OCCUPANCY AND SUCCESS OF NESTING TERRITORIES IN THE EUROPEAN SPARROWHAWK

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Abstract

Of 150 nesting territories occupied by European Sparrowhawks at least once in a five-year period, 82-110 were occupied in individual years. Certain territories were occupied more often, and others less often, than expected on a chance basis at the population levels found ($P < 0.001$). The most popular territories were those in which nesting attempts were most often successful ($P < 0.001$).

On particular territories, about 75 percent of all males and more than 50 percent of all females were replaced between one year and the next. This high turnover was due partly to movement, for at least 30 percent of all marked birds changed territories between years. Most individuals had different mates for each breeding attempt. Changes of females on territories occurred more often after unsuccessful breeding attempts than after successful ones ($P = 0.0025$), but changes of males occurred at the same high rate regardless of success or failure.

Introduction

For five years we have studied a population of European Sparrowhawks (*Accipiter nisus*) in southern Scotland. This paper reports on (a) the occupancy of particular nesting territories in relation to nest success and (b) the rate of replacement of territory owners from year to year. It is a preliminary analysis of work in progress, and both aspects will be developed and presented in greater detail in the future. The term "nesting territory" is used for the area around the nest that is defended and does not include more distant hunting areas. An "occupied territory" is one on which a new nest is built. A "successful nest" is one from which young fledged.

The study area of about 700 km^2 was centered on the River Annan in Dumfries County. It included a section of valley bottom and the hills on either side. The valley was up to 17 km across and presented a flat but varied landscape of mixed farms, woods, villages, and small towns. The hills around were mainly open and used for grazing sheep but also supported several large plantation forests. Sparrowhawks nested in both valley woods and hill forests but also hunted in other habitats, preying almost entirely on small birds. They were nonmigratory in this region, but at least some individuals deserted their nesting territories in the winter. Nonetheless, the same nesting territories were used in different years, but a new nest was usually built each time. In 1971-75 we believe we found every new nest in the study area, and from each we recorded success or failure (see Newton 1976 for methods and other details). On territories which lacked new nests, no indication at all was found that Sparrowhawks were present at any time during the breeding season. We also attempted on a number of territories to catch both birds each year for banding and subsequent recapture. We did it by putting a baited cage trap within 30 m of the nest tree, usually in the period before egg-laying.

Occupancy of Territories in Relation to Nest Success

In the study area as a whole, 150 nesting territories were used at least once in the five-year period, with 82-110 occupied in individual years. The breeding population declined between 1971 and 1975, but nest success fluctuated from year to year with no clear trend (table 1). The reasons for declining numbers and fluctuating success were not obvious, but neither could be attributed to direct human interference, which was slight (Newton 1976). Over the five years, some territories were occupied only once, and others two, three, four, or five times. We therefore asked whether occupancy of territories was random or whether preferences were apparent. This question was examined by calculating, for the population levels found, the expected number of territories that would be occupied one, two, three, four, or five times in the five years, assuming they were occupied on an equal chance basis. Then, the expected values were compared with the observed frequency of occupation (figure 1). The two distributions differed to a highly significant degree ($X^2_4 = 118.8; P < 0.001$). In particular, many more territories were occupied in only one year and in all five years than expected by chance. This finding suggests that Sparrowhawks avoided certain territories to some extent and favored others.

Their preferences were related to nest success. In table 2, territories were arranged according to whether they were occupied in one, two, three, four, or five years. The total number of breeding attempts in each category was calculated, together with the proportions of attempts that were successful. On the average, the most popular territories showed the greatest success. Table 2 also shows the expected number of successful attempts if all grades of territories had the same chance of success. Again the observed and expected distributions differed significantly from one another ($X^2_4 = 20.18; P < 0.001$). Evidently, the birds most often used those territories in which their chances of success were greatest. The question of what constitutes a good nesting territory is under investigation; one factor of obvious importance is the local food supply. In general, territories in small valley woods showed significantly better success than those in large hill forests (Newton 1976) where prey was shown to be scarcer (Moss 1976).

Turnover of Territory Occupants

Females proved easier to catch and provided larger samples than males. Also, on some territories we were unable to catch the occupants every year, but only at two-, three-, or four-year intervals. Our recaptures (table 3a) showed that of 20 territories in which males were caught at one-year intervals, they were different birds on fifteen occasions. Of 46 territories in which females were caught at one-year intervals, they were the same birds on only 21 occasions. For each sex a similar high turnover was also apparent for territories in which birds were caught at longer intervals.

