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The predatory behaviour of captive wild kestrel, *Falco tinnunculus* L.

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ABSTRACT

The predatory behaviour of captive wild kestrels was investigated to ascertain whether prolonged captivity, with no predation opportunities, could affect prey capture. Thirty kestrels were observed. After a 48-hour fast they were offered a live laboratory mouse. The behaviour before and after prey appearance, and latency to predation were recorded. There was no difference in capture efficiency correlated with kestrel age, but adults performed preening significantly more often than young birds. Moreover, a clear inverse correlation was found between the latency of preening and of predation. Therefore, prolonged captivity associated with inactivity does not seem to exert a negative influence on predation in this species.

KEY WORDS: Kestrels; Predation; Behaviour in captivity; Prey recognition.

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INTRODUCTION

As raptors are at the top of the trophic net, predation is a fundamental aspect of their behavioural repertoire. Zoologists have been primarily concerned with the ecological implications of predation, including the prey-predator relationship (e.g. Hamerstrom, 1979; Swenson, 1979; Beissinger, 1983; Snyder & Kale, 1983; Widèn *et al.*, 1987), the problems connected with prey selection and a possible search image (e.g. Mueller, 1975, 1977; Marti & Hogue, 1979; Ruggiero & Cheney, 1979; Ruggiero *et al.*, 1979). Research on the behavioural aspects have been conducted by Meyer-Holzapfel & Raeber (1976) who investigated the ontogenesis of predation in *Strix aluco*, and by Brosset (1973) who compared the behavioural performances of Falconidae and Accipitridae. It is interesting to note that both groups concluded that in tawny owl and falcons, predatory sequences are performed in a stereotyped fashion, with a very low interindividual variability, suggesting that predation is an almost innate behaviour.

We studied the behaviour of wild kestrels (*Falco tinnunculus*) kept in captivity, to investigate whether such an environment could affect such a fundamental activity of these birds of prey before their release in the wild. The kestrels in the study were all illegally shot by hunters or taken from the nest, and came from several parts of Italy to the Centro Recupero Rapaci (CRR) (Raptors Recovery Centre) in Parma, managed by the Lega Italiana Protezione Uccelli (LIPU) (Italian League for Bird Protection).

Birds were kept at the CRR for several months to recover from injuries, before being released. We were thus able to investigate whether there are behavioural differences between adult and *pulli* or juvenile kestrels arriving at the CRR. We also studied predation behaviour in kestrels with severe or permanent injuries.

MATERIAL AND METHODS

The 30 kestrels used for the experiment were housed in a large indoor pen within the CRR. We selected birds that were ready to be released, and that were hence in a good condition in order to have an indication of their efficiency in the wild. The birds lived together with a few individuals of other species, but of similar size: *Falco subbuteo*, *F. vespertinus*, *F. columbarius*, *F. naumanni*. During the whole period at the CRR the kestrels were fed with dead commercial chicken, which is completely different from the usual natural prey of kestrels.

The tests were carried out in an experimental room 4.30 × 2.60 m located in the same building as the maintenance pen. This room was empty apart from a 60 cm long perch located at a height of 1.80 m on the short side of the room, and a square wooden platform (60 cm wide) with wire legs (60 cm long) located in the middle of the room at a distance of 2.60 m from the perch. The platform was exactly in front of a window located on the long side of the room. There was a circular hole in the middle of the window giving access to a remote control «elevator». Once the elevator was pushed to the level of the platform, the hole was closed. The

observer could see the platform from behind the screen window.

The behaviour of the animals on the perch was observed indirectly using their image reflected on a mirror located near the window itself (Fig. 1). To prevent the birds from seeing the observer, the window consisted of a one-way screen. During the tests the observation room remained in full darkness, while the test room was artificially lit. A small window on the short side of the observation room, in front of the perch and covered by a white opaque plastic sheet, gave a natural photoperiod.

The tests were carried out in the morning. An adult laboratory mouse (*Mus domesticus*) with Agouti phenotype was offered as prey. The mouse present during the test was the first prey approached after their arrival at the CRR. The mouse was placed under the hole in the platform. Fifteen minutes later it was elevated on the platform by the observer (this was the start of the observation session) but only if the kestrel was on the perch. Since, as previously stated, the elevator filled the hole, the mouse was forced to stay on the platform, thus being completely visible to the kestrel. For ethical reasons, we limited the tests to the number needed to get a significant sample, thereby sacrificing as few mice as possible (see Huntingford, 1984).

To enhance motivation to predation the raptors were offered the test-prey after two days in which they had no opportunities to feed. In fact, fasting is correlated with prey killing in other Falconiformes, e.g. the American kestrel (*Falco sparverius*), the broad-winged hawk (*Buteo platypterus*) (Mueller, 1973), and Strigiformes, e.g. the screech owl (*Otus asio*) (Marti & Hogue, 1979).

