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The distribution of breeding Merlins *Falco columbarius* in relation to food and nest sites

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Abstract

This study deals with nest site selection and with the importance of food and nest sites as determinants of breeding density of Merlins *Falco columbarius*. Merlins preferred Hooded Crow *Corvus corone cornix* nests less than 2 years old, which had not been used previously by Merlins. Artificial nests meeting these requirements were provided in a study area where the number of suitable nests for Merlins was low. Food abundance (number of passerines) was estimated in this area and in a control area where up to 15 Merlin pairs could breed. The number of breeding Merlin pairs did not increase in the nest provision area in relation to the number of nests provided. One possible reason was that the accessability of prey was limited by snow, which was much more abundant in the nest provision area than in the control area. Therefore, we suggest that the density of breeding Merlins in this area was mainly determined by food particularly during the mating period.

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Introduction

The distribution of breeding birds is associated with the abundance of resources necessary for breeding such as food and nest sites (Lack 1968). For instance, food availability may limit the density of breeding raptors such as Kestrels *Falco tinnunculus* and Sparrowhawks *Accipiter nisus* (Newton 1979, 1986, Newton & Marquiss 1986, Village 1990, Korpimäki & Norrdahl 1991). Moreover, the availability of nest sites has been suggested as one factor limiting the density of breeding Kestrels (Village 1983, 1990) and other raptors (Newton 1979). In the case of the Merlin *Falco columbarius*, increasing availability of suitable nest sites is thought to have caused breeding population expansion in some areas (Oliphant & Haug 1985, James 1988, Warkentin & James 1988, Sodhi et al. 1992).

There are few experimental studies on the relationship between nest site availability and the distribution of breeding raptors, probably because it is difficult to manipulate the availability of nest sites. However, some species such as Kestrels and Merlins accept artificial nests for breeding (Hamerstrom et al. 1973, Newton 1979, Village 1983, Rebecca & Payne 1991). These species should, therefore, be well suited for determining the relative importance of nest site availability and food abundance, respectively, in influencing breeding numbers.

Merlins are adapted mainly to open habitats with few and small stands of trees (Oliphant 1974, Wiklund 1977, Newton et al. 1978, 1984, Bibby 1986, James 1988, Warkentin & James 1988, Sieg & Becker 1990). Like other falcons, Merlins do not build a nest. Rather, Merlins may accept various types of nest sites and breed in old nests of corvids and Rough-legged Buzzards *Buteo lagopus* on cliff-ledges and, in some areas, on the ground (for example Newton et al. 1978, Wiklund 1986, Meek 1988, Warkentin & James 1988, Sieg & Becker 1990). This may be one reason that provision of artificial nests has increased the number of breeding pairs in areas where natural nests are rare (Rebecca & Payne 1991).

In some parts of the Scandinavian mountain region, Merlins have bred with fairly stable numbers for more than a decade (Wiklund 1986, unpublished data). There they are found in small Birch *Betula pubescens ssp. tortuosa* forests near lakes and rivers. In such an area, we studied nest site selection by

Merlins and the distribution of breeding pairs in relation to the availability of nests and food. We increased the number of nest sites by erecting artificial nests in an experimental area where few natural nests were available. Before 1987, no more than one breeding Merlin pair were recorded each year in this area. Thus, if nest site shortage reduced the number of breeding Merlins in this area, we expected that provision of suitable nest sites should increase the number of breeding pairs (see also Rebecca & Payne 1991). Food abundance was estimated from point counts of passerines in this area and in a control area where many Merlin pairs regularly bred.

Study area and methods

Data on nest site selection were collected among Merlins breeding in Padjelanta and Stora Sjöfallet national parks, N Sweden, during 1977–1992. We mapped nests of breeding Merlins and Hooded Crows *Corvus corone cornix*, and recorded nest site selection of Merlins in the following breeding season. The Hooded Crow nests were classed according to four age categories: the nest was made in the same year as the Merlins used it, 1 year old, 2 years old and 3 or more years old. The maximum height of trees and height of the nest above ground were measured with an accuracy of 0.5 m using a Suuntometer, provided by the Forestry Department in Jokkmokk. We used the proportion of the tree above the nest as an approximation of overstory cover.

Manipulation of nest site abundance

The experimental area and the control area were on each side of the valley of Vuojatätno (67° 60' N, 17° 35' E, direction NNE–SSW), approximately 12 km long and 5 km wide, with a large river in the valley bottom. The valley is surrounded, in two directions, by steep mountains, and in the other directions by one large lake, Akkajaure, 10 km×80 km, and one smaller lake, Kutjaure. The habitat includes small birch forests and open land such as alpine meadows, Crowberry *Empetrum nigrum* heaths and Dwarf-birch *Betula nana* heaths, marshes and tundra. Important prey items for Merlins, such as Meadow Pipits *Anthus pratensis* and Wheatears *Oenanthe oenanthe* are encountered mainly on meadows and heaths (Wiklund 1986).

