ACTA ORNITHOLOGICA
Vol. 34 (1999) No. 1

Piotr ZIELIŃSKI, Zbigniew WOJCIECHOWSKI

Feeding frequency in the Barn Swallow *Hirundo rustica* in relation to time of the day

Zieliński P., Wojciechowski Z. 1999. Feeding frequency in the Barn Swallow *Hirundo rustica* in relation to time of the day. Acta orn. 34: 85–88.

Abstract. The study was carried out in Central Poland (52°15'N, 19°25'E) by all-day visual observation of five nests of Barn Swallows feeding their nestlings. Feeding frequency of older (age of 14–20 days) nestlings changed significantly with time of the day and was highest (46 visits/h) before noon, declining in the afternoon (21 visits/h) and after a slight increase during the early evening (25 visits/h) declining again in late evening. Feeding frequency of younger (age of 6 days) nestlings did not showed significant changes in the day cycle (average 20 visits/h). The proportion of midday feedings increased with nestling age while the proportion of evening feedings decreased.

Key words: Barn Swallow *Hirundo rustica*, breeding ecology, behaviour, nestling, feeding

Department of Ecology and Vertebrate Zoology, University of Łódź, Banacha 12/16, 90–237 Łódź, POLAND, pziel@biol.uni.lodz.pl, zbig@biol.uni.lodz.pl

Received — May 1999, accepted — July 1999

INTRODUCTION

Studies of feeding frequency, i.e. the frequency with which adult birds feed their nestlings, were carried out either directly by watching active nests (Moreau & Moreau 1939, Lorek 1992, De Lope & Møller 1993) or by using various types of automatic recording equipment. The equipment included different types of cameras (Blondel et al. 1991, Malacarne et al. 1992, Bańbura et al. 1994) and non-camera automatic recorders, from simple mechanical (Bogucki 1972) and electronic devices (Nur 1984, Blondel et al. 1991) to complex balance systems (Martins & Wright 1993). However, such counting equipment collects data on the number of visits to the nest, which is not always the same as the number of feeding trips. Wright (1990) found it necessary to calibrate the automatically counted numbers of visits.

Visual observation has many advantages over automatic recording, but it is time-consuming. In order to investigate as many nests as possible, most studies were conducted by watching adult birds for rather short period of time (0.5–2.0 hours) at particular nests. To minimise errors associated with diurnal variation in feeding rate, observations usually took place during strictly specified hours once (Jones 1987) or many times a day (Howe 1979, Johnson & Best 1982). Other studies were carried out over longer periods of time. Bédard & Meunier (1983) analyzed parental care in the Savannah Sparrow *Passerculus sandwichensis* during 150 min. periods scheduled randomly over the daylight period at any given nest. Møller (1988) watched Barn Swallows at the breeding sites for one hour at different times of the day and found no significant differences in morning, around noon and evening feeding rates. However, in many studies it has been shown that feeding frequency changes significantly with time of the day (Kluijver 1950, Johnson & Best 1982). The aim of this study is to investigate, by continuous observation, parental feeding frequency in the Barn Swallow in relation to time of the day and nestling age.

MATERIALS AND METHODS

Data were collected as part of a study of the biology of the Barn Swallow (Bańbura 1986). The field-work was carried out at village Ktery, in Łódź province, central Poland (52°15'N, 19°25'E) on 2 randomly chosen days: 17 July (3 nests) and 26 July 1979 (2 nests). Because the modal value of brood size in the study area was 4, four-nestlings broods were taken at random for detailed observation. Each nest was observed continuously during 15 hours between 05.00 and 20.00 h (Central European Time CET) inside pig stables from blinds set up about 4 m away. The weather was sunny and windless during both days. Nestling age in the nests studied was 6, 14, 15, 17 and 20 days as determined by the wing length of the biggest nestling (Zieliński 1993). The adult birds were ringed. No extra juveniles (Zieliński & Bańbura 1995) or adults (Bańbura & Zieliński 1995) disturbing feeding were observed at the nests watched. As, particularly during evening hours, sex determination was difficult feeding trips of both sexes were combined.

Feeding frequency, defined as the number of feeding visits to the nest per hour by both parents, was analysed by Friedman's method for randomised blocks (Sokal & Rohlf 1981). In such a design each cell contains a single reading only and the same subjects (pairs at the nests) are tested repeatedly over time.

