Breeding performance in a Danish suburban population of Sparrowhawks *Accipiter nisus*

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(Med et dansk resumé: Populationstæthed, æglægningstidspunkt og reproduktion i en dansk bynær Spurvehøge-bestand)

Introduction

The Sparrowhawk *Accipiter nisus* is one of several raptor species known to inhabit urban areas. First observations go back to the mid-thirties, when Schnurre (1937) found two pairs breeding in urban parks of Berlin. The same author observed a breeding attempt in the main cemetery of Frankfurt am Main in 1920 (Ortlieb 1981).

In recent years, mainly after 1980, records of Sparrowhawks breeding in towns and large cities of central Europe and the British Isles have increased (see Gedeon 1982, Jencins 1982, Storgård et al. 1983, Newton 1986, Olsen 1986).

Are the still expanding urban areas to be considered as a marginal habitat for the Sparrowhawk, and how well does the species manage in this new habitat, are questions that remain to be answered.

While much is known of the Sparrowhawk breeding habits under natural conditions (see Glutz et al. 1971, Newton 1986), detailed studies in urban environments are very scarce.

In a previous paper (Frimer 1989) the feeding habits of a suburban population of Sparrowhawks were examined. This study deals with the breeding performance of the same population in the suburbs of Århus, Denmark. The study area is described more detailed in Frimer (1989) and shown in Fig. 1 of the present paper. Half of the hawks studied bred inside the city boundary (the urban zone), the rest in the adjacent rural area (the rural zone). The main purpose is to present data on population density, time of laying and reproductive success, to compare data from these two areas and to discuss possible explanations of the recent colonization of urban environments.

For comparisons made later in this paper, it is necessary to know that Sparrowhawks use the same restricted nesting territory from year to year, but usually build a new nest each year near old ones. The territories are regularly spaced in large blocks of woodland as well as in narrow strips, limiting the number of Sparrowhawk breeding pairs in any given area (Newton et al. 1977). While breeding, the hawks begin their

Dansk Orn. Foren. Tidsskr. 83 (1989): 151-156

annual moult. Flight feathers shed by the female can be found on the ground near the nest, and these feathers can be used in individual recognition, as proposed by Opdam & Müskens (1976). After the first year of life, each individual shows a characteristic feather pattern, consistent from year to year. However, Sparrowhawks may start breeding in their first year of life, and these individuals cannot usually be recognized the following year because the first-year plumage differs in feather pattern from the adult plumage (see Opdam & Müskens 1976, Newton 1986). Therefore, when recording the number of breeding individuals in a territory over a period of years by comparing moulted feathers, only a minimum number of females can usually be given.

Materials and methods

The data were primarily collected during the seasons 1979-1980 and 1984-1987. Some data from 1981-1983 are included. In the study period, the annual number of Sparrowhawk breeding pairs was six to eight. In all, these pairs used nine different nesting territories. Non-nesting Sparrowhawks were not counted.

The woods shown in Fig. 1 were searched each year, checking for nests and other signs of Sparrowhawks (droppings, pluckings). The nesting sites were visited regularly (usually weekly) during the breeding season March to August, and pluckings and moulted feathers were collected.

At the age of 14-18 days, the young were ringed and counted, and survival to this age was regarded as successful fledging. Laying dates were estimated by backdating from age of oldest young.

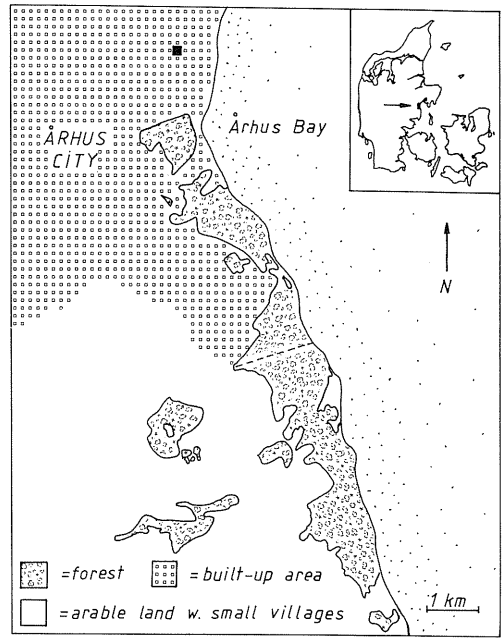

Fig. 1. Map of the study area of 58 km² covering the southern suburbs of Århus (254000 inhabitants in 1986) and the adjacent woodland. Forests cover 9.44 km². The northern third is park-like and engulfed in residential areas and gardens. About 80% of the forested area is deciduous; coniferous stands are regularly distributed. The recreational use of the woods is intense, and both woodland and arable land are intensively managed. Black square indicates city center. Dots indicate water. (----) city boundary.
Undersøgelsesområdet på 58 km² dækker det sydlige Århus med tilstødende skov og agerland. Skove dækker tilsammen 9,44 km²; den nordlige trediedel er parklignende og omsluttet af beboelse og haver. Ca 80% af skovarealet består af løvtræer, resten af spredte klynger af nåletræer. Skovene benyttes rekreativt, og både skove og agerland drives intensivt. Sort firkant angiver bycentrum, prikker vand. (----) bygrænse.