It was noted whether the experimental birds were juveniles or adults. The sex was not taken into account because it is difficult to ascertain in subadult animals. The observation period had a maximum duration of 60 min from the first appearance of the mouse. The activity and the behavioural patterns of the kestrels were recorded before and after the predation. Each individual was tested only once in order to obtain information about their predatory behaviour and efficiency when faced for the first time after several months of «inactivity» with a natural prey.

Finally, six kestrels which had suffered severe injuries were tested using the same technique.

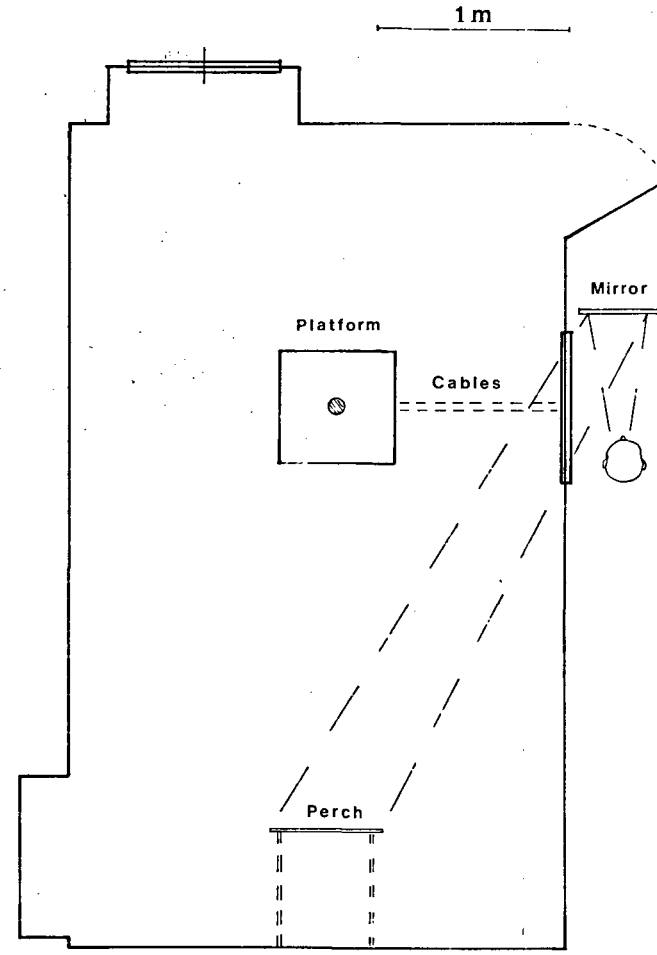

Fig. 1 - View of the experimental room. On the right side the inspection one-way window and the mirror used to observe the kestrel's behaviour when on the perch.

RESULTS

Fourteen individuals out of the 30 used were juveniles, and 13 were adults. Age could not be detected in 3 animals. Activity before predation was recorded on a sample of 19 individuals.

The behaviour of the animals was variable. Three individuals remained completely inactive on the perch, while six showed limited movements. There was no difference between juvenile and adult individuals for these activities. Instead, preening, mostly associated with feather shaking, was performed significantly more often (Chi-square = 6.362, $P < 0.025$) in adults (8 animals). Conversely, four birds out of the five that preened feathers and eventually preyed the mouse belonged to the adult group. Although the data are not very numerous there is a clear inverse correlation between the two latencies (Spearman's rho = -1.000, $P < 0.05$). The latency of performing preening for the first time was 421.00 ± 98.52 (SEM) sec.

Flights before the predation and predation sequence were recorded for all kestrels tested. Flights were usually performed early after the appearance of the mouse over the platform, with a similar frequency in adults and juveniles. Almost every juvenile that performed at least one flight performed a successful predation (five animals out of six) against only a half of the adults (two out of four).

Predation on the mouse occurred in 21 animals out of the 30 tested. Juveniles captured the mouse more frequently, but not significantly so, than adults (12 [85.7%] against 9 [62.9%]; Chi-square test, $P > 0.10$). Moreover, the mean latency to predation (Table I) was shorter in juveniles (465.00 ± 134.29 sec) than in adults (713.30 ± 187.00 sec), but the variability was too high for significance ($P > 0.05$). In the four individuals (one juvenile and three adults) that performed both preening and predation, the mean latency showed an inverse correlation (Spearman's rho = -1.000, $P < 0.05$).

The prey was approached in two ways: indirect or direct. In the indirect way (six juveniles and three adults) the kestrel flew from the perch landing on the platform; then it walked to the mouse and captured it using a leg. In the direct approach (six juveniles and six adults) (Table II) the bird landed directly on the

TABLE I - *Mean (± 1 SEM) latency time (in sec) to predation and ingestion, and total time spent pecking the prey in both age classes.*

	Juveniles (N = 12)	Adults (N = 9)
Latency to predation	465.00 ± 134.29	713.30 ± 187.00
Latency between capture and ingestion	123.00 ± 24.28	142.50 ± 41.29
Cumulative time of pecking	11.96 ± 2.21	6.86 ± 2.48

mouse, blocking it against the platform. The prey was generally captured with one leg (eight cases), and rarely with both (two cases). There was no preference for the use of either leg: three times the right and five times the left were used. All animals preying blocked the mouse movements with only one leg, always at the fore third of its body. The death of the mouse appeared to be by suffocation, since kestrels never appeared to use their talons.