The present study has the advantage of reducing many sources of variation. Firstly, brood size was 4 in all nests. Secondly, the weather was stable during the period of observation and finally, the surrounding area was quite uniform for all pairs because all the nests were at one village.

RESULTS

In total 1928 feeding trips were recorded. Each pair made on average 385.6 ± 29.7 (SE) feeding trips to the nest during 15 hours of each nest observation. Highly significant differences in feeding frequency of older nestlings (age 14, 15, 17 and 20 days) were found with time progress (four nests were observed for 15 hours, Friedman's test — $X^2 = 41.08$, df = 14, $p < 0.001$). In the early morning (06.00–07.00) feeding frequency of older nestlings (averages for four nests) was low (12 feeding trips/hour). Highest feeding frequency was recorded before noon (10.00–11.00 46 f.t./h), then it decreased in the afternoon (15.00–16.00 21 f.t./h), again slightly increased in late afternoon (17.00–18.00 25 f.t./h) and decreased in the evening (19.00–20.00 10 f.t./h) (Fig.1). Highest recorded number of feedings per hour was 51 f.t./h (nestling age 15 days, 12.00–13.00). Young nestlings (six days old) were fed more evenly throughout the whole day with the average feeding intensity of 20 f.t./h.

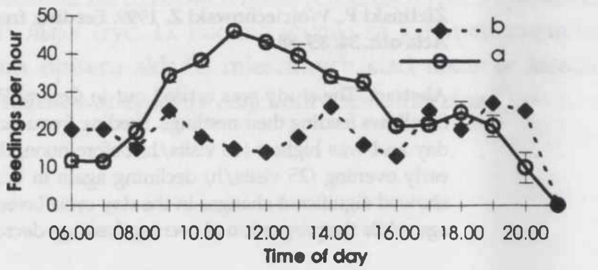

Fig.1. Feeding frequency per hour in relation to time of the day. a — four nests with older (14–20 days) nestlings (mean ± SE). b — younger nestlings (6 days). Data points reflect feeding intensity during the preceding hour.

A part of the variation in the feeding frequency was accounted for by the nestling age. There was a significant positive linear regression (Fig. 2, n = 5 pairs, ANOVA $F_{1,4} = 121.34$, $p < 0.01$) of the percentage of midday feedings i.e. (the number of feeding trips made by a pair from 10.00 to 13.00/total number of feedings)*100 on the nestling age. Therefore, the older the nestlings, the more often (relatively) they were fed during midday hours. A reverse relationship was found in the evening. There was a significant negative linear regression (Fig. 3, n = 5 pairs, ANOVA $F_{1,4} = 26.77$, $p < 0.05$) of the percentage (arsine transformed) of evening feedings i.e. (the number of feeding trips made by a pair from 16.00 to 20.00/total number of feedings)*100 on the nestling age. Therefore, the older the nestlings, the less often (relatively) they were fed during evening hours.

DISCUSSION

Kluijver (1950) reported maximum provisioning activity of the Great Tit in the morning, followed by a

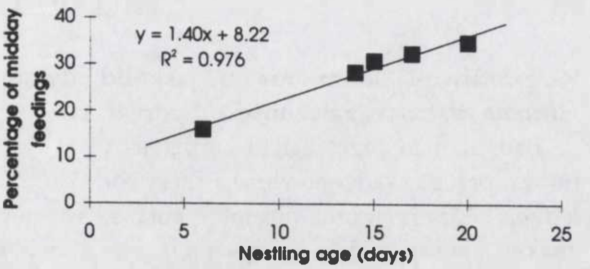

Fig 2. The percentage of midday (10.00–13.00 CET) feedings in relation to nestling age (5 nests).

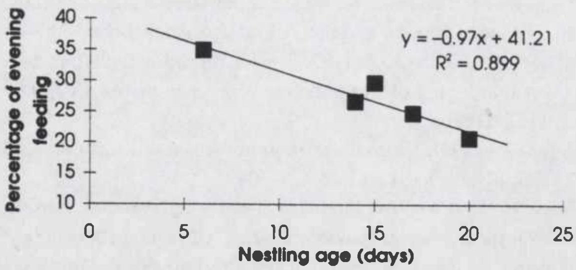

Fig 3. The percentage of evening (16.00–20.00 CET) feedings in relation to nestling age (5 nests).

minimum in the afternoon, with a second maximum in the evening. Howe (1979) studying the Common Grackle *Quiscalus quiscula* found that neither male nor female changed feeding rates during the day. The Gray Catbird *Dumetella carolinensis* (Johnson & Best 1982) was characterised by the highest feeding rate in the early morning.

