

BEHAVIOUR OF RED FOXES *VULPES VULPES* DURING OF MONTAGU'S HARRIER *CIRCUS PYGARGUS* SOCIAL DEFENCES - CASE STUDY FROM SOUTHEAST POLAND

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Behaviour of individuals (n=19) Red Fox *Vulpes vulpes* during of social defence of Montagu's Harrier *Circus pygargus* was studied. During five mobbing foxes counterattacked recruits by performing high jumps. The counterattacked flocks involved more individuals compare to not counterattacked flocks. The counterattacked flocks of Montagu's Harriers involved also more juveniles. The observed behaviour of foxes seems to result behavioural response on reduced resources of available prey, caused by finishing breeding cycles and dispersal of vertebrates.

Key words: Fox, *Vulpes vulpes*, Montagu's Harrier, *Circus pygargus*, mobbing, Poland

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Introduction

Foraging capacity of carnivores may be limited or modified by social mobbing of colonial nesting birds. Published papers analysed spatio-temporal organisation and behaviour of colonial birds during social defences against carnivore mammals (Ven 1977, Clode et al. 2000). Effects of and the impact on the spatial organisation of colonies and breeding effects has also become known (Burness & Morris 1993, van der Kooij 1995, Craik 1997). However, the data on behavioural tactics of carnivorous mammals during avian social mobbing are still found insufficient. Foxes *Vulpes vulpes* are frequent predators of ground nesting birds in different habitats of Europe (Goszczynski 1974, Goszczynski 1985, Blanco 1986, Papageorgiou 1988, Jedrzejewski & Jedrzejewska 1992, Leckie et al. 1998, Fedriani 1999, Tryjanowski et al. 2002). They are also predators of ground nesting raptors-Harriers *Circus* spp. (Schupbach

1996, Dijkstra & Zijlstra 1997, Koks & Visser 2002). Harriers are able to create groups that can perform social defence against terrestrial predators limiting their foraging capacities (Watson 1977, Kitowski 2003, Arroyo et al. 2000). The paper presents an analysis of behaviour of foxes during social defences of Montagu's Harrier. A hypothesis that carnivores are able to control and partially inspire behaviour of recruits is formulated. Their counterattacks are performed under particular, selective circumstances.

Material and methods

The study was carried out on calcareous marshes near Chelm (51°08' N, 23°37' E, south-east Poland). In this area (ca. 1300 ha) between 1989 and 1992 5-6 fox dens were known. In the period 1997-1999 the same area covered 9-10 fox dens (Polish Hunting Association-unpubl. data, I.Kitowski-

unpubl. data). From 1989 to 1992 in the considered area nested up to 32-42 pairs of Montagu's Harriers (Krogulec & Leroux 1994). In the recent years the number of pairs has decreased to about 20 breeding pairs (Kitowski 2002). From late June till late August 12-hour, lasting from 8.00 till 20.00 observational sessions were carried out. Between 1989-92 152 sessions were made, which gave a total of 1824 hours, and in the period 1997-1999 another 86 were added to make the grand total of 1032 hours. Altogether 238 sessions lasting 2856 hours were performed. A 10X20 binocular and a 60 X telescope were during observations from a distance of 250 m. The height of bushes on the marshes whose size was of known, was used to estimate the height of foxes' jumps observed during the study by comparison of both. For the calculation prey mass following (Romanowski 1983) individual Common Vole *Microtus arvalis* mass was estimated as 20 g.

The frequencies were compared by χ^2 test with Yates correction. And the medians were compared

with Mann-Whitney U-test. Trends were ascertained Spearman rang correlation. The results are presented as mean \pm SD (Fowler & Cohen 1992).

Results

Mobbing groups of Harriers

During the studies (n = 19) social defences of Montagu's Harriers against foxes were observed. In the first period of study (lower number of foxe's dens) (n = 8), defences occurred and (n = 11) mobbing were performed in the second period (higher number of foxe's dens). Social defences involved 3-16 recruits, on average 7.6 ± 4.7 recruits, (n = 19) were involved in mobbing. The total time of mobbing lasted: 504.6 ± 392.6 sec, range: 94-1496 sec., (n = 19). Harriers performed 0-8 dives onto foxes, in average: 3.57 ± 2.7 dives (n=19). There were clear correlation between the number of recruits involved and the duration of mobbing (Spearman $r_s = 0.597$, n = 19, $p < 0.001$).

Table 1. Comparison of the composition and behaviour of counterattacked by foxes (*Vulpes vulpes*) and left alone groups of Montagu's Harriers (*Circus pygargus*)

	Groups counterattacked by foxes (n=5)	Groups left alone by foxes (n= 14)	Mann-Whitney U statistics	P
Number of recruits involved in fox mobbing	12.8 ± 2.3 ind. range: 10-16 ind.	5.4 ± 3.2 ind. range: 3-14 ind.	U = 3	p < 0.05
Time spend on fox mobbing by recruits	671.5 ± 466.3 sec. range: 333-1476 sec.	430.5 ± 352 sec. range: 94 -1462 sec.	U = 19	n.s
Number of dives performed by recruits	7.2 ± 1.1 dives range: 6-8 dives	2.3 ± 1.9 dives range: 0-7 dives	U = 34	n.s
Number of juvenile recruits involved	3.4 ± 0.9 juv. recruits range: 2-4 juv. recruits	0.53 ± 0.9 juv. recruits range: 0-3 juv. recruits	U =1	p < 0.05
Number juvenile as percent of total number of recruits	$24.8 \pm 3.2\%$ range: 0.20-0.29%	$6.4 \pm 9.0\%$ range: 0-0.21	U =3.5	p < 0.05