Results

Population size and reproduction 1979 - 1987

The annual number of breeding pairs was fairly stable throughout the study period (mean 7).

In all, 48 breeding attempts were recorded, of which 7 (15%) failed to produce young. Five of these failed in the years 1985-1987, coinciding with an increased intensity of forestry in the second half of the study period (more timber felling and cutting of low vegetation). The actual number of failed breeders may have been somewhat higher, however, because some pairs failing at an early stage may have been overlooked.

In Fig. 2 the mean number of young per nest built and per successful nest is shown in successive years during the study period. All years combined, the mean number of young per nest built was 2.9 ± 0.3 (SE); per successful nest it was 3.4 ± 0.2.

Comparison between urban and rural population

Population density

In the 3.40 km² of park-like woodland inside the city boundary (Fig. 1), 3-4 pairs bred annually, i. e. 0.9 ± 0.1 (SD) pairs per km² forest. Density in the 6.04 km² of rural woods was 0.6 ± 0.1. In each year the population density was higher in

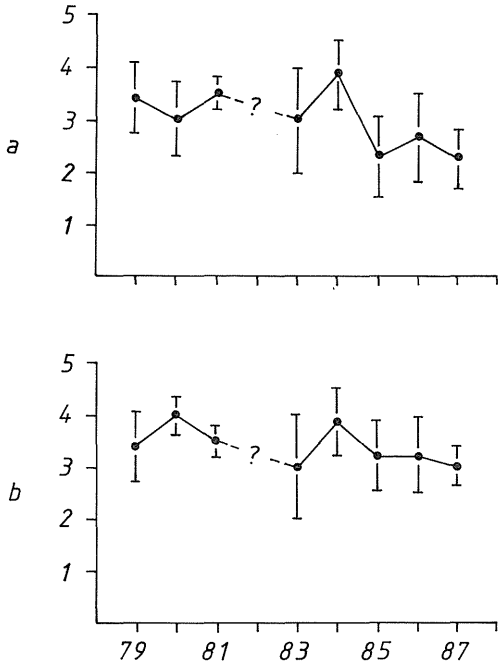

Fig. 2. Mean number of young (±SE) per nest built (a) and per successful nest (b) during the study period.
Gennemsnitlige antal unger (±SE) pr par (a) og pr par med unger (b) gennem undersøgelsesperioden.

the urban zone than in the rural zone. This can also be shown by measuring the nearest neighbour distance between nests in the two areas respectively, ignoring nests in the two smaller rural woods (Tab. 1). In all years the mean nearest neighbour distance was less in the urban zone than in the extensive coastal forest of the rural zone.

Time of laying

Fig. 3 shows (in five-day periods) laying dates for 40 nests.

The mean laying date (± SD), all years combined, was 28 April ± 9 days in the urban zone, and 6 May ± 6 days in the rural zone. (In one case a nest failed and a new clutch was started on 3 June; this date was excluded.) Comparing the mean laying dates of the two zones by means of a Student t-test, the difference is significant ($t=3.2$, $df=38$, $p<0.01$). In each year the mean laying was earlier in the urban zone than in the rural zone.

The mean laying date found in the rural zone is in good agreement with that of a study by Holstein (1950) in a rural habitat in Zealand, Denmark (4 May ± 6 days, $n=22$) ($t=1.1$, $df=42$, $p>0.2$). Even compared with Holstein's data, the urban zone Sparrowhawks laid early ($t=2.3$, $df=38$, $p<0.05$).

Reproductive success

On the average, the reproductive output in the two zones was similar during the study period (Tab. 2). In three years out of eight, the number of young per nest was higher in the urban zone than in the rural zone, while in two years it was highest in the rural zone. Per successful nest the number of young was highest in three out of eight years in both zones.

Number of female individuals in the sample

To examine whether differences in breeding performance between the two zones might have been biased by the performance of a few particular birds, the minimum number of individual females was determined by comparing moulted feathers collected in the respective nesting territories throughout the study period. Males shed their feathers over a wider area, and the number of feathers found were only rarely sufficient for individual recognition.

Combining all nesting territories a minimum of 31 (67%) different individuals were found among a total of 46 moulting females: 14 (67%) out of 21 in the urban zone, and 17 (68%) out of 25 in the rural zone. In any nesting territory a minimum of three different females were recognized during the study period, and except for one individual which may have bred in four successive years, none nested in more than three years in the territory.

