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NOCTURNAL FEEDING OF YOUNG BY URBAN PEREGRINE FALCONS (*FALCO PEREGRINUS)* IN WARSAW (POLAND)

ABSTRACT: In 2000 and 2002, the same pair of Peregrine Falcons occupied a nest box situated on the highest building within the Warsaw city centre. The nest box was monitored with a video camera and an infrared lamp. Records collected between 20:00 and 4:00 (DST) during the nestling stage (after the first chick hatching to fledging the last one) were used for analysis. Data from 34 nights in 2000 and 21 nights in 2002 were analysed. The majority of night feedings of nestlings was performed between 00:00 and 04:00. The average frequency of feedings was 1.5 events per night. It shows that night feedings can be considered an important part of feeding pattern during nestling period.

KEY WORDS: nocturnal activity, chicks' feeding, Peregrine Falcon, *Falco peregrinus*, urban environment

1. INTRODUCTION

The Peregrine Falcon is a cosmopolitan species occurring in a variety of habitats. Nonetheless, in many areas it is considered rare (Cramp and Simmons 1980, del Hoyo *et al.* 1994). Due to the prohibition of the use of DDT, as well as intensive reintroduction efforts undertaken in several countries, the species has been increasing its numbers recently (Wegner 1994, Crick and Ratcliffe 1995, Hepp *et al.* 1995).

Thus far, few results of falcon activity based on continuous observations have been published (Schneider and Wilden 1994, Rejt 2001), despite the availability of data from numerous video cameras available in the internet (e.g. http://www.peregrine-fundation.ca/Web_Cams/index.html, and others). Unfortunately, most of these cameras are active only during the day, so night observations are unavailable. Also, most studies of breeding falcons performed in the field were confined exclusively to daytime activity (Parker 1979, Bird and Aubry 1982, Dickson 2000). The literature contains records of Peregrines hunting on nocturnal animals, such as bats (Stager 1941, Baker 1962, Byre 1990). Such records however, cannot be regarded as evidence of

nocturnal activity of Peregrines because most of these observations were made before dark or after sunrise. Those observations concur with data collected on the activity of bats, as several species are known to be active in daylight (e.g. Kunz 1982). Therefore, data about bats in falcons' diet (e.g. Cramp and Simmons 1980, Langgemach *et al.* 1997) could not be regarded as proof of nocturnal activity of these birds and provided no information about the falcons' activity at night.

Thus far, Peregrines have been observed hunting at night only rarely. Beebe (1960) stated that most of the kills made by Peregrines breeding on the Pacific coast were made so late in the evening or so early in the morning as to be almost nocturnal. He also stated that the experience with trained falcons tends to provide the evidence of very late crepuscular hunting activity. Clunie (1976) as well as Cade and Bird (1990) mentioned Peregrines hunting at night in urban areas. During several years of investigation of urban Peregrines living in Warsaw, it was found that at least 13% of feedings of nestlings had occurred at night, i.e. between 20:00 and 04:00 (Rejt 2001). The main aim of the present study was to analyse in detail the nocturnal activity of Peregrines breeding in a city. It is possible that urbanised areas enhance such activity (e.g. Clunie 1976). Data collected in Warsaw provide information on the frequency of feeding at night, the scale of this phenomenon and the importance of such behaviour for nestlings in an urban environment.

2. MATERIAL AND METHODS

The study was performed in Warsaw, Poland (21°E, 5°23'N), a city of about 1,600,000 inhabitants. In 2000 and 2002, the same Peregrine pair occupied a nest box situated about 185 meters above ground on the highest building within the city. The nest box was monitored with a STEP KPC-400 video camera and an infrared lamp placed within the nest area. Records collected between 20:00 and 4:00 (Daylight Saving Time, hereafter DST) during the nestling stage (after the first chick hatched to fledging) were used for analysis. In total, data from 34 nights (i.e. 272 hours) in 2000 and 21 nights (168 hours) in 2002 were analysed. Frequency of feeding the young and duration of feeding were determined. The sex of the bird carrying the prey to the nest and feeding the nestlings was also established. Data concerning the Peregrines' diet composition are available in other publications (Rejt 2000, 2001).