The distribution of breeding Merlins in this valley is irregular; many more pairs breed on one side of the valley, the control area (facing to the NW), than on the other side (facing to the SE), where no more than one pair has nested each year (see below). Because the distribution of breeding Hooded Crows in these areas is similar to that of the Merlins, potential nest sites for Merlins are produced continually in and near the control area. In the experiental area, there were only three Rough-legged Buzzard nests that could be used by Merlins attempting to breed during 1988–1991.

In early April 1991, about two weeks before the Merlins arrive, we erected 23 artificial nests in the experimental area. These nests were of Hooded Crow type as described by Rebecca and Payne (1991). Each nest was placed in a birch-tree at about 2/3 of its maximum height (see below) and firmly tied to the tree using wire. The distance between two neighbouring nests was approximately 1 km.

Before the 1992 breeding season in March, the artifical nests were repaired and changed slightly. A nest-cup was made of matted wool and filled with a thick layer of coarse sand allowing the birds to scrape a shallow hollow. It should be noted that we were not allowed to test the artificial nests in the control area due to National Parks regulations.

Estimating food abundance

Six routes, each approximately 6 km long, were used for censuses of passerines. Three routes traversed each of the experimental (routes: 4, 5 and 6) and the control (routes: 1, 2 and 3) areas. On each side of the valley, one route (1 and 6) was high on the slope near the tree border, another was 100–200 m from the river at the valley bottom (3 and 4), and the third between the other two. The routes went through habitats representing hunting as well as nesting areas for Merlins. In 1991, censuses were made from 2 to 7 June. This year the Merlins commenced laying, on average, on 29 May. Thus, some Merlin pairs were still laying when passerine abundance was estimated. In 1992, censuses were made from 6 to 10 May, that is, in the pre-laying period.

The censuses were made as point counts; the observers (CGW, Nigel Harding, Yngve Ryd) stopped after 15 min and recorded all birds during a 3 min period. After each point count, snow depth was measured, and snow cover was classified within a square, 50×50 m, according to: 0=no snow, 1=1–25% of the ground covered, 2=26–50% of the ground covered, 3=51–75% of the ground covered, 4=76–100% of the ground covered. Censuses were made twice per route by walking (1991) and skiing (1992).

We separately examined the abundance of Meadow Pipits and Wheatears because these birds are, by numbers, the most important prey items of Merlins during the nestling period (Wiklund 1986). Other passerines included in the study were: Yellow Wagtail *Motacilla flava*, Redstart *Phoenicurus phoenicurus*, Bluethroat *Luscinia svecica*, Redwing *Turdus iliacus*, Fieldfare *T. pilaris*, Chaffinch *Fringilla coelebs*, Brambling *F. montifringilla*, Redpoll *Carduelis flammea*, Reed Bunting *Emberiza schoeniclus*, Snow Bunting *Plectrophenax nivalis* and Lapland Bunting *Calcarius lapponicus*.

We used ANOVA and Scheffe's F-test to examine any differences in numbers of birds between routes as well as between the experimental and control areas. Since we could predict the relationship between bird abundance and snow from other studies (Svensson 1986, Kostrzewa & Kostrzewa 1991), we used one-tailed tests in this analysis. Other statistical tests follow Siegel (1956) and SAS (1988). Means are given ±one standard deviation.

Table 1. Nest site selection by breeding Merlins. The number of Merlin pairs occupying nests of various origin and age are presented. Age 0 indicates that the nest was built in the same year as the Merlin pair bred, and 3+ that the nest was three years old or older. Cliff-ledge nest and nests on the ground were not aged.

Boplatsval hos stenfalk. Antalet häckande stenfalkspar i bon av olika ursprung, och ålder på bo byggda av kråka och fjällvråk. En nolla betyder att boet byggdes samma år som stenfalkarna häckade i det, och 3+ att boet var minst 3 år gammalt. Bon på klipphyllor och på marken åldersbestämdes ej.

Nest site *Boplats*	Age *Ålder*				Total
	0	1	2	3+	
Hooded Crow *kråka*	20	60	26	28	134
Rough-legged Buzzard *fjällvråk*	–	–	–	8	8
Cliff-ledge *klipphylla*	–	–	–	–	5
Ground *marken*	–	–	–	–	7

Results

Nest site selection

Over the study period, 149 nest sites were categorized according to type and age. There was a clear preference for breeding in nests of Hooded Crows. Thus, 134 (90%) Merlin nesting attempts were in nests made by Hooded Crows and only 8 (5%) were in nests made by Rough-legged Buzzards, including 3 on cliffs (Table 1). The numbers of Merlin pairs breeding on cliffs and on the ground were 5 and 7, respectively (Table 1).