Discussion

The overall mean number of young per successful nest in the study area is in agreement with that of other recent studies in Denmark (Bomholt & Nielsen 1987, Jørgensen 1987), the Netherlands/Germany (Opdam et al. 1987), GDR (Gedeon & Meyer 1986) and Scotland (Newton 1986). However, the mean number of young per nest built was higher in this study, due to a lower proportion of nest failures (15%) compared to the studies mentioned above (24-39%, 35%, 20-30%, 43% and 44%, respectively). This may indicate a comparatively greater abundance of prey in the study area (Newton 1976, Newton et al. 1977), as pointed out by Frimer (1989).

Tab. 1. Mean nearest-neighbour distance (d) between Sparrowhawk nests.
Gennemsnitlige afstand til nærmeste naborede (d).

year *år*	Urban zone *By-zonen* no. nests *antal reder*	d (km)	Rural zone *Land-zonen* no. nests *antal reder*	d (km)
1979	3	1.06	3	1.98
1980	3	1.03	3	1.93
1984	3	1.01	3	2.01
1985	3	1.81	2	2.03
1986	3	1.80	1	–
1987	4	1.80	2	2.01
All years *Alle år*	19	1.37 (SD = 0.6)	14	1.98 (SD = 0.1)

In the urban zone, the Sparrowhawk population density was higher and the mean laying date was earlier, compared to the rural zone. The differences were apparent each year, but this might be expected to some extent, if many of the same nesting territories and birds were involved in successive years. The consistent difference in population density from year to year may partly be due to the fact that the hawks only used nine different territories throughout the study period, but the high turnover of females in the nesting territories suggests that difference in laying dates mainly was due to environmental differences between the two habitats.

Higher Sparrowhawk population densities and earlier laying dates have been found to be correlated with higher prey densities in other areas (Newton 1976, Newton et al. 1977, Newton & Marquiss 1981), suggesting that prey density in the urban zone of this study was higher than in the rural zone.

Frimer (1989) has shown that Sparrowhawks breeding in the rural zone, to some extent, have been prevented from hunting in the bird-rich urban parks and gardens, presumably because these areas formed part of occupied territories of other pairs. This is partly confirmed by the significant difference in mean laying dates between the two zones, and by the fact that the mean laying date of the rural zone was similar to that of a rural habitat in Zealand. Sparrowhawks living in woodland adjacent to the residential area (i.e. in the rural zone) hence seem to live under "rural prey-conditions".

What have caused the recent Sparrowhawk colonization of urban areas recorded in several European countries? When explaining this question, the following points should be considered: a) After the population crash in the 1960s caused by widespread use of organochlorine compounds (see Newton & Haas 1984, Opdam et al. 1987), the population has recovered following legislative protection in the sixties (1967 in Denmark) and banning of organochlorine compounds in the late sixties and early seventies (1970 in Denmark). Recovery of the Danish population mainly occurred in the years 1973-1978 (Dyck et al. 1981, Bomholt & Nielsen 1987). Similar trends have been found elsewhere in Europe (see Newton 1986, Opdam et al. 1987). b) Suburban residential areas with parks and gardens have expanded since the 1960s (Owen & Owen 1975, and others) and gradually created a new habitat of high prey-bird density (see Strawinski 1966, Eggers 1975, Owen & Owen 1975, Møller 1976, Hansen 1978, Mulsow 1980, Bezzel 1985). c) Feeding of birds and other wild animals in parks and gardens during the winter time has become more popular. This may have increased the survival of prey birds to the benefit of the Sparrowhawks, especially in the early spring when the flocks of winter visitors disperse and Sparrowhawk prey become scarce. d) Increasing intensity of human utilization of the rural habitat has resulted in reduced diversity and abundance of Sparrowhawk prey (Bezzel 1985; see also Newton 1986). e) A behavioural change may have taken place in Sparrowhawks after the human attitude towards birds of prey became more tolerant (Newton 1986).

Whatever the cause of the colonization, the key factor in choice of nesting habitat is the food supply (Newton 1986). The breeding performance found in this study shows that urban and suburban environments may be good breeding habitats with plenty of prey. The hawks here bred in woods and parks, but also groves and small groups of trees in gardens and cemeteries have

Tab. 2. Mean number of young raised per nest built (a) and per successful nest (b) in the urban and in the rural zone, 1979-1987.
Gennemsnitlige antal unger pr par (a) og pr par med unger (b) i by-zonen og i land-zonen, 1979-1987.