Data concerning meteorological conditions (the air temperature and precipitation) were taken from the Agrometeorological Bulletin (1999–2002). The mean temperature and precipitation in both years varied for each 10-day period (Table 1). The mean temperatures in April and May in 2000 were very similar; differences were less than 0.5°C (15.7°C and 15.3°C, respectively). Mean daily precipitation was lower in April (0.6 mm) than in May (13 mm). The opposite situation was observed in 2002: the temperature in May (17.3°C) was higher than in April (11.3°C) and mean precipitation was similar in both months (8.5 mm and 10 mm, respectively).

Table 1. Weather conditions in Warsaw in 10-day periods: mean daily temperature (t) and daily precipitation (r) during the study period.

Period	2000		2002	
	r (mm)	t (°C)	r (mm)	t (°C)
11–20 April	1	13.2	5	10.8
21–30 April	0.2	18.3	12	11.9
1–10 May	0	14.7	0	18.8
11–20 May	17	15.8	20	15.9
21–21 May	22	15.5		

3. RESULTS

Nocturnal feedings were performed on 59% of the monitored nights in 2000 (n = 34 nights) and on 76% in 2002 (n = 21). Most feedings (over 60%) in both years occurred during the second half of the night, between 00:00 and 04:00. In 2000, the Peregrines fed their young less frequently at 20:00–21:00 and 02:00–03:00. In 2002, the lowest number of feedings was observed between 21:00 and 22:00. Pooled data on the nocturnal activity pattern in both study years showed that there was a peak at midnight and then feeding frequency decreased. The second highest peak was observed between 03:00 and 04:00 (Fig. 1).

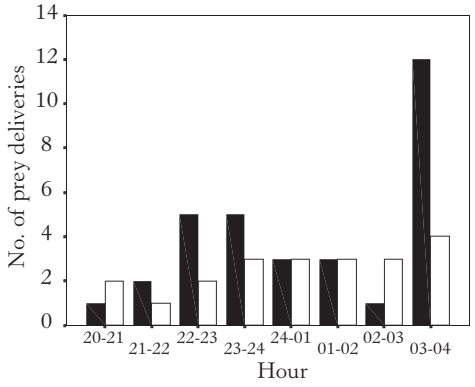

Fig.1. Nocturnal pattern of feeding frequency. Grey bars – data collected in 2000, white bars – data collected in 2002.

In 2000, chicks were fed 1.6 times per night on those nights when feeding was confirmed. In 2002 falcons performed 1.3 feedings per night. The number of feedings per night ranged from 1 to 3 in both years. It was hard to establish a clear pattern of feeding throughout the nesting period. In 2000, the rate of feedings per night was lowest in the 1st week of chicks' age (0.4), reached its peak twice – in 2nd (1.4) and 6th (1.2) weeks. During the 3rd, 4th and 5th weeks it was stable (0.7–0.9 feedings per night). In 2002 rate of feedings was highest in 1st week (1.8) and than decreased over consecutive weeks of nestlings' age with a small peak in the 4th (0.6) (Fig. 2).

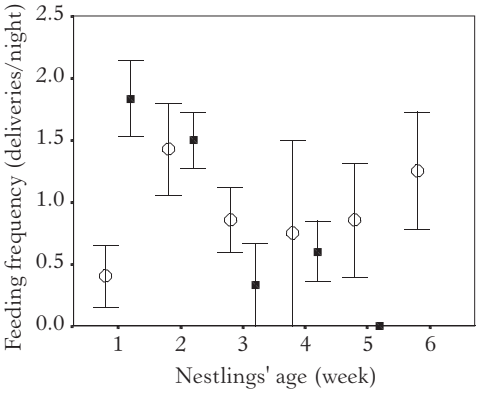

Fig. 2. Average number of feeding events per night during the six weeks of nesting period in 2000 (circles) and 2002 (squares).

The average duration of feedings was 6.5 minutes in 2000 (range of 3–15 minutes, n = 22) and 6.1 minutes in 2002 (range 2–9 minutes, n = 23). Significantly more feedings were performed by the female in both 2000 and 2002 (90%), while the male delivered prey in 60% and 80% cases, respectively. In 2000, the Peregrines removed prey remains after 11.8% of the feedings (n = 32), two years later – after 43.5% (n = 23).

