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## Age-related differences in foraging behavior of Montagu's harrier *Circus pygargus* males in south-east Poland

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**Abstract** The hunting behaviour and habitat use of second-calendar-year males (subadult) and grey (adult) males of Montagu's harrier *Circus pygargus* were compared in south-east Poland. Subadult males performed cruising flights less frequently than did adult males. In contrast, subadult males more frequently soared thermals and were harassed more often by other birds. Overall, adult males were more frequently engaged in hunting activities than subadult males. Additionally, adult males were more successful in trapping prey than were subadult males. Only 7% ( $n=92$ ) of trapping attempts by subadult males were successful, compared with 17% ( $n=126$ ) by grey males. Both adult and subadult males tried to catch prey flushed by foxes *Vulpes vulpes*. Subadult males were seen begging and pirating from prey-carrying raptors.

**Keywords** Montagu's harrier · Hunting behaviour · Infantile behaviour · Kleptoparasitic behaviour

### Introduction

Mortality of first-year birds is very high (Newton 1989; Clutton-Brock 1991). This is usually because younger individuals are less expert foragers. Younger individuals also usually breed more poorly, and this is said to be related to their poorer performance as foragers. As a result, in some birds (e.g. the Montagu's harrier) younger birds usually do not enter the breeding population, even if they might be fertile. There is little published information on the behaviour of subadult individuals in Montagu's harriers. Male Montagu's harriers as a rule mate for the first time in the fourth calendar year (Cramp and Simmons 1980), or at 3 years of age. However, the

presence of males with brown plumage (in their second calendar year) is noted frequently in the breeding grounds, but they usually do not mate with females. Sometimes they can assist with nest provision during the breeding season (Arroyo 1996a), only exceptionally breeding successfully (Arroyo 1996b; Clarke 1996). Here I compare the behaviour, foraging techniques, and habitat selection of 2-year-old (brown) and adult (grey) Montagu's harrier males in south-east Poland.

### Methods

The study was carried out from 15 May to 25 July in 1997–1998 in an area of open managed meadows located between the villages Rudolfin and Andrzejow near Chelm (SE Poland). This area is in the neighbourhood (2–4 km) of the calcareous marshes near Chelm (51°08'N, 23°37'E, SE Poland), which is one of the most important nesting sites of Montagu's harriers in Poland and represents a foraging ground for the birds nesting there. About 32–42 pairs nest in the marshes at densities of 1.0–1.3 pairs/10 ha (Krogulec 1992; Krogulec and Leroux 1994; Buczek and Buczek 1996), although in recent years numbers of breeding pairs have diminished by approximately half (Kitowski 2002).

Individuals foraging in the study area were classed as second-calendar-year males (subadult) or adult males according to plumage. Detailed descriptions of differences are given by Lontkowski and Skakuj (1994) and Arroyo and King (1996). Differences in plumage are easily distinguishable. Especially useful was the comparison of colour differences between primaries and secondaries, and the presence or absence of streaks on the belly. Monitoring of three communal roosts occupied exclusively by males during the pre-laying and post-fledging dependency period showed as many as 3–6 second-calendar-year males were present in the study area (I. Kitowski, unpublished data).

Observations were conducted between 700 and 1900 hours. Three observers performed 24 observation sessions, totalling 288 h of scan sampling (Altman 1974; Skonieczny and Dunk 1997). Field studies consisted in making scans every 6 min (10 scans per hour) noting all birds within a radius of 1.00 km around the observer. Overall, 2,880 scans were performed. One scan lasted 50–60 s. Scans were performed with a 60x telescope. Other observations were made with 10x60 binoculars.

During the scans the behaviour of birds at the moment of first sight was recorded, and the habitat type in which the behaviour occurred when possible. The duration of each behavioural pattern was measured with a stopwatch. Activities included (1) cruising, (2) hovering, (3) wind soaring, (4) thermal soaring, (5) perching,

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(6) harassing, and (7) other miscellaneous (see Jimenez and Jaksic 1989, 1991). I considered as “foraging” those males that were performing cruising flights, hovering, and/or perching. Soaring males were omitted from the analyses of habitat because of the difficulty of assigning a soaring raptor to a habitat patch (Preston 1990). Nine habitat types were identified: (1) regularly cut (intensive) meadows, (2) burnt meadows, (3) extensive meadows with high vegetation, (4) wasteland with high vegetation, (5) fields, (6) orchards, (7) settlements, (8) shrub coppices, and (9) other. I mapped the distribution of these habitats in the study area and calculated their surface areas with a digital planimeter from a high-resolution aerial photo. The obtained frequencies were further compared by chi-square test with Yates correction, and the medians were compared with a Mann–Whitney *U*-test. The results are presented as means±SD (Sokal and Rohlf 1981; Fowler and Cohen 1992).