	Uran zone *By-zonen*		Rural zone *Land-zonen*	
	a	b	a	b
1979	4.5	4.5	2.7	2.7
1980	1.3	4.0	4.0	4.0
1981	3.0	3.0	3.7	3.7
1982	?	?	?	?
1983	2.5	2.5	4.0	4.0
1984	4.0	4.0	3.8	3.8
1985	3.7	3.7	1.3	2.5
1986	2.0	3.0	3.3	3.3
1987	2.3	3.0	2.3	3.0
All years *Alle år*	2.8	3.5	3.0	3.4

frequently been recorded as nesting sites, even in areas with high intensity of recreational use (Newton 1986). In the future this ability to accept urban areas as breeding habitats may prove to be important to the Sparrowhawks in parts of Europe where man-made environments cover vast and increasing areas.

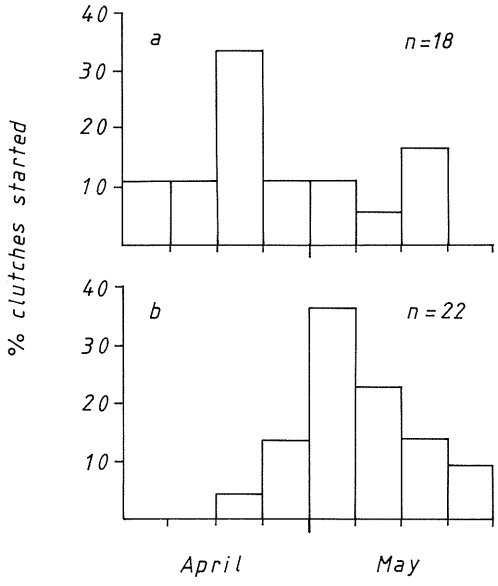

Fig. 3. Laying dates in five-day periods, 1979-1987. a: urban zone, b: rural zone.
Procent påbegyndte kuld i 5-dages perioder, 1979-1987. a: by-zonen, b: land-zonen.

Acknowledgments

I am grateful to Sussie M. Nielsen for help and company in the field; to Lars Abrahamsen and the late Flemming Kristensen for help in ringing Sparrowhawk nestlings; and to Birger Jensen, Museum of Natural History, Århus for permission to use the museum's skin collection and for valuable comments on a draft manuscript. I also wish to thank the forest supervisors Kjeld Ladefoged and P. Bruun Madsen for permission to work in the forests; Henning Noer and Volker Loeschcke for suggestions and for criticism of the manuscript; and Anne Castleman for correcting my use of the English language.

Resumé

Populationstæthed, æglingstidspunkt og reproduktion i en dansk bynær Spurvehøge-bestand

Efter Spurvehøgens indvandring til europæiske byer, som især har fundet sted i 80erne, melder spørgsmålene sig om hvorvidt denne habitat er at betragte som marginal-habitat for Spurvehøgen, og hvor god reproduktionen er i disse for arten nye yngle-omgivelser.

I en tidligere artikel (Frimer 1989) blev fødevalg og prædation for en bynær bestand af Spurvehøge behandlet. Denne artikel har til formål at præsentere yngledata for den samme bestand i et område ved Århus (Fig. 1), samt at sammenligne data for Spurvehøge, der yngler inden for bygrænsen (by-zonen), med høge, der yngler uden for denne grænse (land-zonen).

I undersøgelsesperioden 1979-1987 lå den årlige bestand i området stabilt omkring 7 par.

Ved bestigning af redetræerne blev ungerne talt, aldersbestemt og ringmærket. Æglægningsdatoer blev estimeret efter ældste unges alder.

Det gennemsnitlige antal unger pr par (Fig. 2) var forholdsvis højt i dette område sammenlignet med nyere danske og udenlandske studier. Dette skyldtes et lavere antal fejlslagne yngleforsøg (15%).

I by-zonen var populationstætheden højere (Tab. 1) og den gennemsnitlige æglægningsdato tidligere (Fig. 3) end i land-zonen. Dette gælder alle år i undersøgelsesperioden. Men medens den vedvarende forskel i populationstæthed kan have grund i det faktum, at Spurvehøgene kun benyttede ialt 9 forskellige territorier gennem hele undersøgelsesperioden, så synes den signifikante forskel i gennemsnitlig æglægningsdato at antyde habitat-forskelle mellem de 2 zoner.

Tidligere skotske undersøgelser har vist, at ynglesucces, populationstæthed og æglægningsdato er positivt korreleret med en højere byttetæthed.

Spurvehøgens yngledata fra området ved Århus viser, at bynære områder kan være gode ynglehabitater for arten, med tilstrækkeligt fødeudbud. (Se også Frimer 1989.)

Evnen til at tilpasse sig menneske-skabte omgivelser kan vise sig at være afgørende for artens fremtid i dele af Europa, hvor sådanne områder er i stadig vækst.

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Received 5 January 1989

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