

Observations on the behaviour of male Montagu's Harriers *Circus pygargus* at communal roosts during the post-fledging period: a case study

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ABSTRACT

On calcareous marshes in south-east Poland communal roosts are formed during Montagu's Harriers' post-fledging dependency period solely by males. The observed males roosted exclusively on the ground in fields of saw sedge.. Significant differences were found in the number of roosting males in the early and late 1990s, though the area available for roosting had increased. Changes in the behaviour of roosting males in the specified period were also observed. The rate of birds involved in "pre-roost" sitting on the ground decreased. A distinct shortening of time needed for all males to drop onto the vegetation roost was noted in the second period of studies. Communal defences against foxes performed in pre-roost context were recorded. However, in the late 1990s the number of social defences, as well as their duration, increased. In the late 1990s Montagu's Harrier males preferred wetter 'bed forms' than in the early 1990s. In daytime owls were observed to use 'bed forms' of Montagu's Harrier males.

INTRODUCTION

Harriers (*Circus* spp.) are known to form communal roosts, mainly in the non-breeding period. These provide a number of functions of adaptive value such as: defence against predators, information centres significant in the search for optimal foraging areas, or choice of a mate. Such conclusions were based on observational studies focused on roosting behaviour of Hen Harriers *Circus cyaneus* and Australasian Harrier *Circus approximans* performed in Great Britain and New Zealand (Gurr 1968; Watson 1977; Picozzi & Cuthbert 1982). However, little is still known about the communal roosting of Montagu's Harrier *Circus pygargus*, although interesting observations during the post-

breeding period were made in India by Clarke (1996). Earlier data showed that males and non-breeders frequently roost communally (Looft *et al.* 1967).

Particularly little is known about the formation and adaptational functions of communal roosts formed in the post-fledging dependency period. For Montagu's Harriers nesting on calcareous marshes in south-eastern Poland, in their post-fledging dependency period only males were found to form communal roosts. The purpose of the present study was to determine the changes in behaviour of males in communal roosts and the way they choose a site for spending the night.

STUDY AREA AND METHODS

Studies were carried out in the 'Rozkosz' reserve near Chelm (51°08' N, 23°37' E, SE Poland) in two research periods. The first was in 1991-1992 (referred to as early 90s.). The studies were then continued at the same observation points (250-350m from the edge of the communal roost) in 1998-1999 (referred to as late 90s). Nearly the entire area of the reserve is covered by large fields of saw sedge *Cladium mariscus* with an admixture of Reed *Phragmites australis*. Associations of sedge communities *Magnocaricion* cover the remaining area of the marshes. From season to season a saw sedge field was a nesting site for 6 to 15 pairs of Montagu's Harrier (Krogulec *et al.* 2000; Kitowski 2002).

Six observation sessions, each lasting 3 hours, were conducted in each year of the study, making a total of 24 effective sessions of 72 hours. Observations were conducted weekly. Four sessions were performed every year in July and two in August, made between 1 July and 15 August. Places where birds drop down for the night were marked on a 1:10000 map, used to denote boundaries and size of communal roost. Studies were carried out with 10X 60 binoculars and a telescope 60 X, from a distance of 250-300 m.

RESULTS

Number of males and roost size

An essential feature of the observed communal roost was a spatial separation of males from females. Not a single case of a female spending the night among males was recorded during the evening observations (N=24). In the roost studied, only adult males (grey plumage) and sub-adult males (grey-brown plumage) were noted. Males spent the night only in saw sedge fields. In the early 90s groups of 13.1 ± 2.1 males roosted communally, with a range of from 10 to 16 males per night. In the late 90s the average dropped to 10.3 ± 1.7 males, and the respective range narrowed to 7-13 males (Table 1). Statistically significant differences were found between the numbers of males observed in the roost in the considered periods ($Z = -2.48$, $n_1 = 12$, $n_2 = 12$, $p < 0.013$). Differences for particular years of the study were also detected (Kruskall Wallis ANOVA: $H = 10.62$, $df = 3$, $p < 0.02$). For all sessions a decreasing trend in the number of males was found ($r_s = -0.481$, $n = 24$, $p < 0.017$) as the post-fledging period progressed, but for some years the tendency was insignificant (Table 1). In the first period of the study the roost area formed by convex polygons marked by males that dropped down peripherally was equal to

3125±423 m² and ranged from 2541 to 3681 m². In the second period the respective roost area increased to an average of 5376±1451 m², covering a range from 4038 to 7533 m². Differences were statistically significant (determined by the Mann-Whitney U test: $Z = -3.52$, $n_1 = 12$, $n_2 = 12$, $p < 0.0006$).