The behaviour of foxes during the avian mobbing

While mobbing foxes kept jumping high to catch one of the diving Montagu's Harriers. In the first period of studies only one high fox jump targeted on a juvenile Harrier was noted. In the time of the second part of studies four counterattacks were seen. Performed jumps were 1.5-2.5 m high. Overall, foxes tried to catch 3 adults and 2 young diving individuals. The counterattacks on recruits took place when a dive onto a fox was about to be completed. At such moments foxes were close to catching the recruits by touching their back or wing. Mobbing groups of Harriers counterattacked by foxes involved more individuals than groups which were not attacked (Table 1). The foxes also preferred counterattacking if the mobbing groups of Harriers involved more juveniles in number and as percent of all recruits (Table 1). However, differences neither in the duration nor the number of performed dives were found between the attacked and not attacked groups of recruits (Table 1). All the observed counterattacks were performed between 7th and 16th of August. In (90%, n = 19) cases the foxes were discovered by birds on the meadows close to the marsh. In (77%, n = 17) cases after the fox was detected by recruits stepped into paths leading to Saw Sedge covered the marsh. Then the foxes would penetrate the area abandoned semicolonies of Montagu's Harriers, or bushes were juveniles of Montagu's Harrier perched frequently. In (23%, n = 17) of cases foxes moved away from abandoned semicolonies after the detection. Differences were found for frequency of straits chosen by foxes that had been previously detected by recruits ($\chi^2= 4.76$, $df = 1$, $p < 0.029$). All of the catch trials of recruits by foxes were performed when foxes were closest vicinity of the semicolonies (< 60 m.).

The four sequences of foxes' behaviour lasting 25.0 ± 7.0 sec., range: 17-33 sec. observed on the meadows were really surprising. Foxes would stop suddenly, sat down for a while and then lie down on the one side of the body, in which position they would spent from 4 to 7 sec. Such sequences of behaviour were observed at two different

marshes during 3 interactions with flocks of recruits. They took place before three described counterattacks performed by foxes. Therefore, the probability that such kind of behaviour occurs during other mobbing sessions is high. Despite dives that targeted the back or abdomen, no symptoms that could be taken as serious injury were noted in foxes' behaviour; to the contrary, foxes kept penetrating the left colony area and than moving away from the peat-bog. Such behaviour made Harrier's flocks broke up. During defences the foxes never moved as fast as when chasing a prey such as: European Brown Hares *Lepus capensis*, Pheasants *Phasianus colchicus*.

DISCUSSION

At the beginning of 90'. a clear increase in the number of foxes in Poland was observed. Most likely it resulted from program vaccination against rabbies and recession in the fox skin market (Bresinski & Panek 2000a, Bresinski & Panek 2000b). In the studied area an impact of the growing population of foxes on the diminishing number of breeding pairs of Montagu's Harrier was shown (Krogulec & Leroux 1994, Kitowski 2002).

The observed activities of foxes was a behavioural response to reduction of available vertebrate prey exploited during spring and early summer. Such a reduction of availability of the vertebrate prey has resulted from the end of breeding period and dispersal animal that constitute an important component of the diet. The factors mentioned above particularly affected vertebrates breeding abundantly in the ecotonal zone of the meadows and the marsh, such as Lapwing *Vanelus vanelus*, Black-tailed Godwit *Limosa limosa*, Mallard *Anas platyrhynchos*, Redshank *Tringa totanus*, and finally European Brown Hare (Buczek & Buczek 1996, I. Kitowski - unpubl. data). The foxes in spring and summer hunted also on Common Voles whose importance grew in autumn and winter time (I. Kitowski-unpubl. data) when other prey is scarce, similarly to other Poland and European areas (Goszczyński 1985, Lanszki et al. 1999, Jędrzejewski & Jędrzejewska 1992) The remains of mentioned vertebrates were found in the exam-

ined fox dense (I. Kitowski-unpubl. data). The foxes response to decreased availability of prey were attempts to penetrate the closest villages to catch domestic animals, which was also noted in other studies from Central Europe (Goszczynski 1985, Lanszki et al. 1999). However, human activities limited this behaviour and led to the extermination of particular individuals (I. Kitowski - unpubl. data).

Paradoxically, it has been advantageous for foxes to hold still the interesting of Harriers in mobbing since it guaranteed occurrence of recruits in bigger groups what was proved by clear correlation between the number of recruits involved and the duration of social mobbing. It also made the probability of catching one of the recruits higher. The foxes' behaviour showed that they could even invest in being hurt by the recruits, because it allowed foxes to take the optimal decision about attacking such a very attractive prey as adults of Montagu's Harriers (295g -males, 345g-females) (Leroux & Bretagnolle 1996) and their juveniles (315g males, 340g females) (Arroyo et al. 2000). The such prey is the equivalent of 15-17 individuals of Common Vole. Foxes' counterattacked on recruits when they are to completed the diving, seemed to be effective due to well developed jumping skills, which they used also in the contexts of interactions with other animals and their foraging activity (Henry 1986, Sargeant & Allen 1989, Jedrzejewski & Jedrzejewska 1992). In the period of abundant vertebrate prey (from April till early July) events of mobbing were noted (N=14), but none of the foxes tried to counterattack (I.Kitowski - unpubl. data).

It should be noted, however, that the relations between birds and foxes can be non-antagonistic to which the registered playing between foxes and birds (Blumstein & Foggin 1993) can serve as an evidence. In the studied area cases foxes being followed by Montagu's Harriers were observed. Harriers could have been using foxes as the flushing agent of the prey (Kitowski 2003). Very similar non-antagonistic relations between Red Foxes and Hen Harriers *Circus cyaneus* are known (Bandy & Bandy 1978).

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