## Results

The presence of one or two brown males simultaneously was recorded during 123 (4.3%) performed scans. In these, I noted  $n=157$  events concerning behaviour of subadult males and  $n=418$  events concerning behaviour of adult males (Table 1). Brown (subadult) males performed cruising flights less frequently than did grey males (Table 1). In contrast, subadult males performed thermal soaring and were harassed by other birds (Table 2) more frequently than were grey males (Table 1). Overall, grey males more frequently engaged in activities recognised as hunting than subadult males (83.7% vs 65.0%;  $\chi^2=22.8$ ,  $df=1$ ,  $P<0.001$ ).

Subadult males performed  $n=92$  capture attempts of which only 6 (7%) were successful. All caught prey were small mammals. Adult males performed  $n=126$  capture attempts including 21 (17%) successful ones (90 small mammals and 2 passerines were caught). Hunting success differed significantly between the two age classes of Montagu’s harrier males ( $\chi^2=4.15$ ,  $df=1$ ,  $P<0.05$ ).

When foraging, grey males preferred areas without high and dense vegetation, such as intensive meadows or burnt meadows. Subadult males preferred intensive meadows also, but a high proportion of birds was also noted over wasteland areas (Table 3).

Foxes were frequently observed hunting in the study area (at least one fox in 103 scans: 3.6%). In one certain and one possible case (noted in 4 scans), subadult males

**Table 1** Frequency of behaviour of adult and subadult (>2 years old) Montagu’s harrier *Circus pygargus* males in foraging areas

Behaviour	Adult males		Subadult males		$\chi^2$ , $df=1$
	n	%	n	%	
Cruising	332	79%	101	64%	13.8**
Hovering	4	1%	1	<1%	0.02
Wind soaring	37	9%	21	13%	2.10
Thermal soaring	17	4%	18	12%	10.9*
Perching	16	4%	1	<1%	3.01
Harassing	12	3%	14	9%	8.31*
Other	–	–	1	<1%	–
Total	418	100	157	100	–

\* $P<0.01$ ; \*\* $P<0.001$

**Table 2** Species that interacted with Montagu’s harrier *C. pygargus* during surveys

Species	Grey males	Brown males
<i>Circus pygargus</i> males	3	4
<i>C. pygargus</i> females	1	3
<i>C. aeruginosus</i> males	2	1
<i>C. aeruginosus</i> females	2	1
<i>Corvus corone cornix</i>	–	1
<i>Buteo buteo</i>	1	1
<i>Vanelus vanelus</i>	3	3
Total	12	14

were observed following hunting foxes *Vulpes vulpes*. Subadult males performed unsuccessful dives directed to skylark *Alauda arvensis* and yellow wagtail *Motacilla flava* flushed by hunting foxes. Adult males were also observed following hunting foxes ( $n=8$  cases). One chased prey – yellow wagtail – was successfully caught. In these cases no alarm calling nor diving on the foxes was performed, and the routes of the harriers strictly reflected the routes of the foxes.

In addition to prey captures, subadult males attempted to rob prey from other raptors 18 times. Begging calls were sometimes observed preceding the attempts at prey robbing. Four of these robbing attempts were directed towards kestrels *Falco tinnunculus*. Begging bouts lasted 11–36 s ( $\bar{x}=29.0\pm 12.02$ ) and were followed by chases of 21–30 s ( $\bar{x}=26.6\pm 5.68$ ) after which harriers dove once or

**Table 3** Frequency of observations of foraging males in relation to habitat type for adult and subadult Montagu’s harrier males, and comparisons with expected distributions

Habitat type	Availability %	Adult males		Subadult males	
		n	$\chi^2$ , $df=1$	$n_1$	$\chi^2$ , $df=1$
Intensive meadows	47%	253	88.3***	31	11.27***
Extensive meadows	23%	13	74.1***	24	–
Burnt meadows	7%	71	91.1***	8	0.153
Wasteland	8%	3	24.2***	18	12.5***
Fields	6%	9	7.3**	9	1.59
Orchards	4%	2	10.7**	8	4.16*
Human settlement	2%	1	–	–	–
Small forests	2%	–	–	3	0.5, n.s
Other	1%	–	–	2	–
Total	100%	352	–	103	–

\* $P<0.05$ ; \*\* $P<0.01$ ; \*\*\* $P<0.001$

twice on the kestrels. Three of these attempts were successful. Six further cases were directed towards adult Montagu's harrier females bringing small mammals. Begging ranged from 20 to 36 s ( $\bar{x}=27.16\pm 7.19$ ) and chases 7–22 s ( $\bar{x}=16.8\pm 5.26$ ) after which no dive or one dive on the prey was observed. Only two of these attempts were successful. Four further cases were directed towards adult Montagu's harrier males. Begging ranged from 24 to 40 s ( $\bar{x}=29.25\pm 7.27$ ), chases 12 to 25 s ( $\bar{x}=19.2\pm 4.65$ ). In all cases one dive on the prey was observed. Only one robbery attempt was successful. Begging preceding successful chases was longer ( $\bar{x}=36.0\pm 2.09$  s,  $n=6$ ) than begging preceding unsuccessful chases ( $\bar{x}=22.5\pm 5.2$  s,  $n=8$ ; Whitney–Mann  $U$ -test:  $U=0$ ,  $n_1=6$ ,  $n_2=8$ ,  $P<0.05$ ).