4. DISCUSSION

The results of present study support the theory that urban conditions seemed to promote the nocturnal activity of falcons. Rejt (2001) found that more than 10% of all feedings or prey deliveries among urban Peregrines were made at night. North American ornithologists observed Peregrines hunting birds after dusk or flying during the night to capture migrants blinded by bright city lights (Cade and Bird 1990). Similar was also observed by other authors (Clunie 1976). The dark silhouettes of birds flying over a light city background can be well seen by falcons perched on high buildings. It could be a factor increasing hunting success. City lights also could be an important source of ultraviolet light (UV, 320–400 nm). It is known that many birds are able to detect these wavelengths (Siitari and Hovi 2002). Several species are known to use ultraviolet light when foraging (Viitala *et al.* 1995, Siitari and Hovi 2002). Sachslehner (1996) stated that light with UV allowed the Common Kestrel *Falco tinnunculus* to capture nocturnal prey. According to the data of Radwan (1993) and other authors (McGraw *et al.* 1999), claiming that UV increased brightness of some passerines, it is highly possible that urban Peregrines are able to detect at night birds illuminated with ultraviolet light. It could be also connected with individual experience (Clunie 1976).

However, Schneider and Wilden (1994) did not observe any feeding or hunting between 19:00 p.m. and 04:00 a.m. during their detailed study on urban Peregrines in Berlin. Their results are in agreement with other studies conducted both in urban (Haller 1984 after Schneider and Wilden 1994) and natural environments (Heatherley 1913 after Ratcliffe 1980). Parker (1979) observed coastal falcons feeding their young as late as 21:00 but not before 05:00. An inclination to hunt at night may be due to individual preference or fitness of a particular bird.

Night hunting may also result from the availability of prey in a particular territory. The results obtained in Warsaw confirm the few existing records concerning Peregrines' activity after sunset (Beebe 1960, Cade and Bird 1990). Night hunting among falcons was observed in those areas where a significant number of their prey consisted of birds active after dusk; for example, Cassin's Auklets *Ptychoramphus eleutica*, Ancient Murrelets *Synthliboramphus antiquus*, Storm-petrels *Oceanodroma furcata* and *O. leucorhoa* – the coast species (Beebe 1960, Bent 1961). Rejt (2000, 2001) found in Warsaw that Peregrines changed their diet as the breeding season progressed. In March and April they preyed mostly on spring migrants, later in the season – on Feral Pigeons *Columba livia*. Among the prey killed in April numerous were night migrants, such as Thrushes *Turdus* sp., Corncrakes *Crex crex* or Skylarks *Alauda arvensis*. It is known that also several bird species inhabiting urban areas could be active at night (Oertel 1979, Luniak *et al.* 1990, Paterson 2001). This data confirms the statement of Schneider and Wilden (1994) that environmental factors (such as light or UV illumination, for instance) as well as the general pattern of moving activity of potential prey could affect the Peregrines' hunting activity. Feeding at night seems to be an important part of the entire feeding activity. It occurs frequently, falcons fed their young during more than half of nights. A comparison of the average number of night feedings (about 1.5 per 8-hour-night) with the data obtained at daylight, where the average number of feedings was 4–8 per day (i.e. during 12 or 16 hours of observation) (Parker 1979, Ratcliffe 1980, Schneider and Wilden 1994, Dickson 2000, Rejt 2001), shows that night feedings can be considered an important part of feeding pattern during nestling period.

However, observed changes in the frequency of feeding during the breeding season are hard to connect with the changing needs of the nestlings and did not concur with the other data collected on the daylight activity of Peregrine Falcons (Schneider and Wilden 1994, Rejt 2001). Lack of variation in feeding frequency found between consecutive weeks of nestlings' age could be explained by low nocturnal activity of chicks which did not enhance parental hunting efforts. Differences in 5th week with no doubt resulted from extremely low sample size (only 1 night in 2002). Totally different were the results obtained for the 1st week. In both years the sample size was similar, different was first of all the number of nestlings (3 in 2000, 2 in 2002). In Warsaw higher rate of feeding was found in the year of the lower number of chicks. However, from other studies on raptors it is known that the rate of food delivery was either not related to brood size (e.g. Gard and Bird 1990) or increased in larger broods (e.g. Dijkstra *et al.* 1990).