In this area, most Hooded Crow pairs finished nest-building in late April, when the Merlin mating season begin. Therefore, most potential nest sites for Merlins attempting to breed were at least a year old. About 79% of the Merlins occupied a nest less than three years old. Each year some Hooded Crow pairs abandoned their nests, sometimes before the nest was completed, so the mud-cup or the inner nest-lining was missing. Twenty Merlin attempts were in nests built in the same year (Table 1). A significantly larger proportion of the pairs bred in one year old nests than in nests of other age categories (Table 1, $\chi^2_{(3)}=28.98$, $P<0.001$). Only 4 nests had previously been used by Merlins.

The nests made by Hooded Crows were in birch-trees, whose maximum height was, on average, 8.0±2.3 m (N=23), range 5.5–12.5 m. The height above ground of these nests ranged between 3.0 and 8.5 m and was, on average, 5.4±1.6 m. There was a positive correlation between maximum height of the trees and height of the nests (r=0.87, N=23, P<0.0001, Pearson). The overstory cover varied greatly and ranged from 19.0% to 50.0% (mean=32.5±10.0%). However, overstory cover was correlated neither with maximum height of the trees (r=0.14, N=23, P>0.50, Pearson) nor with height of the nest (r=–0.36, N=23, P>0.09, Pearson).

Availability of nests in breeding territories

There is evidence that intra-sexual contests among males occur mainly near the nest and rarely away from it (Wiklund & Village 1992). Moreover, in the case of the Merlin there is a large overlap in hunting ranges of neighbouring Merlins (Sodhi 1993a). Thus, it seems likely that intra-sexual contests for breeding territories concern nest sites and the area near the nesting site.

During the mating period, the Merlin male shows a nest to the female. The presentation is preceded by a display-flight, the V-flight, and after alighting on the nest he walks around in it, scratches and calls, the *tic-call* (Sodhi et al. 1993). If there are several old Hooded Crow nests near each other, he may present more than one nest to the female. We recorded more than 10 instances where females scraped in at least two old Hooded Crow nests before laying started. This behaviour of the female may be associated with

Table 2. The number of Merlin pairs breeding in territories of different quality as determined by the number of old Hooded Crow nests in each territory. The number of territories of each category is shown within parenthesis.

Antalet stenfalkspar som häckade i territorier med olika antal tillgängliga kråkbon. Antalet tillgängliga territorier av olika kvalitet anges inom parentes.

Year *År*	Number of potential nest sites *Antalet potentiella boplatser* 1	 2	 >2
1985	1 (1)	2 (4)	12 (17)
1986	0 (1)	0 (1)	8 (14)
1987	0 (1)	3 (4)	9 (13)
1988	1 (2)	1 (2)	17 (22)
1989	0 (0)	4 (5)	17 (22)

Table 3. The number of Merlin territories in the control area and in the experimental area during 1988–1992. The experimental area was provided with 23 artificial nests of Hooded Crow type in 1991 and 1992.

Antalet stenfalksrevir i experimentområdet och i kontrollområdet under 1988–1992. Försöksområdet försågs med 23 konstgjorda kråkbon under 1991 och 1992.

Year *År*	Number of breeding territories *Antalet häckningsrevir* Control area	 Experimental area
1988	12	0
1989	15	0
1990	13	0
1991	10	2
1992	12	1

her requirement of a safe nesting site. For instance, two females switched nest site possibly because they were disturbed on the day before laying commenced (see also Wiklund 1990). Hence, a territory with more than one Hooded Crow nest may be more attractive than a territory with only one nest.

We classed 119 potential nesting territories according to the number of crow nests available. The territories appeared similar in many other respects for example the nest(s) were near the edge of a small Birch forest that was surrounded by open land. Most territories (82%) contained more than two nests while territories with only one nest were rare (4%) (Table 2).

Territories with one old Hooded Crow nest were occupied by Merlins on two out of 5 occasions (Table 2), that is, a rate of occupancy of 40%. The percentage of territories with two nests that was occupied by Merlins was 62.5%, and breeding was confirmed in 64.3% of the territories with more than 2 nests. There was no significant difference in rate of occupancy between the three categories of territories (pooled data, F=0.80, P>0.35, ANOVA).

Occupancy of territories in the experimental and control areas

During 1988–1992, the number of territorial Merlin pairs in the control area varied between 10 and 15 (Table 3). Thus, there might have been some unoccupied territories in this area during the two years when artificial nests were provided in the study area. In 1991, Merlins occupied two territories in the experimental area. One Merlin pair consisting of two first-time breeders, a 2 year old male and a 1 year old female, bred in a Rough-legged Buzzard nest about 600 m away from an artifical nest. This female commenced laying about two weeks later than the earliest Merlin female in the control area did, so the possibility that she reared a replacement brood could not be excluded. In the other territory, a male was observed near an artificial nest during at least 10 days, although breeding could not be confirmed. The male that bred in the experimental area in 1991 also bred in 1992 with a yearling female in the same territory as was used in 1991. A Hooded Crow nest made in the same year was then used by the Merlins. This breeding attempt failed due to predation.

