

Choice of Prey and Feeding Activity of urban Peregrine Falcons *Falco peregrinus* during the Breeding Season

R. Schneider and I. Wilden

ABSTRACT

From March-July 1991 a pair of Peregrines with two young nesting on a building in Berlin/Niederschöneeweide was observed. All activities related to the nest were recorded continuously by a quick-motion video system. Remains from feeding and plucking were collected around the nest site each day.

Prey amplitude was divided into constant (urban birds: 26.6% Pigeons, 18.7% Starlings) and variable portions (opportunities: spring migration of Thrushes, roosting flights of Black-headed Gulls). There was a preference for large-sized birds. Thus, prey selection seems to be guided by availability and size of birds. The nestlings were nearly exclusively fed by the female. Feeding was observed between about 4.34 a.m. and 6.57 p.m. Mean number of feedings per day was 6.7 with a median interval of 122.5 min. Maxima of feeding activity could be found in the morning and in the afternoon. Due to food storage, climatic factors had only little effect on the daily feeding pattern. Number of feedings and length of intervals were mostly affected by age.

Changes in the feeding pattern are considered as evidence of an arising conflict between growing needs and behavioural development of the young and growing costs for the parents. Food seems not to be a limiting factor in an urban environment.

INTRODUCTION

Man is changing his world and the ecological consequences we can see today are dramatic. Plant and animal species die out and Rathmayer (1990) suggested that in the middle of the next century approximately 30% of recent animal species will be extinct. Unfortunately, the worldwide decline of Peregrine Falcon populations is one of the most famous examples for this work of destruction.

On the other hand, man creates by his work new habitats for animals. Both the diversity of Central European bird life which came about with traditional forms of agriculture up to the 18th

Table 1: Prey taken by the falcons from March 1st until July 10th. 1991 (food items identified from remains of plucking and feeding, n=128)

Species	March			April			May			June			July		Total
	I	II	III	I	II	III	I	II	III	I	II	III	I	II	
<i>Larus ridibundus</i>	-	-	18.2	16.7	16.7	-	25.0	-	10.0	-	-	-	30.0	-	8.6
<i>Columba livia</i>	20.0	10.0	5.7	16.7	16.7	-	-	-	40.0	48.3	25.0	37.5	60.0	-	26.6
<i>Sreptopelia decaocto</i>	-	10.0	5.7	-	16.7	-	25.0	-	-	3.4	-	12.5	10.0	-	5.4
<i>Melopsittacus undulatus</i>	-	-	-	-	-	10.0	-	-	-	-	-	-	-	-	0.8
<i>Nymphicus hollandicus</i>	-	-	-	-	-	-	-	-	-	-	12.5	-	-	-	0.8
<i>Apus apus</i>	-	-	-	-	-	-	-	-	20.0	24.2	25.0	12.5	-	-	9.4
<i>Alauda arvensis</i>	40.0	10.0	5.7	-	-	-	-	-	-	-	-	-	-	-	3.1
<i>Phylloscopus</i> , sp.	-	-	-	10.0	-	-	-	-	-	-	-	-	-	-	0.8
<i>Turdus pilaris</i>	-	-	-	-	16.7	-	-	-	-	-	-	-	-	-	0.8
<i>Turdus iliacus</i>	-	10.0	-	-	-	-	-	-	-	-	-	-	-	-	0.8
<i>Turdus philomelos</i>	-	10.0	27.2	16.7	-	10.0	-	-	-	3.4	12.5	-	-	-	8.6
<i>Parus major</i>	-	20.0	-	-	-	-	-	-	-	-	-	-	-	-	1.6
<i>Parus caeruleus</i>	-	10.0	-	-	-	-	-	-	-	-	-	-	-	-	0.8
<i>Emberiza schoeniclus</i>	-	-	5.7	-	-	-	-	-	-	-	-	-	-	-	0.8
<i>Fringilla coelebs</i>	-	-	-	16.7	16.7	-	-	-	-	-	-	-	-	-	1.5
<i>Chloris chloris</i>	-	-	-	-	-	10.0	-	-	10.0	-	-	-	-	-	1.5
<i>Pyrrhula pyrrhula</i>	-	-	5.7	-	-	-	-	-	-	-	-	-	-	-	0.8
<i>C. coccythraustes</i>	-	10.0	-	-	-	-	-	-	-	-	-	-	-	-	0.8
<i>Loxia curvirostra</i>	-	-	-	-	-	-	-	-	-	-	-	12.5	-	-	0.8
<i>Passer domesticus</i>	20.0	-	5.7	-	-	10.0	-	-	-	-	-	-	-	-	2.3
<i>Sturnus vulgaris</i>	20.0	10.0	22.7	33.3	-	40.0	25.0	-	20.0	13.8	12.5	25.0	-	-	18.7
<i>Garrulus glandarius</i>	-	-	5.7	-	16.7	10.0	25.0	-	-	6.9	-	-	-	-	4.7