Table 1. Roosting behaviour of males of Montagu's Harrier

Years	N	Number of males	Rate of males engaged in "pre-roost sitting behaviour"	Seasonal changes in number of males (r_s)	Time (secs) between drop of first and last males on roost vegetation	Distance of birds closest to verge of marshes [m.]
1991	6	13.2±2.1	0.801±0.07	-0.811*	1192.5±112.5	132.8±13.2
1992	6	13.0±2.2	0.763±0.04	-0.318, n.s.	1303.3±172.8	126.8±11.7
1998	6	11.2±1.2	0.494±0.05	-0.470, n.s.	962.5±134.7	156.5±19.3
1999	6	9.5±1.9	0.495±0.04	-0.942**	996.5±124.0	136.7±22.1

* $P < 0.05$, ** $P < 0.005$

For all sessions there was a decreasing trend in roost area ($r_s = -0.943$, $n = 24$, $p < 0.0001$) as the post-fledging period progressed, but for year 1992 this tendency was insignificant (Table 2).

Table 2. Parameters describing the roost size

Years	N	Area of roost [m ²]	Changes in area of roost with progress of post-fledging period (r_s)
1991	6	3159.2±342.7	-0.942**
1992	6	3091.2±522.7	-0.428, n.s.
1998	6	5306.5±1765.5	-0.982***
1999	6	5445.5±1225.5	-0.940**

* $P < 0.05$, ** $P < 0.005$, *** $P < 0.001$

Behaviour in communal roost

Before finally roosting in the marsh, resting groups of males, called pre-roosts, were observed sitting in the meadows neighbouring the saw sedge (at a distance of up to 30 m), forming clusters that involved on average 7.7±3.14 individuals (range: 4-15 individuals). In the early 90s a total of 157 roosting males was observed, of which 124 (78.9%) participated in the pre-roost groups. In the late 90s 134 roosting males were observed, of which only 61 (45.5%) were involved in the pre-roost groups. Statistically significant differences were evident between the number of adults involved in pre-roost sitting groups in the early and late 90s (2 x 2 tables; $\chi^2 = 34.95$, $df = 1$, $p < 0.0001$).

The time needed for all birds to occupy the roost, i.e. the time between the first and the last male to drop onto the roost amounted to 1247± 150.6 sec

(range: 1055-1466 sec) and 979.5 ± 124.7 (range: 797-1144 sec) in the first and second period of the research respectively. A distinct shortening of that time was observed in the second period (Mann-Whitney U test: $Z = -3.58$, $n_1 = 12$, $n_2 = 12$, $p < 0.0004$) (Table 1).

A number of communal defences against predators such as foxes *Vulpes vulpes* ($N=4$) was recorded in the pre-roost context, each lasting 362.2 ± 93.1 sec (range: 280-496 sec), that involved 6.25 ± 2.5 males (range: 3-9) performing 3.0 ± 3.5 dives (range: 0-8) on mammals. In the second period as many as seven such communal defences were recorded ($N=7$). Each lasted 737.0 ± 286.1 sec (range: 481-1276 sec) and involved 10.0 ± 2.2 (range 3-12) males that performed 5.14 ± 2.7 (range: 4-8) dives. The durations of such communal defences were found to differ statistically (Mann-Whitney U test: $U = 1.5$, $n_1 = 4$, $n_2 = 7$, $p < 0.05$) when compared with the time needed to expel carnivorous mammals from the considered roost. However, such differences were not statistically significant for the number of males involved (Mann-Whitney U test: $U = 10$, $n_1 = 4$, $n_2 = 7$, n.s) or dives performed by them (Mann-Whitney U test: $U = 9$, $n_1 = 4$, $n_2 = 7$, n.s.). In late July 1998 one communal defence against Goshawks *Accipiter gentilis* was observed. It lasted 324 sec and involved seven males, four of which performed dives on the intruder. In the first period of study ($n=1$) and the second ($n=3$) some males with empty crops tried hawking on bats *Chiroptera* in the vicinity of the roost (Kitowski in press).

'Bed forms' of Montagu's Harrier males

For fear of predatory foxes and Raccoon Dogs *Nyctereutes procyonoides* examination of "bed forms" utilized by male Montagu's Harriers was avoided in our studies in large scale. Despite a somewhat conservative attachment to the site and its perpetual use for roosting, birds closest to the verge of the marshes spent the night at an average distance of 138.2 ± 19.6 (range 116-182 m) from it (Table 2). There were, however, differences in the distances noted in the particular years of the study (Kruskall Wallis ANOVA: $H = 15.27$, $df = 3$, $p < 0.01$). A total of 'bed forms' ($N = 49$) localised in saw sedge of an average height of 89.06 ± 9.65 cm (range: 80-115 cm) were found and marked in the first period. The water level amounted to an average of 5.6 ± 2.4 cm (range: 3-11 cm). In the second period, 36 'bed forms' localised in vegetation that was 88 ± 0.6 cm high (range: 75-120 cm) were found. The water level at 'night' sites amounted to 12.6 ± 2.5 cm (range: 6-15 cm). Unlike the vegetation height ($t = 0.474$, $df = 83$, n.s), differences in water level near the 'bed forms' were found for the analysed periods ($t = 12.3$, $df = 83$, $p < 0.0005$).