Food abundance

In early June 1991, on average 3.3±1.5 (N=41) passerines per point count were recorded in the control area. There were no significant differences in passerine abundance between the transect routes of this area (P>0.05, mean difference: routes 1 vs 2= 0.31, F= 0.06, routes 1 vs 3=–1.07, F= 0.81, routes 2 vs 3=–1.38, F=1.29). Similarly, no significant differences in passerine abundance were detected between transect routes of the experimental area (P>0.05, mean difference: routes 4 vs 5=–0.62, F= 0.31, routes 4 vs 6=–0.51, F= 0.23, routes 5 vs 6= 0.11, F= 0.01). In this area, mean number of passerines was 2.3±1.4 (N= 52). The abundance of passerines was significantly higher in the control area (F= 9.65, P<0.01, ANOVA). One apparent difference

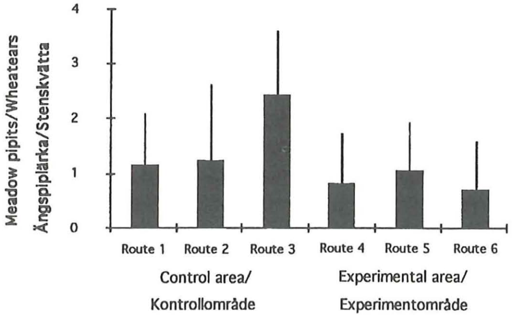

Fig. 1. The number of Meadow Pipits/Wheatears in each line transect route (±SD) in the experimental area and in the control area, respectively.

Medelantalet ängspiplärkor och stenskvättor (±standardavvikelse) längs varje taxeringsrutt i experimentområdet och i kontrollområdet.

was that, on the valley bottom (routes 3 vs 4), there were more passerines in the control area than in the experimental area (mean difference: 2.13, F=3.41, P<0.05, ANOVA).

We separately examined the numbers of Meadow Pipits and Wheatears in each area because they are important prey for breeding Merlins. On average 1.6±1.3 (N=41) Meadow Pipits and Wheatears per point count was recorded in the control area (Fig. 1). The numbers of Meadow Pipits and Wheatears did not differ significantly between the transect routes of this area (Fig. 1, P>0.05, mean difference: routes 1 vs 2=–0.09, F=0.01, routes 1 vs 3=–1.29, F=2.26, routes 2 vs 3=–1.20, F=1.89). The number of Meadow Pipits/Wheatears was significantly higher in the control area (F=11.64, P<0.01, ANOVA). Moreover, Meadow Pipits and Wheatears were more abundant in the valley bottom route (3) of the control area than in any of the routes in the experimental area (Fig. 1, P<0.05, mean difference: routes 3 vs 4=1.62, F=3.81, routes 3 vs 5=1.36, F=2.72, routes 3 vs 6=1.73, F=4.81). In the experimental area, mean number of Meadow Pipits/Wheatears was 0.8±0.9, N=52, (Fig. 1). There were no differences in abundance of Meadow Pipits/Wheatears between the transect routes (P>0.05, mean difference: routes 4 vs 5=–0.25, F=0.10, routes 4 vs 6=0.11, F=0.02, routes 5 vs 6=0.36, F=0.23).

In early May 1992, we recorded only 20 and 19 passerines during line transects in the experimental and control areas, respectively. Snow Buntings and Redpolls accounted for 75% of the observations in each area. During this period, we regularly recorded small flocks of Snow Buntings of about 5 individuals on snow-free patches in and near the control area.

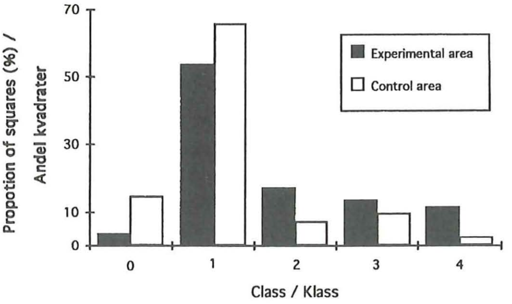

Fig. 2. The proportion of ground covered by snow in the experimental area and in the control area as shown by the frequencies of 50 x 50 m squares of various classes. We classed snow cover of each square by estimating the proportion of the square that was covered by snow, as follows: Class 0=0 %, Class 1=1–25%, Class 2=26–50 %, Class 2=51–75 %, Class 4=76–100 %.

Snötäckets utbredning i experimentområdet och kontrollområdet. Procenten 50 x 50 m. kvadrater av olika snötäckningsgrad: Klass 0=0 % av ytan snötäckt, Klass 1=1–25 %, Klass 2=26–50 %, Klass 3=51–75 %, Klass 4=76–100 %.