(Numbers in columns: Percentage from the total amount of identified individuals for each decade and the whole collection period)

century (Berthold 1990) and the process of urbanization which includes a lot of bird species (Stephan 1987) are examples. Thus, it has been known for a long time that even the Peregrine Falcon is able to live in a manmade environment using buildings as substitutes for cliff nesting sites (Kuhk 1968; Mebs 1968).

Urban spreading observed in several animal species leads us to question the reasons. Maybe there is a simple answer: an animal's specific requirements regarding space, time, metabolism, information, protection and mate should be realized better than elsewhere in an urban environment, or at least well enough to prevent it from seeking an alternative. That is, there should be some advantage. Knowledge about such "advantages" is necessary for each kind of animal protection or reintroduction. The following investigations on Peregrine Falcons are within such a framework.

Attention was paid to feeding behaviour, because food is regarded as one of the ultimate factors in habitat selection (Hilden 1965). Information about the feeding of Peregrines is mostly based on prey amplitudes sampled over a long time (reviewed by Brüll 1984; Sömmer 1989). Detailed quantitative studies on actual feeding activity are rare (Thiollay 1982; Haller 1984). Moreover, the mode of prey selection - opportunism or individual specialization - is still discussed (Sömmer 1989). Thus, it seems to be worthwhile to present our first results from observations of an urban breeding pair of Peregrines.

METHODS

From March-July 1991 a breeding pair of Peregrine Falcons *Falco p. peregrinus* nesting under the roof of the former broadcasting station Berlin/Niederschöneweide was observed. Two young hatched from a clutch of four eggs and were successfully raised.

From hatching of the first young on April 25th until the young left the nest on May 24th, all activities of the birds in the immediate vicinity of the nest were recorded by a quick-motion video system. Two cameras (a CCD F 12 colour-TV camera and a CCD-100 infra-red camera with infra-red spot) installed 2m in front of the nest allowed continuous monitoring and recording of the activities in an adjacent room. The records were applied to further analyses of parental care. Feedings of the young were scored both for the female and the male. Length of feeding bouts and intervals between feedings were timed.

In addition, remains from plucking and feeding were daily collected around the nest site during the whole breeding and nestling period.

Information about the weather conditions related to Berlin-Tegel (49m a. s. l.) were taken from the official weather service (DWD 1991).

RESULTS

Altogether 128 identifiable food items were obtained from the collected pluckings. Table 1 shows the resulting composition of the prey amplitude and its seasonal changes. Domestic pigeons and Starlings were caught over the whole observation period, thereby reaching the highest percentages. A second group ranging from a percentage of 8 to 10% involved Songthrushes, Black-headed Gulls and Swifts, which were caught only during distinct periods. Collared Doves at a lowest total percentage of about 5% were taken regularly. All other species were found in smaller quantities, although Skylarks and Jays reached remarkable seasonal peaks.

Table 2. Size preferences in prey selection

classes of caught birds (body weight)	percentage of total prey amplitude
0 - 25 g	5.5 %
26 - 50 g	18.8 %
51 - 100 g	30.5 %
100 - 300 g	45.2 %

The distribution of prey items among different weight classes is significantly different from a random one (chi-squared test, $p < 0.001$). Nearly half the birds were heavier than 100g, indicating

a clear size preference (Table 2).

The nestlings were fed almost exclusively by the female. Only 2.5% from a total of 202 feedings were directly performed by the male. The first feeding by the male was observed ten days after the beginning of hatching.