In the Barn Swallow, a typical aerial feeder (Bryant & Turner 1982), the food provisioning activity is related to insect abundance, air temperature and nestlings begging intensity. *Syrphidae* and *Muscidae*, the main components of the Barn Swallow diet (Kožená 1979, Loske 1992), fly mainly around midday (Lewis & Taylor 1964), which corresponds to the highest level of the Barn Swallow provisioning activity reported in this study. Highest feeding rate in the late morning was also reported by Lorek (1992) and Turner (1994).

The second peak in the Barn Swallow feeding frequency might be, to some extent, related to the second peak in aphid activity. A bimodal distribution of aphid density in the air (the later peak in in most species the larger) is a general feature of the aphid flight activity (Eastop 1951, Taylor 1958, Lewis & Taylor 1964).

In addition, on days with good weather conditions (in this study weather was sunny during the period when the observations were carried out) lower feeding activity of the Barn Swallow in the afternoon might occur because nestlings get easily satiated during peak hours and parents wait with intensive feeding until nestlings beg more later.

Møller (1988) observed diurnal variation in feeding rates (sexes studied separately) of the Swallow in the morning (from sun rise to 08.00 hours), around noon (11.00 to 13.00) and in the evening (18.00 to sun set), for one hour in each period. Although feeding rates around noon tended to be higher, he did not find statistically significant differences in morning, around noon and evening feeding rates and concluded that morning (from sun rise to 12.00 hours) watches were thus representative of the entire day.

Our conclusion is that feeding frequency of the Barn Swallow changes significantly with time of the day and nestling age. Therefore, to obtain representative data on the entire-day Barn Swallow activity it is desirable to observe (record) birds either continuously or for many periods of time scheduled randomly over the whole daylight time.

ACKNOWLEDGEMENTS

We wish to thank members of the Students' Ornithological Section at Łódź University for help in field work. J. Bańbura and J. Wright provided helpful comments on the manuscript.

REFERENCES

Bańbura J. 1986. Sexual dimorphism in wing and tail length as shown by the Swallow, *Hirundo rustica*. J. Zool. Lond. (A) 210: 131–136.

Bańbura J., Blondel J., de Wilde-Lambrechts H., Galan M., Maistre M. 1994. Nestling diet varition in an insular Mediterranean population of Blue Tits *Parus caeruleus*: effects of years, territories and individuals. Oecologia 100: 413–420.

Bańbura J., Zieliński P. 1995. A clear case of sexually selected infanticide in the Swallow *Hirundo rustica*. J. Orn. 136: 299–301.

Bédard J., Meunier M. 1983. Parental care in the Savannah Sparrow. Can. J. Zool. 61: 2836–2843.

Blondel J., Dervieux A., Maistre M., Perret P. 1991. Feeding ecology and life history variation of the Blue Tit in the Mediterranean deciduous and sclerophyllous habitats. Oecologia 88: 9–14.

Bogucki Z. 1972. Studies on the activities of Starlings *Sturnus vulgaris* Linneaus 1758, in the breeding season. Acta zool. cracov. 17: 97–122.