That this turnover was not entirely due to mortality was evident from the records of particular birds (table 3b). Of 32 females caught at one-year intervals, 21 were on the same territory. Of nine caught at two-year intervals, seven had shifted. And of four caught at three- or four-year intervals, two had shifted. The samples for males were small, but showed similar movements between territories. At least 30 percent of marked birds moved from one year to the next. However, we could not estimate the true proportion because the chances of recapture were greater among birds that stayed than among birds that moved. Some may have left the trapping area completely. For this reason the data in table 3b are not strictly comparable with those in table 3a.

No bird was definitely known to occupy the same territory for more than three successive years, though two females were caught on the same territory four years apart. In one of these instances the territory had been used by different birds in the interim, and in the other the occupant had not been caught in the interim.

The distances moved in relation to distances between territories are shown in figure 2. For many birds the shifts between years represented more than a movement to a neighboring territory. Most territories in the study area were less than 1 km from their nearest neighbor, but most Sparrowhawks moved more than 1 km – up to 8.5 km. Opportunity to record long movements was limited by the extent of the study area.

Without a good estimate of adult mortality we could not calculate what proportion of pairs could remain intact from year to year. From five territories in which both partners were caught in different years and in which the female was the same both times, the male was the same in two. And of seven females that moved, and whose mates were caught both times, each time the male was different in the second year. Hence most birds had a different mate each year, and the two which kept the same mate were also on the same territory.

Turnover in Occupants in Relation to Nest Success

We next considered whether, on any given territory, a change of occupants was more likely to follow an unsuccessful (failed) breeding attempt than a successful one (table 4a). Of 12 successful nestings the same male remained the following year in only three of the territories involved. Of eight failed nestings, the same male remained in two territories (no significant difference). Of 34 successful nestings, the next year the same female was present in 20 territories. Of 12 failed nestings, the same female was present in only one. The difference was statistically significant ($P = 0.0025$, Fisher's Exact Test) showing that successful breeding attempts were less often followed by a change of female than were failed ones.

This result could be due to either greater mortality or greater movements among failed than among successful breeders (table 4b). Too few males were caught for analysis. However, of 28 females that bred successfully, the next year 20 were on the same territory. Of four females that failed, only one stayed on the same territory. The difference suggests that failed breeders moved more often than successful ones, but statistical significance was lacking ($P = 0.106$, Fisher's Exact Test).

Discussion

Sparrowhawks nested most often in those territories where breeding attempts were most often successful. The implications were that (a) not all territories were of equal quality, i.e., not all offered the same chance of successful breeding; and (b) the birds reacted to these differences and more often used the "better" territories. It is possible that birds competed for territories and that the best birds got the best territories. The observed nest success would then result from a combination of territory quality and bird quality and would accentuate any difference that might have arisen from territory quality (habitat) alone.

On any one territory a change of female was more likely to occur after a breeding failure than after a success. This result could have arisen either (a) because a high turnover of occupants and poor success were correlated or (b) because of a behavioral response –individuals were more likely to shift after a failed attempt than after a successful one. From the data available we could not distinguish between these possibilities.

We know of no other published work on the replacement rate of marked raptors on particular nesting territories, but Hammerstrom (1969) discussed the homing of Marsh Hawks *Circus cyaneus* to her study area in Wisconsin. As in *Accipiter nisus*, successful birds more often returned than failed ones, and mate fidelity was rare. The only other work known to us which related the occupancy and success of nesting territories is that of Hagar (1969) on Peregrines *Falco peregrinus*. His results parallel ours, with greater occupancy on cliffs where success was greatest. In Peregrines territory quality was associated with features of the nesting cliff itself and the degree of security it offered. Several other authors have related nesting success to local food supplies (see Date 1961 and Picozzi and Weir 1974 for *Buteo buteo*).

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Table 1. Occupancy and success of 150 nesting territories.

	No. (%) occupied	No. (%) which produced young
1971	110 (73%)	67 (61%)
1972	105 (70%)	56 (53%)
1973	94 (63%)	46 (49%)
1974	97 (65%)	63 (65%)
1975	82 (55%)	49 (60%)

Table 2. Success of nesting territories in relation to frequency of occupation.