Some larger flocks of 20 (N=1) and 50 (N=3) individuals were recorded on the largest patches. The range in size of these patches was 5–1000 m^2, on average 110±190 m^2 (N=36). In the experimental area, there were only a few snow-free patches, and they were less than 5 m^2 in size.

Snow and passerine abundance

The proportion of ground covered by snow in early June was higher in the experimental area than in the

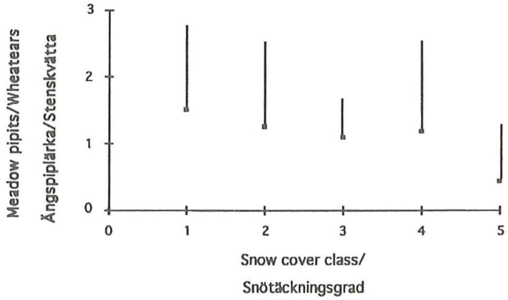

Fig. 3. The number of Meadow Pipits/Wheatears ±SD) in relation to the proportion of ground covered by snow as indicated by snow cover classes (see text and Fig. 2). The proportion of ground covered by snow increased from class 0 to class 4.

Medelantalet ängspiplärkor och stenskvättor (±standardavvikelse) i relation till snötäckets utbredning (se text och Fig. 2). Snötäckets utbredning ökar från klass 0 till klass 4.

control area (Fig. 2, $P<0.05$, ANOVA). Similarly, snow depth was greater in the experimental area (131.4±256.6 mm, N=52) compared with the control area, 45.6±133.7 mm, N=41, ($P<0.05$, ANOVA). There was a strong correlation between the proportion of ground covered by snow and snow depth ($r_s= 0.82$, N= 93, $P<0.01$). Hence, there was much more snow in the experimental area than in the control area.

The number of Meadow Pipits/Wheatears was negatively correlated with snow cover (Fig. 3, $r_s=-0.17$, N=93, P=0.05), suggesting an inverse relationship between snow and passerine abundance. The total number of passerines was not significantly correlated with snow cover ($r_s=-0.11$, N=93, P=0.13).

Discussion

Newton (1991) summarized studies of various raptor populations and concluded that in habitats where nest sites are available in excess, breeding density is limited by food supply. The main finding of our study was that Merlins used old Hooded Crow nests for breeding, and that food rather than the availability of nest sites limited the density of breeding Merlins.

Nest site selection

The Merlins mainly used old Hooded Crow nests for breeding (Table 1). There were few pairs that bred on the ground, presumably because such nests often fail due to predation (Newton et al. 1978, Wiklund 1986). Hooded Crow nests were much more common than nests of Rough-legged Buzzards. For instance, approximately thirty Hooded Crow nests were available for five Merlin pairs that bred each year in a birch forest of about 8.0×0.4 km some 20 km away from the nest provision area. The number of Rough-legged Buzzard nests available for Merlins was also reduced because several Rough-legged Buzzards claimed nests each year. The number of nests available in the territory seemed not to affect the Merlins' choice of breeding territories.

One feature of Hooded Crow nests was that they were well concealed compared with those of Rough-legged Buzzards. Nests of the Rough-legged Buzzard were larger and often in the top of the trees and therefore easy for predators to detect. The choice of concealed nests by Merlins is common (Warkentin & James 1988, Sieg & Becker 1990) and probably an adaptation to reduce predation by avian predators.

Merlins showed a strong preference for Hooded Crow nests less than two years old. In these nests, the nest-cup was still intact, although the inner nest-lining and sometimes the mud-cup were missing. However, Merlins rarely used a nest that had been used previously by breeding Merlins. One reason could be that breeding destroyed the nest-cup, so that the nesting base became flat. We recorded some instances of females knocking eggs or chicks out of such nests. In one case, the parents were feeding half grown chicks, two on the ground below the nest and two in it. Another reason could be that, after being used by Merlins in a previous year, a nest might have a high parasite load. Thus, Merlins seemed to select a nest that had not been used by Merlins already, and that provided a shallow hollow for the brood.

In this area, Merlins have been studied since the early seventies (Wiklund 1986, this study). During this study period, we have encountered many Merlin pairs breeding in poor nests. Some examples are (see also above): the mud-cup and a large part of the bottom were missing in one nest (it was possible to look through the nest) leaving only the edge of the nest for the chicks, small and very old Hooded Crow nests with no edge (half the size of a 1 year old nest) consisting of a filled mud-cup and sticks attached to the bottom of the mud-cup. In contrast, our artificial nests were similar in size to fresh Hooded Crow nests, with a strong edge and a shallow hollow. Therefore, we believe that the artificial nests increased the availability of suitable nests in the experimental area, as similar nests did in another area (Rebecca & Payne 1991).