Bryant D. M., Turner A. K. 1982. Central place foraging by swallows (Hirundinidea): the question of load size. Anim. Behav. 30: 845–856.
De Lope F., Møller A. P. 1993. Female reproductive effort depends on the degree of ornamentation of their mates. Evolution 47: 1152–1160.
Eastop V. F. 1951. Diurnal variation in the aerial density of Aphidae. Proc. R. ent. Soc. Lond. 26: 129–134.
Howe H. F. 1979. Evolutionary aspects of parental care in the Common Grackle, *Quiscalus quiscula* L. Evolution 33: 41–51.
Johnson E. J., Best L. B. 1982. Factors affecting feeding and brooding of Gray Catbird nestlings. Auk 99: 148–156.
Jones G. 1987. Parental foraging ecology and feeding behaviour during nestling rearing in the swallow. Ardea 75: 169–174.
Kluijver H. N. 1950. Daily routines of the Great Tit *Parus m. major* L. Ardea 38: 99–135.
Kožená I. 1979. A study on the qualitative composition of the diet of young Swallows *Hirundo rustica* in an agricultural farm. Folia Zool. 28: 337–346.
Lewis T., Taylor L. R. 1964. Diurnal periodicity of flight by insects. Trans. R. ent. Soc. Lond. 116: 393–476.
Lorek G. 1992. [Breeding biology of Chimney Swallow *Hirundo rustica* in southern Wielkopolska]. Lubuski Prz. Przyr. 3: 71–83.
Loske K. H. 1992. [Nestling food of the Swallow (*Hirundo rustica*) in Central Westphalia]. Vogelvarte 36: 173–187.
Malacarne G., Cucco M., Orechia G. 1992. Nest attendance, parental roles and breeding success in the Pallid Swift *Apus pallidus*. Vogelwarte 36: 203–210.
Martins T. L. F., Wright J. 1993. Brood reduction in response to manipulated brood sizes in the Common Swift *Apus apus*. Behav. Ecol. Sociobiol. 32: 61–70.
Moreau R. E., Moreau W. M. 1939. Observations on swallows and house–martins at the nest. Brit. Birds 33: 146–151.
Møller A. P. 1988. Paternity and paternal care in the swallow *Hirundo rustica*. Anim. Behav. 36: 996–1005.
Nur N. 1984. Feeding frequencies of nestling Blue Tits *Parus caeruleus*: cost, benefits and a model of optimal feeding frequency. Oecologia 65: 125–137.
Sokal R. R., Rohlf F. J. 1981. Biometry. San Francisco, Freeman and Co.
Taylor L. R. 1958. Aphid dispersal and diurnal periodicity. Proc. Linn. Soc. Lond. 169: 76–83.
Turner A. K. 1994. The Swallow. Hamlyn, London.
Wright J. 1990. Sex differences in parental investment: seeking an evolutionary stable strategy. Ph. D. thesis. Univ. of Oxford.
Zieliński P. 1993. Nestling growth and feeding frequency in the swallow. IV Congress ESEB, 22–28.08, Montpellier (France), p. 498.
Zieliński P., Bańbura J. 1995. Selfish behaviour of juvenile Barn Swallows *Hirundo rustica* intruding in active nests. Ornis Fennica 72: 89–90.

STRESZCZENIE

[Częstotliwość karmienia u jaskółki dymówki *Hirundo rustica* w zależności od pory dnia]

Badania nad przebiegiem karmienia piskląt u dymówki przeprowadzono we wsi Ktery nad Bzurą, woj. łódzkie. Obserwacjami objęto 5 gniazd, w których znajdowały się pisklęta w wieku 6, 14, 15, 17 i 20 dni. Badania przeprowadzono w ciągu dwóch dni w godz. 5.00–20.00 w chlewniach, podczas słonecznej i bezwietrznej pogody, odnotowując liczbę przylotów z pokarmem (obie płcie razem) podczas kolejnych 15 godzin obserwacji.

W gniazdach ze starszymi pisklętami (wiek piskląt 14, 15, 17 i 20 dni) pora dnia miała statystycznie istotny (test rang Friedmana, p < 0,001) wpływ na częstotliwość karmienia piskląt (rys. 1). W godzinach rannych starsze pisklęta były karmione z częstotliwością 12 wizyt z pokarmem/h, przed południem 46/h, po południu intensywność karmienia spadała do 21/h, następnie nieznacznie rosła do 25/h i ustawała zupełnie około godz. 20.00. Młodsze pisklęta (wiek 6 dni) były karmione bardziej równomiernie w ciągu dnia, ze średnią intensywnością 20/h (rys. 1). Najwyższa odnotowana w niniejszych badaniach częstotliwość karmienia dla pojedynczej pary wynosiła 51 wizyt z pokarmem/h.

Wiek piskląt miał istotny statystycznie wpływ na częstotliwość karmienia. Procentowy udział lotów z pokarmem w godz. 10.00–13.00 rósł w miarę zwiększania się wieku piskląt (rys. 2, p < 0,01). Natomiast w godz. 16.00–20.00 procentowy udział lotów z pokarmem spadał w miarę zwiększania się wieku piskląt (rys. 3, p < 0,05). Zatem, wraz z rosnącym wiekiem piskląt zwiększa się udział karmienia w godzinach okołopołudniowych, a maleje w godzinach wieczornych.

Z uwagi na dużą liczbę zmiennych mających wpływ na intensywność karmienia piskląt dymówki, w celu oszacowania całodobowej częstotliwości karmienia celowe jest nieprzerwane rejestrowanie tego procesu lub też obserwowanie karmienia podczas wielu losowo wybranych odcinków czasowych.