No. years occupied	Total attempts observed	Observed number successful	Expected number successful
1	26	10 (38%)	15
2	58	23 (40%)	33
3	60	28 (47%)	35
4	124	79 (64%)	71
5	220	141 (64%)	127

Table 3. Turnover and movements of breeding sparrowhawks.

(Data are presented in terms of "bird-years" or "territory years." Individual birds or territories may thus figure more than once.)

a. Trapping results from particular nesting territories at intervals of one, two, three, and four years.

	One year		Two years		Three years		Four years	
	Same Bird	Different Bird	Same Bird	Different Bird	Same Bird	Different Bird	Same Bird	Different Bird
Males (n=28)	5	15	1	4	0	3	0	0
Females (n=75)	21	25	2	14	1	5	1	6

b. Trapping results from particular birds at intervals of one, two, three, and four years.

	One year		Two years		Three years		Four years	
	Same territory	Different Territory	Same territory	Different Territory	Same territory	Different territory	Same territory	Different territory
Males (n=10)	5	0	1	2	0	2	0	0
Females (n=46)	21	11	2	7	1	1	2	1

Table 4. Turnover of birds in relation to breeding performance.

a. Trapping results from particular nesting territories at an interval of one year.

	Male in next year		Female in next year	
	Same bird	Different bird	Same bird	Different bird
Nest successful	3	9	20	14
Nest failed	2	6	1	11

b. Trapping results from particular birds at an interval of one year.

	Male in next year		Female in next year	
	Same territory	Different territory	Same territory	Different territory
Nest successful	3	0	20	8
Nest failed	2	0	1	3