Difference found could be linked with weather conditions. The mean temperature during 1st week in 2000 was higher in comparison with 2002 (18.3°C *vs* 10.3°C) while mean precipitation was lower (0.2 mm *vs* 5 mm). Hot, dry weather may increase the effort required in transporting prey. The falcons seemed to exert great effort in transporting prey to their young due to the 185-meter height of nest placement. For example, the female was observed taking rests along the route to the nest with a pigeon, unable to make the trip in one flight (G. Dzik, pers. comm.). However, it is impossible to find a strong correlation because of lack of precise meteorological data. So, the present study does not clearly support the theory of the influence of weather on the frequency of nocturnal feedings. It concurs with the statement of Schneider and Wilden (1994) who observed that the number of feedings was not affected by climatic conditions. They found only one obvious effect of weather on food delivery, i.e. on rainy days Peregrines used stored prey more frequently to feed their young. Other researchers reported similar findings (Ratcliffe 1980). Warsaw falcons stored food, but the scale of its exploitation was unknown. So it cannot be ruled out that Peregrines fed their young at night with prey stored in the neighbourhood of the nest. Maybe higher rate of feeding frequency in 2002 was caused by another, unknown factor – possible the number of available migrating birds, the bulk of Peregrines' prey during that time (Rejt 2001).

5. CONCLUSIONS

1. Urban Peregrines fed their young at night during the breeding season. The majority of night feedings occurred between 00:00 and 04:00 (DST). The frequency of feeding at night exceeded 1.5 events per night.

2. Nocturnal activity of falcons was probably possible due to the presence of potential prey, such as spring migrants (like thrushes or corncrakes) passing at night (predominantly in April) and urban pigeons (later in the season), as well as environmental factors (city lights, UV illumination). But the nocturnal exploitation of stored food could not be excluded as a source for these feedings.

3. The present study does not strongly support the theory that Peregrines' activity at night could be affected by weather conditions.

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6. SUMMARY

Thus far, few results of falcon activity based on continuous observations have been published, despite the availability of data from numerous video cameras available in the internet. Unfortunately, most of these cameras are active only during the day, so night observations are unavailable. Also, most studies of breeding falcons performed in the field were confined exclusively to daytime activity. Available records of Peregrines hunting on bats cannot be regarded as evidence of nocturnal activity of falcons because most of these observations were made before dark or after sunrise. The study on night activity of Peregrines was performed in Warsaw, Poland (21°E, 5°23'N) in 2000 and 2002. The nest box occupied by falcons was monitored with a STEP KPC-400 video camera and an infrared lamp placed within the nest area. Records collected between 20:00 and 4:00 (DST) during the nestling stage (after the first chick hatched to fledging) were used for analysis.

Nocturnal feedings were performed on 59–76% of the monitored nights. Most feedings (over 60%) in both years occurred during the second half of the night, between 00:00 and 04:00. Pooled data on the nocturnal activity pattern in both study years showed that there was a peak at midnight and then feeding frequency decreased. The second highest peak was observed between 03:00 and 04:00 (Fig. 1). Chicks were fed 1.3–1.6 times per night on those nights when feeding was confirmed. The number of feedings per night ranged from 1 to 3 in both years. Pattern of feeding changed throughout the nesting period (Fig. 2). The average duration of feedings was about 6 minutes. Significantly more feedings were performed by the female (90%), while the male delivered prey in 60–80% cases.

The results of present study support the theory that urban conditions seemed to promote the nocturnal activity of falcons. The dark silhouettes of birds flying over a light city background can be well seen by falcons perched on high buildings. City lights also could be an important source of ultraviolet light (UV, 320–400 nm) increasing brightness of some passerines. Night hunting may also result from the availability of prey in a particular territory – falcons was observed hunting at night in those areas where a significant number of their prey consisted of birds active after dusk. Present study does not clearly support the theory of the influence of weather on the frequency of nocturnal feedings (Table 1). Also it cannot be ruled out that Peregrines fed their young at night with prey stored in the neighbourhood of the nest.

A comparison of the average number of night feedings with the data obtained at daylight shows that night feedings can be considered an important part of feeding pattern during nestling period.

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