Fidelity to breeding territories is low in Merlins. For instance, average distances moved between successive breeding seasons are among males 1.9±2.0 km, and among females 4.8±6.7 km (Wiklund unpublished data). Moreover, we recorded Merlins in the experimental area in early May. Therefore, we believe that the experimental nests provided an opportunity for Merlins attempting to breed unless some other resource was in short supply. The number of Merlin territories did not increase as a function of the number of nests provided, however. Only a few Merlins established territories in the experimental area. Thus, in terms of proportion available nests for breeding, nest sites seemed not to limit the density of breeding Merlins in this area (see also Warkentin & James 1988).

During the nest provision period, there was a slightly lower density of breeding Merlins in the control area than the maximum recorded for the area. Therefore, breeding territories were probably available in the control area. This created a problem because birds mainly move from poor to rich areas (review in Newton 1992). Thus, more territories could have been occupied in the experimental area, if the breeding densities in the control area had been higher in the years concerned.

Food abundance

Merlins may prefer to nest close to areas with high food abundance (Sieg & Becker 1990) because that would reduce the time spent for hunting and, consequently, the foraging effort particularly for males. The time males spend flying depends on hunting ranges (Sodhi 1993b), which is related to prey abundance (Sodhi 1993a). Moreover, short duration of foraging bouts would allow the male to allocate more time to be near the nest, where the female spends most of her time in the mating period (Newton 1979, Wiklund 1990). This is important because she may not expel other males but accept extra-pair copulations (Sodhi 1991, Wiklund & Village 1992), which could reduce the male's reproductive success.

Newton (1992) reviewed territoriality in birds and pointed out that, in removal experiments, replacements of birds occurred in rich areas but rarely or not in poor areas. Moreover, removed birds in rich areas were often replaced while poor sites remained vacant. During the mating period, we recorded Merlin males hunting Snow Buntings that fed on snow-free patches in and near the control area. Up to mid-May, this was the only passerine that was abundant in large numbers in the mountain region. Hunting Merlins were not encountered in the experimental area, where snow-free patches were small and less common. If food abundance already in the mating period is a que for selection of breeding territories by Merlins, that would also explain the distribution of breeding Merlins in our study area.

The difference in number of Merlin territories between the two areas did not correspond to the difference in passerine abundance in the Merlins' laying period. It is therefore doubtful that food abundance during this period was the most important determinant of the distribution of breeding Merlin pairs.

Breeding of Hooded Crows was rarely recorded in the experimental area. In June and July in N Sweden, Hooded Crows often feed on eggs and nestlings of other birds. Similarly, nestlings as well as newly fledged chicks of passerines form a comparatively large part of the food that Merlin chicks receive (Enemar & Hård 1980). If our passerine counts reflect the difference in number of breeding passerines between the areas, more passerines would have bred in the control area. However, that difference is not large enough to explain why breeding Merlins and Hooded Crows were almost absent from the experimental area.

There is evidence that spacing of breeding raptors is determined by food abundance, which could be associated with land productivity (Newton & Marquiss 1986, Newton et al. 1986, Village 1990). Our study was performed in a mountain area, where in spring the availability of food is strongly reduced by snow, particularly for birds feeding on the ground. Conceivably, this is one important reason that passerines were encountered mainly in areas with little snow. Hence, like low soil productivity snow may reduce food abundance and, consequently, the breeding density of raptors. For instance, the number of Kestrel territories occupied in any one year is negatively correlated with the days of snow cover in the preceeding winter (Kostrzewa & Kostrzewa 1991). We believe, therefore, that the skewed distribution of Merlin territories in this valley reflects passerine abundance particularly the abundance of Snow Buntings during the mating period of Merlins.

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Sammanfattning

Inverkan av födo- och boplatstillgång för den rumsliga utbredningen av häckande stenfalkar Falco columbarius.

Den här rapporten behandlar stenfalkens boplatsval och faktorer som påverkar tätheten av häckande stenfalkspar. Många studier av fåglar, även rovfåglar, indikerar att tillgången på föda och boplatser påverkar häckningstätheten. Ett problem vid studier av rovfågelspopulationer är emellertid att det är svårt att experimentellt undersöka den relativa betydelsen av en viss resurs. Det är till exempel svårt att manipulera boplatstillgången, då få arter accepterar konstgjorda bon. Stenfalken är dock en av dessa arter.

Under häckningstiden finns stenfalken i öppna habitat, där antalet träd och skogsdungar är få och små. Stenfalkarna bygger inget eget bo utan häckar i gamla bon av kråkfåglar och fjällvråk, eller på klipphyllor. Ibland är boet bara en fördjupning i marken. Stenfalkens val av boplats är alltså mångskiftande och kan vara en förklaring till att individer av arten accepterar konstgjorda bon.

I vårt undersökningsområde har det häckande stenfalksbeståndet varit stabilt under mer än 10 år. Stenfalkarnas häckningsplats finns i regel i små björkdungar och jaktområdet utgörs av de öppna markerna som omger häckningsplatsen. Vi undersökte stenfalkens boplatsval och fördelningen av häckande stenfalkspar i en mindre del av undersökningsområdet.