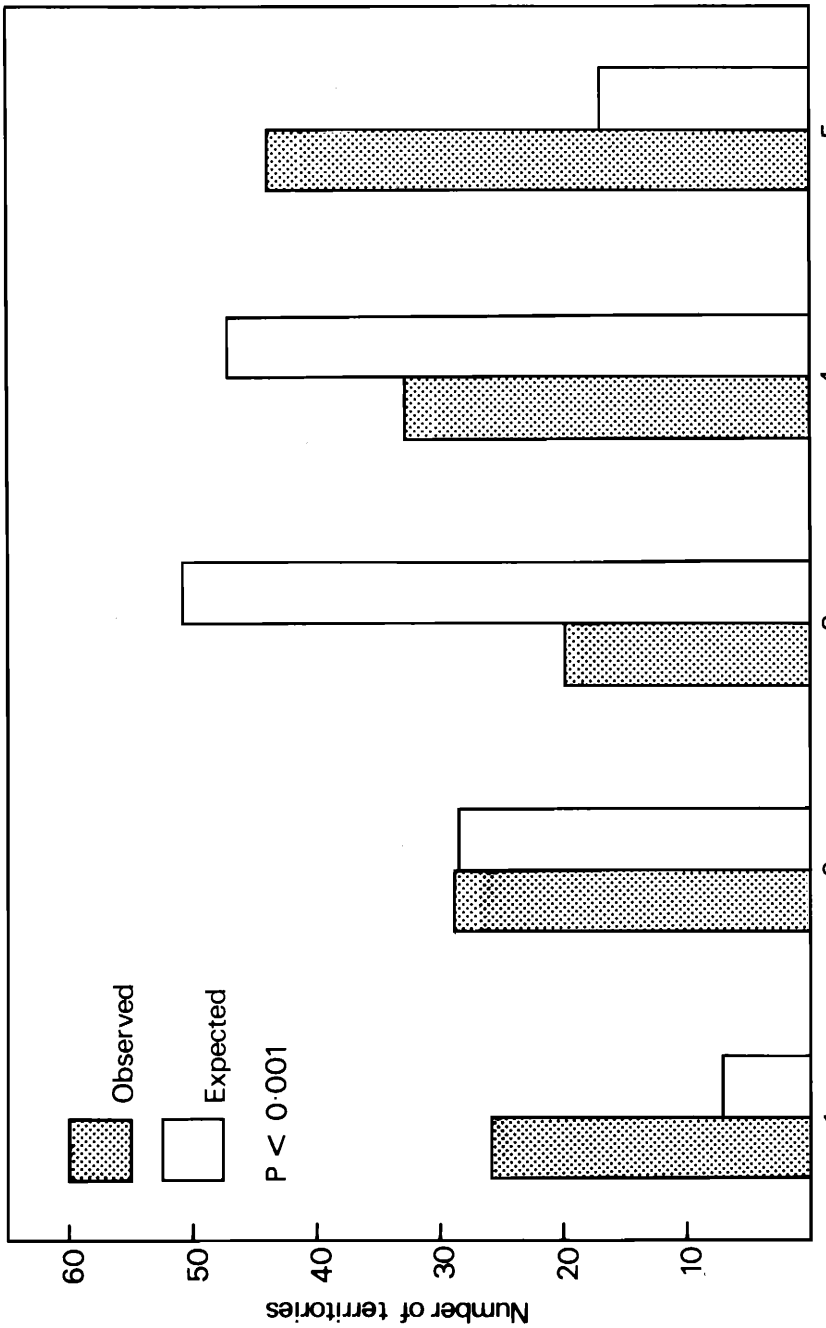

Figure 1. Observed and expected occupancy of Sparrowhawk nesting territories in a five-year period.

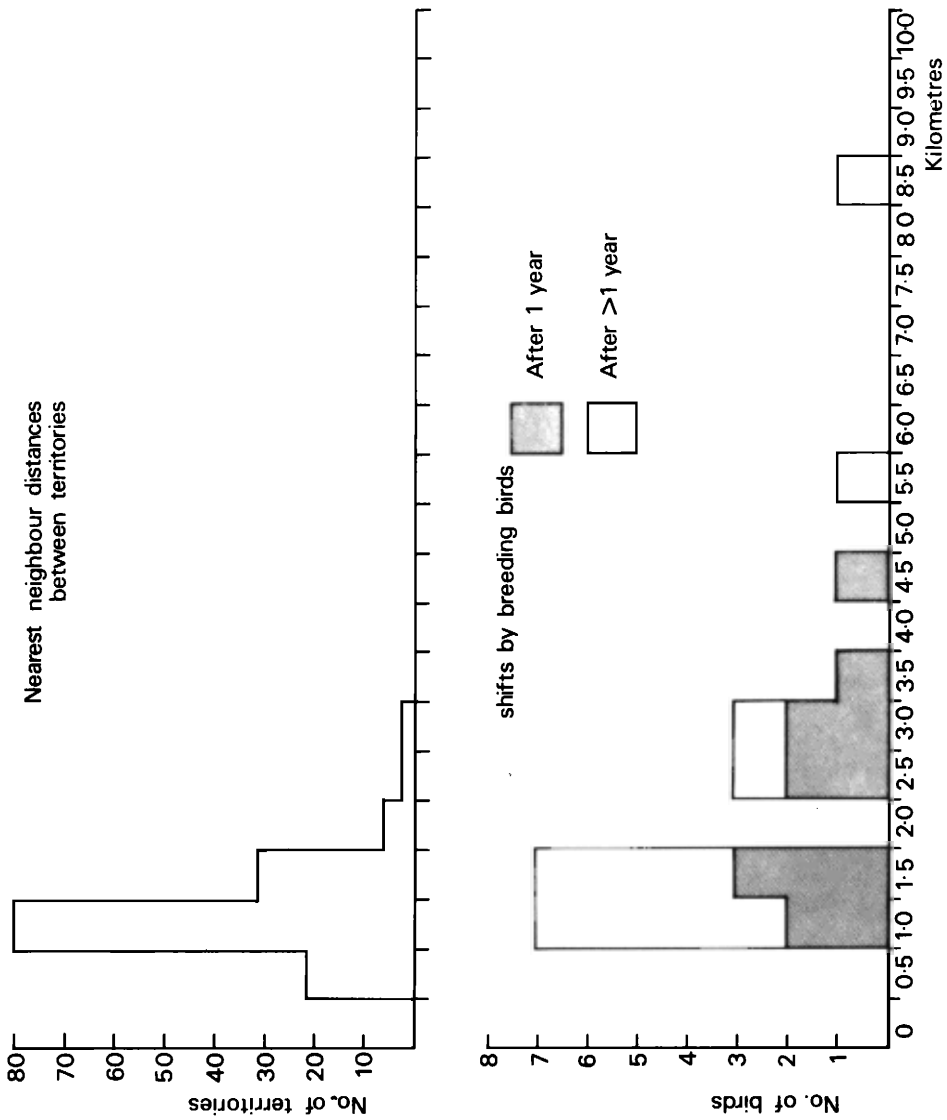

Figure 2. Movements made by breeding birds in successive years in relation to nearest neighbor distances between territories.