Figure 1: Daily feeding pattern (all feeding events summarized within 3-hour intervals over the whole observation period)

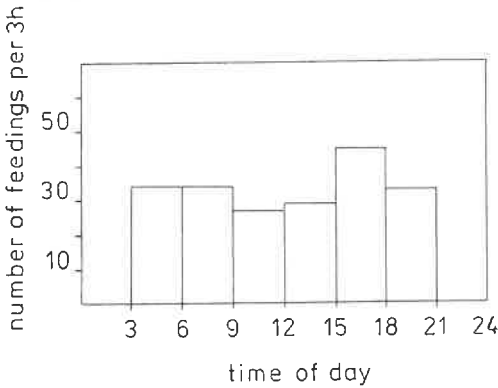


Figure 1 shows the daily feeding pattern. There were on average 6.7 feedings per day, each lasting on average 11.8 min, with a median interval of 122.5 min between them . In the morning, feeding began at about 4.34 a.m. (Central European time). In the evening, last feeding was at about 6.57 p.m. There was only little variation in those times ($V=15.2\%$ or 18.4%). On that account, correlations between time of sunrise/sunset and time of first/last feeding didn't reach any significance. But there were two stable peaks of feeding activity in the morning and in the afternoon.

Effects of several climatic factors (daily mean temperature, rainfall, wind force, sunshine) on feeding activity were estimated by calculating coefficients of correlation. Neither times of first feeding nor number of feedings per day, total time spent feeding per day, and daily range of feeding intervals could be found to be affected by climatic conditions. But there was an obvious effect of weather conditions on food delivery (Table 3). On rainy days the use of deposited prey was significantly higher than on days without any rainfall. On the latter days food was mostly handed over from the male to the female at the nest.

Table 3: Use of deposited prey dependent on weather conditions

	rainy days	days without any rainfall
total number of feedings	120	82
number of feedings with deposited prey	80	36
percentage and 5%-confidence interval of feedings with deposited prey	75 (± 10.2)	44 (± 14.1)

Figure 2: Feeding activity (number of feedings per day) during the nestling period.

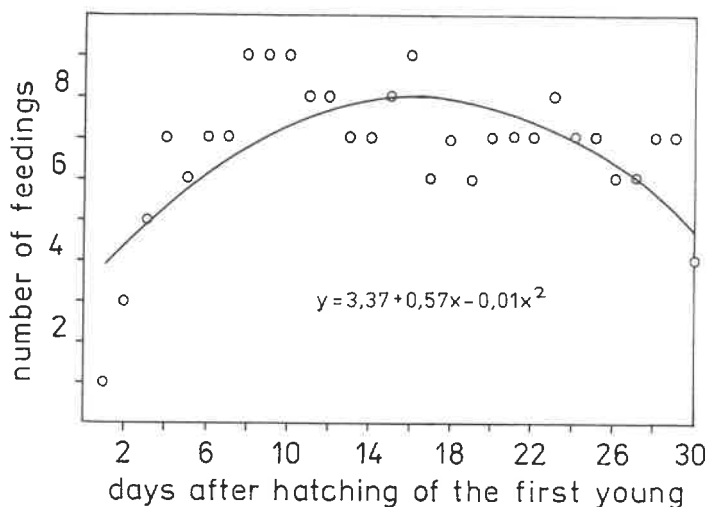
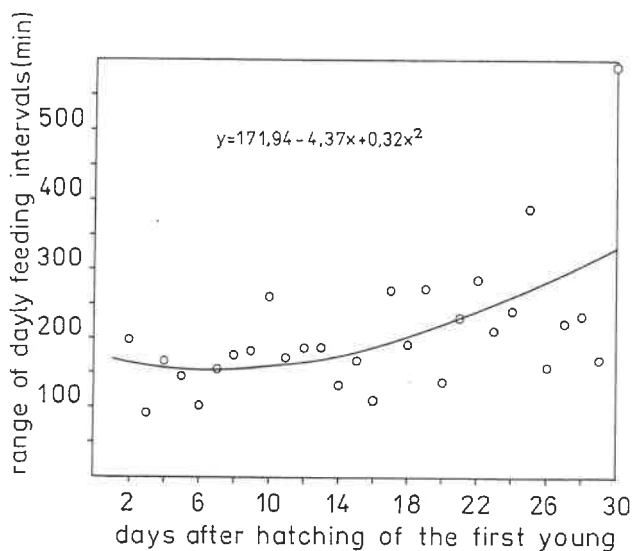


Figure 3: Variability of feeding intervals during the nestling period.