During diurnal examination in the early 90s single individuals of Short-eared Owl *Asio flammeus* and Barn Owl *Tyto alba* were flushed two times from 'bed forms'. At one 'bed form' a Barn Owl feather was also found. In the early 90s, out of all the 'bed forms' considered only six (12.2%) were used in the post-breeding period by wintering Hen Harriers. In both periods the area of communal roosts of wintering Hen Harriers (3-13 roosting birds) (Kitowski & Wojtak 1998; Kitowski & Cierech in press) covered the area of the communal roost of Montagu's Harrier males. Unfortunately, in the late 90s studies on winter use of Montagu's Harrier 'bed forms' by Hen Harriers were not conducted due to a drastic decrease in the number of Hen Harriers in the communal roost in this particular marsh (Kitowski & Cierech in press).

DISCUSSION

These studies proved the occurrence of spatial separation of male and female Montagu's Harriers during the post-fledging period. Such a phenomenon is not typical for communal roosts of Harriers (Gurr 1968; Watson 1977; Cramp & Simmons 1980; Clarke 1996). Three reasons seem most plausible to explain it. Firstly, a relatively close relationship between females and juveniles originating from the nesting period (Newton 1979; Krogulec 1992) makes females spend nights at a short distance from their young, the distance becoming distinctly longer in the late post-fledging period (Kitowski unpublished). Secondly, grasshoppers *Tettigonioides*, whose mass appearance in south Poland coincides with Montagu's Harriers' post-fledging period (Kitowski 2000; A. Liana, pers. comm) are well-known prey of Montagu's Harriers. Moreover, Montagu's Harrier males in their post-fledging period seem to exploit such an abundance of prey to a greater extent than females (Kitowski, unpublished personal data). Communal roosting can serve as a significant information centre for finding patches of habitat rich in this small size invertebrate prey. The importance of communal roosts in the search for food has been already proven for some raptors (Knight & Knight 1983; Green 1987). Thirdly, observed cases of mobbing groups formed by males (see below) can be another pro-roosting factor. Concentration of males in a small area, even at the moment of forming pre-roost resting groups, may favour their greater involvement in communal defence, as confirmed by observations of social mobbing of the species in question (Arroyo *et al.* 2000; Kitowski 2003).

These studies showed changes in the roosting behaviour of Montagu's Harrier males as well as in their preferences for places to roost in the early and late 90s. The observed changes were a response to an increasing predatory pressure of terrestrial mammals, especially foxes and Raccoon Dogs. One evidence of that pressure was a distinct decrease in the number of Montagu's Harrier breeding pairs and other breeding birds (waders *Charadriiformes*, ducks *Anatidae*) that occurred both within the study area and in other sites of south-east Poland (Krogulec *et al.* 2000, Kitowski -personal unpublished data). This decrease in the late 90s was accompanied by a high percentage of lost broods of Montagu's Harrier as a result of mammalian predation (Kitowski 2002).

A direct reaction of Montagu's Harriers to the presence of carnivorous mammals threatening their broods can be social defences of many birds simultaneously mobbing an individual intruder (Arroyo *et al.* 2000). During communal defence Harriers are able to differentiate their behaviour in relation to the intruder depending on the threat it poses to broods (Arroyo *et al.* 2000, Kitowski 2003). The larger number of communal defences and extended time of social mobbing recorded in the late 90s as compared with the early 90s indicates that roosting Montagu's Harrier males have adjusted also their defensive behaviour to the increased predatory pressure of terrestrial mammals.

This study confirmed also the previously reported phenomenon (Kitowski & Wojtak 1998) of the utilisation of post-fledging 'bed forms' of male Montagu's Harriers by Hen Harriers in late autumn and winter. It seems that droppings, pellets and feathers left in the roosts can play a significant role in the adoption of these places by Hen Harriers. Their high quality can be indicated by the very

fact that they have been used earlier. These studies on calcareous marshes in south-east Poland also confirmed the diurnal use of Montagu's Harrier 'bed forms' by owls, as previously reported for Hen Harrier communal roosts (Watson 1977; Kitowski & Wojtak 1998).

The present study revealed that roosting males of Montagu's Harriers prefer 'bed forms' located in plants that are 75-120 cm high. Such height of saw sedge corresponds to that of other vegetation (80-100 cm) used by Montagu's Harriers for nesting (Krogulec 1992; Wiacek 1998). Such preferences seem likely to be connected with the role the males play in selecting the nest in the pre-laying period (Wiacek 1998).

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