Besides piracy, hunting on prey flushed by foxes and other attempts to obtain food were noted in subadult males. A subadult male grabbed carrion (foreleg of the European hare *Lepus europeus*) from a marsh harrier female on the ground. Another subadult male was unsuccessful in an attempt to rob remnants of a dead fox from a buzzard *Buteo buteo* and two magpies *Pica pica*. There were two additional unsuccessful robbery attempts of prey from Montagu's harrier males, lasting 11 and 14 s, that were not preceded by begging behaviour. Subadult males were also observed twice approaching to beg (22 s, 24 s) from adult female Montagu's harriers carrying small mammal prey, and three times they begged from marsh harrier females (for 9, 11, 14 s) without chasing them. Finally, three unsuccessful attacks of subadult males upon flocks (up to 30 individuals) of wood pigeons (*Columba palumbus*) sitting on the ground were observed.

## Discussion

The foraging behaviour of subadult males differed from that of adult individuals. Subadult birds hunted in patches inadequate for foraging more frequently (Table 3) and were often engaged in activities not connected with hunting (Tables 1, 2). The above observation is compatible with a reduced hunting efficiency of non-adult birds as suspected by Mendelson and Jaksic (1989) and observed by other authors (Simmons 1984; Toland 1986).

Subadult Montagu's harrier males were found to maintain behaviour characteristic of juveniles of harriers (*Circus* sp.) from the post-fledging dependency period. This refers particularly to begging behaviour, piracy, and scavenging (Witkowski 1989; Kitowski 1994; Bavoux et al. 1998), which were observed when harriers were not able to forage themselves. It seems that cultivating such behaviour can have a great adaptive value, being extremely significant in relation to a high mortality of raptors in their first years of life (Piper et al. 1981; Schmutz and Fye 1987; Preston and Beane 1993). We suggested that the described infantile begging behaviour also may take place in the wintering area. Clarke (1996) reported information about cases of begging performed by immatures in the wintering areas.

Some males (both grey and brown) tried to catch passerine birds disturbed by a flushing agent. This hunting tactic is known in other harriers (Jackson et al. 1977) and raptors (Ellis et al. 1993). Such a tactic is undoubtedly supported by the open character of the meadows, which facilitates piratical approach of raptors (Paulson 1985). It allows males easily to localise foraging foxes. When harriers followed hunting foxes no alarm calling or diving typical of mobbing defensive behaviour were performed (cf. Kitowski 1998; Arroyo et al. 2000). It seems that harriers were able to recognise that the foraging behaviour of this mammal might be beneficial to them and did not disturb it. Furthermore, foxes were encountered far away from the nesting areas. This harrier behaviour is increasingly frequent (I. Kitowski, unpublished data) following a badly conducted action for combating rabies at the beginning of the 1990s and the collapse of the hide market in Poland, which was followed by a radical increase in the population of foxes (Bresinski and Panek 2000).

The low hunting efficiency observed in subadults may be one of the factors that exclude second-calendar-year males from pair formation processes, because they are not able to perform courtship feeding at an adequate level for the females. The large number of prey-robbery cases recorded might indicate that kleptoparasitism and infantile behaviour is, at least for some subadult individuals, an effective tactic for obtaining food, with scavenging and opportunistic hunting of prey flushed by foxes constituting an alternative to searching actively for prey. It appears that with increasing experience subadult Montagu's harriers can remove from their behavioural repertoire costly attacks upon inadequate prey, which has been observed in this species (Kitowski 1994) as well as in other raptors during the post-fledging dependency period (Oliphant 1974; Johnson 1986; Wheeler 1988).

Subadult males do not acquire enough experience in selection of optimal habitat patches for hunting in the wintering area, which might account for the high percentage of subadult males in habitat patches avoided by adult males (Table 3). Alternatively, subadult males may use these patches as a way to avoid competition with adult males. The higher hunting success of adult males and the higher frequency of individuals engaged in hunting activities point to open meadows with short grass (burnt off or cut short) as the optimal foraging habitat for Montagu's harriers in the agricultural landscapes of south-east Poland (Table 3), which confirms results of a previous study (Kitowski and Wojtak 2001). This may be associated with the hunting tactics of harriers *Circus* spp. in which a significant role is played by acoustic localisation of prey (Clark and Stanley 1976; Rice 1982).

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