After the prey was blocked, it was invariably «pecked» with the bill. The preferred target was the head (100% of times); the flanks and hind quarters were rarely pecked (10% and 16% of times, respectively). The incongruency in the sum of percentages is because the bird pecked the mouse many times, striking more than one of the considered targets, since they are obviously not mutually exclusive. Although not significantly different, the duration of this behaviour (Table I) was longer in juvenile animals (11.96 ± 2.21 sec) than in adults (6.86 ± 2.48 sec). Ingestion started immediately after the kestrel assumed an «ingestion posture» (Table II): it stood with both legs on the middle of the mouse body, with the muzzle towards itself. Feeding started from the head, with a mean latency of 227.14 ± 95.60 sec after actual capture; there was no difference between the two groups (Table I). The whole animal was rarely eaten; in fact, seven kestrels left part of the tail and/or of intestines. Ten other birds ingested only the front half. In the latter case, the remains were dropped on the room floor, away from the platform.

TABLE II - *Percentage of animals in the two age classes performing the direct approach to the prey and the typical ingestion posture.*

	Juveniles (N = 12)	Adults (N = 9)
Direct approach	50.0	66.6
Typical ingestion posture	70.0	55.5

The same test was carried out on six kestrels that were in poorer conditions than the 30 birds described above. Their injuries were various: two adults had only one leg (left and right, respectively) and another adult had had a wing fracture, but was near to the complete recovery. One juvenile could see only out of one eye, the other being infected; another juvenile could not move one leg and two showed impaired flying.

It is interesting to note that despite their severe injuries all these six individuals were successful predators, with a mean latency of 650.00 ± 147.06 sec. Moreover, all captured the prey with a direct approach. The ingestion technique was similar to that described for the group of 30 birds, except that the kestrels with only one leg had some difficulty in standing and blocking the mouse at the same time.

DISCUSSION

The animals tested were practically undisturbed by captivity, even prolonged, and by the presence of humans immediately before the test, i.e. when the mouse was placed in the elevator under the platform. Most birds preyed within a few minutes of seeing the mouse and displayed a good capture technique. These observations show that prolonged captivity and several months without predation had no effect on the efficacy of predation. The predatory behaviour observed in our experimental situation cannot be compared to that in the wild since there are no detailed observations on wild kestrels.

The behaviour of the kestrels before predation seems to indicate a certain conflict, internal to the individual. In fact, preening could be a redirected activity indicating a conflict situation. The conflict is possibly due not to the dimensions of the room *per se*, but to the short distance of the kestrel from the prey. In fact, the birds were unable to conceal themselves in the room. They were probably aware that the prey could be caught only if attacked immediately or within a short time.

This tactic may maximize the possibility of reward even though the mouse was not in an ideal environment for capture, i.e. on a small surface. A similar tactic has been observed in the American kestrel (Sparrowe, 1972). According to Curio (1976), the animals choose either a quick attack, as shown by the short latency to predation, or ignored the mouse because of the low probability of a success. Thus, the conflict between the two tendencies is shown by preening, whose latency is inversely correlated to the predation latency. We suggest that the flights were not a true conflict behaviour, but rather a form of exploration or, at least, a way to detect if the mouse could escape easily, in which case predation would have been useless.

It appears that captivity had a greater effect on the adult animals than on juveniles. In fact, juvenile animals had a shorter mean latency to predation and a lower frequency of preening. When they arrive at the CRR, young animals probably have less predation experience than adults, and this leads to quicker adaptation to the conditions of captivity. In addition, the behaviour of juvenile animals is always more flexible than that of adults. Nevertheless, adults were successful predators, with a slightly reduced capture frequency. In fact, they were more likely to perform a direct attack and less likely to use bill pecking, thus showing a good ability to capture, derived from a greater experience of predation in the wild. Moreover, the rarer use of the bill in adult kestrels is indirect evidence of their greater ability to block the prey, since the bill is probably used to damage the nervous motor system of the mouse when it tries to escape. This could occur when the kestrel's legs do not completely block the prey.

Ingestion was similar in juveniles and adults. This is in accord with the marked genetic control, and hence with low interindividual variability, of the final part of the predatory sequence.

In conclusion, the predatory behaviour of wild kestrels is not affected by captivity, even prolonged, or anatomical malformations. In addition, predation behaviour was not affected in birds suffering from severe malformations. The only difference found is due to preceding experience obtained by the single animal in the wild, a behavioural sequence that is probably under strong genetic control, but that has been finely adjusted by experience.

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