All feeding parameters differed significantly with age of the young (analysis of variance, $p < 0.01$). Number of feedings per day as well as daily mean duration of feeding events rose to a maximum level and were lowered again during the second half of the nestling period (correlations of 2nd degree, $r = 0.70$ or 0.54). Figure 2 shows age dependent changes of feeding frequency. Feeding intervals were likewise correlated with age (correlation of 2nd degree, $r = 0.59$). However, changes in the opposite direction were found with advancing age. Range of feeding intervals, that is the variability of feeding time, increased with advancing maturity in the young too (Figure 3: correlation of 2nd degree, $r = 0.56$). Finally, the length of a feeding event depended on the length of the preceding interval (correlation of 2nd degree, $r = 0.14$, $p < 0.05$).

DISCUSSION

Feeding habits did not differ much from those reported elsewhere (Uttendörfer 1952; Brüll 1984; Sömmer 1989). Despite all the problems connected with sampling methods mentioned by Sömmer (1989), some tendencies in prey selection should be pointed out.

Firstly, there is a group of birds taken throughout the whole observation period: on a considerably high level, domestic pigeons and Starlings, on a lower level Collared Doves. They all belong to the most common urban breeding birds (Degen & Otto 1988), and they spend the winter here. Secondly, a group of birds caught only during distinct periods can be distinguished. These are for instance Swifts, which are highly active in the air during their reproduction period, Thrushes, which have a notable spring migration over Berlin (Reckin 1987), and Black-headed Gulls which are available on roosting-flights outside their breeding period. Maxima of capture are in accordance with the periods of highest mobility in those species (reviewed by Rutschke 1983). That is, availability of prey seems to be a main criterion of prey selection, and this explains local differences in the composition of prey amplitudes mentioned by Sömmer (1989).

A second cue for prey selection seems to be size. A preference for heavy birds is not surprising, because profitability of prey is positively correlated with its size (Tembrock 1983). Thiollay (1982) pointed out that the Peregrine's hunting effort for a small Passerine bird is four times higher than for a pigeon.

The daily pattern of feeding is in accordance with that reported by Haller (1984). There is only one exception: Haller couldn't find any feeding activity before 6.00h. We observed the first feeding at about half past four and take this for an environmental effect (lighting, traffic, human activities). The Peregrine's feeding activity with two peaks in the morning and in the afternoon reflects the general pattern of locomotor activity found in its potential prey species (Aschoff & Wever 1962), the earlier beginning of feeding being due to their advanced activity under urban conditions.

It is amazing that feeding wasn't affected by external (climatic) factors. Vogt (1984) had very good correlations between sunrise or sunset and locomotor activity which we could not find. Maybe it was due to the type of activity measured or to the lighting downtown. We still have to test this.

It is known that weather conditions have little or no effect on the activity of Ospreys (Stinson *et al.* 1987) hunting fish. But the activity of the Peregrine's prey is dependent on weather. This disadvantage was excluded by food storage. We found it to a much larger extent than reported by Haller (1984). It seemed to be due to a good food supply. That it was really good had been reflected by the male's low participation in actual feeding.

Thus, variability of feeding patterns should have been mostly affected by internal factors. The mean duration of a feeding event was dependent on the length of the preceding interval, that is from the degree of hunger of the young. Age was in 2nd degree correlation with all feeding parameters. In that manner, the maximum level of food supply (highest number of feedings per day, brief intervals) corresponded with the period of maximum weight gain per day (weight gain see Heinroth & Heinroth 1925). Moreover, variability of feeding intervals changed over the period. That is, with advanced maturity food supply of the young became not only less frequent but also more unpredictable. It is assumed to be a parental response to growing effort. In addition, it could stimulate the young to become independent or at least to leave the nest.

Altogether, food quantity seems not to limit the Peregrine's living conditions in an urban environment but there are still some questions about the bird's ability to rear more than two young under such circumstances and about food quality. We should try to find the answers.

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Dr. R. Schneider and I. Wilden
 Institut für Verhaltensbiologie und Zoologie
 Fachbereich Biologie der Humboldt-Universität zu Berlin
 Invalidenstr. 43, D-1040 Berlin
 Germany



Merlin *Falco columbarius* - adult male