolet (339–357 nm) than females, ( $Z = 4.26$ ,  $P = 0.0001$ ) with a mean reflectance of  $49.71 \pm 1.86$  for males ( $N = 56$ ) and  $33.47 \pm 2.78$  for females ( $N = 22$ ).

**Nestling mass.** The date of hatching was known for 10 chat nests. At those nests, the mean mass of 6 d old nestlings (typically 3–4 d before fledging) did not differ ( $Z = 0.12$ ,  $P = 0.9$ ) between first nests ( $14.7 \pm 0.5$  g for seven nests with 27 nestlings) and later nests ( $14.2 \pm 1.1$  g for three nests with 10 nestlings). Similarly, there were no significant correlations between adult morphological characteristics (mass, eye stripe length, tarsus length, wing chord length, tail length, and peak reflectance in the ultraviolet) and nestling mass at 6 d post-hatching (Spearman correlations,  $P > 0.39$ ;  $N = 10$  pairs).

**Adult morphology and provisioning behavior.** We found no significant correlations between morphological characteristics (mass, eye stripe length, tarsus length, wing chord length, and tail length) of either males or females and the amount of prey biomass delivered to nestling Yellow-breasted Chats (Spearman correlations,  $P > 0.12$ ;  $N = 12$  pairs). In addition, we found no significant correlations (Spearman correlations,  $P > 0.10$ ) between peak reflectance in the ultraviolet and either provisioning rates (number of visits per hour) or prey biomass delivered to nestlings (number of prey delivered per hour) for either male or female chats.

## DISCUSSION

We found no differences in the provisioning behavior of male and female Yellow-breasted Chats. Similarly, Schadd and Ritchison (1998) found that male and female chats fed nestlings at similar rates, delivered similar numbers of prey per visit, and delivered similar-sized prey. Other investigators have reported similar results for other species (Haggerty 1992; Sandell et al. 1996; Sejberg et al. 2000). Silver et al. (1985)

reviewed the literature concerning male parental care in birds and observed that both males and females provision nestlings in nearly 60% of all avian subfamilies. Factors apparently contributing to this tendency of male birds to provide parental care include the altricial mode of development and socially monogamous mating systems (Silver et al. 1985). The substantial investment needed to successfully raise altricial young favored, and continues to favor, the contributions of males (Silver et al. 1985).

#### **Effect of nesting attempt on provisioning.**

Adult Yellow-breasted Chats in our study provisioned nestlings at higher rates and delivered more prey biomass (prey items/h) during first nesting attempts than during later nesting attempts. Similarly, Harper (1985) noted that early broods of American Robins (*Turdus migratorius*) tended to be fed at higher rates than later broods, and Goodbred and Holmes (1996) reported that Black-throated Blue Warblers (*Dendroica caerulescens*) made fewer feeding visits and delivered less food biomass to nestlings in mid-summer (July) than earlier in the season (June). Other investigators have reported no change in provisioning rates during the breeding season (Johnson and Best 1982).

Goodbred and Holmes (1996) suggested that three factors could contribute to reduced provisioning rates later in the breeding season: (1) nestlings may have lower energy requirements because warmer temperatures may lower thermoregulatory costs; (2) adults may be less willing to invest in later broods because of other energy demands such as the onset of molt or the need to prepare (via fat deposition) for migration; and (3) parents may have more difficulty finding food later in the season. If adult Yellow-breasted Chats provision at lower rates because prey are more difficult to find, then nestlings later in the season should grow at slower rates. However, the mass of nestling chats on day 6 after hatching did not differ between first (initiated in May) and later (initiated in June and July) nests. Thus, nestling Yellow-breasted Chats grew at similar rates later in the season, even though adults provided less insect biomass. This suggests that nestling chats required less energy later in the season, perhaps because, with warmer temperatures, thermoregulatory costs were lower. Data obtained from the Lexington, Kentucky, weather station (located 34 km northwest of our study site) re-

vealed that in 1999 mean monthly temperatures increased progressively during May (18.6°C), June (23.2°C), and July (26.5°C).

#### **Adult morphology and provisioning.**

We found no significant correlations (either positive or negative) between morphological characteristics (mass, eye stripe length, tail length, wing chord, tarsus length, or plumage coloration) and the provisioning behavior of male and female Yellow-breasted Chats. Assuming that such characteristics provide information about individual quality, our results do not provide support for either the honest advertisement hypothesis (that predicts a positive relationship between quality and parental care) or the differential allocation hypothesis (that predicts a negative relationship). Other investigators have also examined possible relationships between morphological characteristics, particularly plumage characteristics, of birds and levels of parental care. While some authors have found evidence suggesting a correlation between measures of parental care (such as provisioning rates) and some morphological characteristics (Palokangas et al. 1994; Linville et al. 1998), most have either found no relationship or found that variation can be explained by other factors such as age. For example, Lozano and Lemon (1996) found no relationship between the degree of brown streaking on the chests of Yellow Warblers and levels of paternal care. Similarly, Norris (1990) found no evidence to suggest that feeding rates of male Great Tits (*Parus major*) were correlated with the size of the central black breast strip, and Rohde et al. (1999a) found no evidence that more colorful female Bluethroats (*Luscinia svecica svecica*) fed nestlings at higher rates than less colorful females. Rohde et al. (1999b) also reported no relationship between male attractiveness and provisioning rates in male Bluethroats.

If mate choice by Yellow-breasted Chats is based on future parental care in the form of feeding rates, the absence of correlations between morphological characters and provisioning behavior indicates that chats make choices based on characteristics not examined in our study. Female chats could, for example, use male singing behavior (e.g., rates or repertoire sizes) as an indicator of future paternal care. Commitment to provide care could also be signaled through time spent by males with their

mates (Langmore and Davies 1997). Alternatively, the morphological characters we examined could be correlated with other important components of paternal care, such as nest defense (e.g., Norris 1990).

Finally, Yellow-breasted Chats may not base mate choice decisions on future parental care. For example, females may choose mates based on territory quality rather than the quality of the male (Lozano and Lemon 1996). If so, individual variation in morphological features such as size or plumage quality may be more important in intrasexual competition than in mate choice.

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