Metoder

Stenfalkens boplatsval undersöktes i Padjelanta och Stora Sjöfallets nationalparker under åren 1977–1992. På kartor prickade vi in bon av stenfalk och kråka. Nästa häckningssäsong noterades stenfalkens val av bo. Kråkbona delades in i fyra ålderskategorier: boet hade byggts samma år som stenfalkarna använde det, 1 år gammalt bo, 2 år gammalt bo och bon som var 3 år eller äldre. Boträdets höjd och boets höjd över marken mättes med en Suuntometer. Proportionen av trädet som var över boet användes som mått på hur väl kamoflouerat boet var.

Experiment- och kontrollområde för manipulering av boplatstillgången valdes i Vuojatätnos dalgång. Den sydöstra delen av dalgången hyser varje år många häckande par av stenfalk och kråka under det att endast enstaka par av de två arterna häckar på den nordvästra sidan. Experimentområdet förlades till den nordvästra delen av dalgången. I detta område fanns enbart 3 fjällvråksbon som kunde utnyttjas av stenfalkar. Kontrollområdet placerades i den sydöstra delen av dalgången. Det första experimentåret, 1991, satte vi upp 23 konstgjorda kråkbon i experimentområdet cirka 2 veckor innan stenfalkarna anlände till trakten. Bona sattes upp i björkar och surrades fast med järntråd. Det andra experimentåret, 1992 reparerade vi bona och försåg dem med en ny bobale gjord av tovad ull som täcktes med grov sand.

Tre taxeringsrutter, var och en 6 km lång, snitslades för kartering av småfåglar i varje område. En rutt gick nära trädgränsen och en i dalbottnen samt den tredje mellan dessa. Rutterna gick igenom både jakt- och boterräng för stenfalk. Under första experimentåret, 1991, taxerade vi småfåglar under stenfalkarnas äggläggningstid, 2–7 juni. Nästa experimentår, 1992, taxerades småfågelförekomsten under stenfalkens parbildningstid, 6–10 maj. Taxeringarna utfördes som punkträkningar; taxeraren stannade efter 15 minuter och noterade alla fåglar under en 3 minuters period. Efter varje punkttaxering mättes snödjupet på platsen och snötäckets utbredning klassifierades i en ruta om 50×50 m. enligt: 0=ingen snö, 1=1–25% av marken snötäckt, 2=26–50% av marken snötäckt, 3=51–75% av marken snötäckt och 4=76–100% av marken snötäckt. Varje rutt taxerades 2 gånger.

Eventuella skillnader i småfågeltillgången mellan rutterna och mellan experiment- och kontrollområde undersöktes med hjälp av variansanalys (ANOVA). Vi gjorde en separat analys av tillgången på ängspiplärka och stenskvätta eftersom dessa arter antalsmässigt dominerar stenfalkens diet under boungetiden.

Resultat

Vi fann att 134 (90%) stenfalkshäckningar skedde i kråkbon och 8 (5%) i fjällvråksbon varav 3 låg på klipphyllor. Övriga häckningar var på klipphylla, 5, och på marken, 7. Cirka 79% av stenfalkarna valde ett kråkbo som var yngre än 3 år. Åldern på de flesta bona var ett år (Tabell 1). Tjugo par häckade i årsbon av kråka.

Boträdens höjd varierade mellan 5.5 och 12.5 m och boets placering över marken varierade mellan 3.0 och 8.5 m. Det var en positiv korrelation mellan trädets höjd och boets höjd över marken. Mellan 19% och 50% av trädet var ovanför boet.

Totalt 119 potentiella stenfalksrevir klassifierades med avseende på antalet kråkbon i reviret. Reviren skiljde sig ej mycket åt i andra avseenden rörande habitatets struktur. Bona fanns nära skogskanten i små björkdungar, som var omgivna av öppen mark. Proportionerna revir med stenfalkar var lika för de 3 revirkategorierna; 1 bo, 2 bon och mer än 2 bon. Antalet bon i reviret påverkade alltså inte stenfalkens val (Tabell 2).

I experimentområdet etablerades 2 stenfalksrevir under 1991. Ett par gick till häckning och 1 hane höll ett revir (med konstgjort bo). Följande år, 1992, häckade den förstnämnda hanen med en ny hona i samma revir som häckningsåret 1991. De två häckningarna skedde i ett fjällvråksbo (1991) och i ett årsbo av kråka (1992).

Småfågeltillgången var lägre i experimentområdet än i kontrollområdet. Detsamma gällde också tillgången på ängspiplärka och stenskvätta (Fig. 1). Det var framför allt i dalgångens botten som antalet ängspiplärka/stenskvätta skiljde sig mellan de två områdena. I maj, 1992, noterades endast ett fåtal tättingar. Snösparven var i särklass vanligast. Den förekom i större antal i och nära kontrollområdet än i experimentområdet.

Tillgången på ängspiplärka/stenskvätta var relaterad till snömängden. Där det var mycket snö var antalet individer litet och tvärtom. Det var mer snö i experimentområdet än i kontrollområdet.

Diskussion

I en översikt av olika rovfågelspopulationer kom Newton (1992) till slutsatsen att tätheten av häckande individer begränsas av födotillgången i områden med överskott på boplatser. Vår studie visar att stenfalkarna i regel väljer att häcka i gamla kråkbon och att det troligen är födotillgången som begränsar antalet häckande par.

Det var en betydligt större förekomst av kråkbon än fjällvråksbon. I en närbelägen dalgång fanns det cirka 30 kråkbon för de 5 stenfalkspar som varje år häckade i dalgången. Antalet tillgängliga fjällvråksbon reducerades också av att ett antal fjällvråkar hävdade revir varje år. En orsak till att antalet markbon var så litet är att sådana bon ofta plundras.

Stenfalkarna visade en klar preferens för kråkbon som var mindre än 2 år gamla. Utmärkande drag för dessa bon är att det finns en fördjupning, en boskål, i boet även om kråkornas byggnation har avslutats innan den inre delen av bobalen och emellanåt även boskålsformen av lera har färdigställts. Stenfalkarna häckade ytterst sällan i bon som vid ett tidigare tillfälle hade utnyttjats av stenfalk. En orsak kan vara att efter en stenfalkshäckning försvinner boskålen och boets översida blir platt. Vid häckningar i sådana bon har honor emellanåt knuffat ägg eller ungar ur boet. Exempelvis matade ett stenfalkspar 2 ungar i boet och 2 ungar nedanför boet. Ett annan orsak är att sådana bon kan innehålla en stor mängd parasiter.

Under de senaste 20 årens studier av stenfalk har vi vid flera tillfällen funnit stenfalkar som har häckat i bon av mycket dålig kvalité. Bon som i princip har saknat botten eller gamla slitna kråkbon som har varit hälften så stora som nya bon. Våra konstgjorda bon var av samma storlek som nya kråkbon och försedda med en boskål och en förstärkt kant. Därför tror vi att de konstgjorda bona utgjorde ett realistiskt alternativ i experimentområdet, där det saknades riktiga kråkbon. Vi noterade också stenfalkar i detta område under den tid då reviretablering sker. Antalet nyetableringar av stenfalk var emellertid så litet att det knappast kan ha varit boplatsbrist som begränsade antalet häckande par.

Stenfalkar häckar ofta nära områden med hög bytestillgång. Detta reducerar jakttiden, vilket minskar i synnerhet hanens ansträngning att skaffa föda. Korta jakttider under parningstiden är viktiga också ur en annan synvinkel. Under cirka två veckor före äggläggningen tillbringar honan merparten av tiden vid boet och hanen förser henne med all mat hon behöver. Det är vid den här tidpunkten som äggen befruktas och om hanen inte vaktar henne emot konkurrerande hanar kan faderskapet riskeras. Honorna accepterar att para sig även med främmande hanar.

Under parbildningstiden såg vi stenfalkshanar som jagade snösparvar på barfläckarna både i och i närheten av kontrollområdet. I experimentområdet var barfläckarna små och sällsynta. Snösparven är den enda vanliga tättingen i området fram till senare hälften av maj. Om födotillgången under parbildningstiden är viktig för stenfalkens val av häckningsterritorier detta förklara den skeva fördelningen av stenfalkar i Vuojatätnos dalgång.

Skillnaderna i småfågeltätheten mellan experiment- och kontrollområde under stenfalkarnas läggningstid var för små för att förklara den stora skillnaden i antalet besatta revir. På samma vis förhåller det sig med skillnaden i antalet häckande småfåglar, om vi antager att våra punkttaxeringar under stenfalkarnas läggningstid också var ett mått på antalet häckande småfåglar.

Det finns samband mellan den häckande tätheten av rovfåglar och bytestillgången och produktiviteten i ett område, mätt som sambandet mellan jordmån och växtlighet. I vårt undersökningsområde reducerades födotillgången i april och maj av snö. I synnerhet för de småfåglar som söker föda på marken. Därför är förhållandet mellan snö och småfågelförekomsten i vårt område jämförbart med förhållandet mellan produktivitet och småfågelförekomst i snöfria områden. Småfågelförekomsten är liten i områden med omfattande snötäcke och vice versa. En konsekvens är naturligtvis att småfågelpredatorernas antal också kan påverkas av snötäckets utbredning. Tornfalken ännu ett exempel på en predator som påverkas av att bytestillgången reduceras av snö. Studier av arten har visat att antalet besatta territorier är omvänt relaterat till antalet dagar med snötäcke. Det är inte bytesvalet i sig som är av störst intresse (tornfalken lever främst av smågnagare) utan det faktum att snö kan påverka bytestillgången för falkarna och därigenom också påverka antalet besatta revir.