The breeding success of the Jackdaw *Corvus monedula* in nesting cells

EERO ANTIKAINEN

ANTIKAINEN, E. 1980: *The breeding success of the Jackdaw* Corvus monedula *in nesting cells.* — Ornis Fennica 58:72—77.

The paper deals with the breeding success of the Jackdaw in man-made nesting cells in the attic of Laitila Church, SW Finland. The data for the years 1969 and 1971—74 are compared with the results obtained for three colonies in open church attics in SW Finland. The breeding success, 67.2 %, was much higher than in the colonies in open attics. This is attributed to territorial factors, competition for nest-sites, the intracolonial behaviour of the birds, and the protection provided by the nesting cells from cannibalism of the eggs and young.

Eero Antikainen, c/o Department of Zoology, University of Kuopio, SF-70100 Kuopio 10, Finland

Introduction

The social organization and colonial nesting habits of the Jackdaw have raised a number of theoretical questions. What, for example, is the effect on breeding success of the complex of factors including competition for nest sites, the structure of the nesting holes and the intracolonial behaviour of the species (Folk 1968, Tamm 1977, Röell 1978, Högstedt 1980)? Breeding success, in its turn, is known to be decisive for the maintenance of colonies and the survival of populations in passerines (e.g. Perrins 1965, O'Connor 1978).

The results of my previous study indicated that Jackdaws in Finland produce more fledglings in small colonies in churches (less than 15 pairs) and in small safe nesting holes than in larger church colonies (Antikainen 1978). This paper reports on the breeding success in man-made nesting cells, which provided improved protection during the critical incubation and nestling periods. Attention was also paid to the size and shape of the eggs, and the sizes of the clutches laid in these cells.

When the medieval church of Laitila was restored in 1967, the old Jackdaw nesting holes were closed up by the workers, and nesting cells were constructed in their place. This changed the size of the Jackdaw colony and also the nature of the nesting holes (cf. Antikainen 1968, 1974a). The nesting data obtained at Laitila could be compared with records from open attics in other medieval churches in SW Finland (Antikainen 1978).

Material

The material was obtained from the nesting cells in the attic of Laitila Church (60°53'N, 21°41'E) in the years 1969 and 1971—74. The church is made of stone and brick. Six wooden cells were constructed in the gable corners of the church (sites illustrated in Antikainen 1978: Fig. 4). The entrance, 8×6 cm in diameter, afforded the only access to the cell, and the Jackdaws were not able to nest in the open

attic. The cells were furnished with small doors at the back for nest inspection. The approximate volume of the cells varied from 19 to 47 dm^3.

The results are compared with data from my earlier paper (Antikainen 1978) on (1) the open-attic colonies in the churches of Mynämäki (60°19′N, 21°59′E, large colony), Rusko (60°32′N, 22°19′E, small colony) and Lohja (60°14′N, 24°09′E, small colony), (2) the total population of SW Finland in the years 1971—74 and (3) the total SW population in 1966—69 (see Antikainen 1978:2).

For the determination of the clutch size and egg parameters, see Antikainen (1978:3—4 and 26—27).

Results

The average date on which the first egg was laid during the five study years was 26 April (Fig. 1). This is the same as the average date for the total SW population in the same years (see Antikainen 1978:28).

The mean clutch size in 1971—74 did not differ between the nesting cells and the total SW population (Table 1). The distribution within the observed range from 3 to 7 in the two sets of data was also similar (Spearman's rank correlation coefficient $R_S = 0.90$). Nor did the clutch size in the nesting cells differ from that in the open-attic colonies (Mynämäki 4.43 ± 0.12, $N = 84$, Rusko 4.56±0.20, $N = 18$ and Lohja 4.00±0.49, $N = 5$; Table 2) or in the SW population in 1966—69 (4.79±0.09, $N = 167$, Antikainen 1978: 17).

However, there was a striking difference in the breeding success between the two materials: in the nesting cells the losses of eggs and/or young were very low, averaging only 1.61±0.12 eggs or young per clutch. Thus each of the 18 nests produced an average of 3.30 fledglings, the breeding success being as high as 67 %. This differs significantly ($P<0.001$) from the result obtained for the total SW population

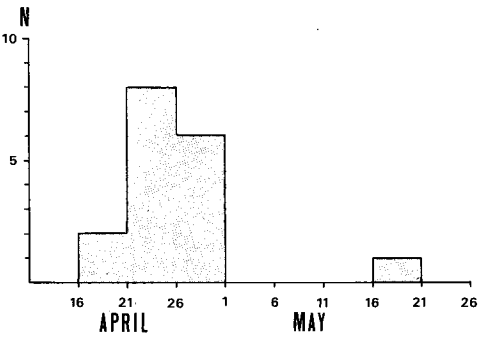

FIG. 1. Commencement of egg laying of the Jackdaw in the nesting cells in Laitila Church, SW Finland (years 1969 and 1973—74, 17 nests).

(1.94 fledglings, i.e. 39 %, Antikainen 1978:30). The breeding success was also superior to that in the open church attics; the difference from the large open colony was statistically highly significant (Table 2; breeding success in Mynämäki 2.09±0.12, i.e. 47 %), that from the small colonies was also significant (Rusko 1.60±0.38, 35 % and Lohja 1.80±0.52, 45 %).

No differences in egg size parameters were observed between the two types of nesting colonies (Table 3).

Discussion

The functions of territory in birds are twofold: (1) The territory results in attachment to a site, and (2) in relationships (often hostile) with other members of the same species (cf. Tinbergen 1957, Röell 1978).

The territory proper of Jackdaws in the church colonies comprises the nest and its base, the nest passage, the entrance and the sitting space in front of it, i.e. the nest hole and its immediate vicinity (Lockie 1955, 1956, Glutz von Blotzheim 1962, Antikainen 1978). In large attics the territory usually opens

TABLE 1. Clutch size of the Jackdaw in nesting cells in Laitila Church compared with data from open-attic nests in the total SW population in 1972—74 (Antikainen 1978).

	Clutch size						
	3	4	5	6	7	Mean ± *SE*	*N*
Nesting cells							
No. of clutches	1	6	11	4	1	4.91 ± 0.18	23
%	4.3	26.1	47.8	17.4	4.3		
Open attics							
No. of clutches	10	21	42	18	5	4.86 ± 0.10	96
%	10.4	21.9	43.8	18.8	5.2		

towards the vaulting (see Antikainen 1978:6). The provision of separate nesting cells for the birds had the following consequences: (1) the entrance, which closely fitted the size of the bird (one entrance/nest), was easier to defend; (2) the length of the nest passage was reduced; (3) the nesting cell was darker than an open nesting space; (4) no outer rim was needed in the nests (see Antikainen 1978:8); (5) disturbance and cannibalism by neighbours in the attic was eliminated; (6) the nestlings could not get lost in the open attic; (7) the disturbance caused by the investigator during the nest checks was minimized (cf. Gillet et al. 1975).

In the church colonies the nesting density of the Jackdaw is limited by the number of available holes (see Borczynski & Sokołowski 1953, Folk 1968, Antikainen 1968, Röell 1978). In Laitila Church, with a population of about 12—16 pairs in 1965—66, the restoration work reduced the number of nest-sites. Hence competition for nesting holes became more severe (Antikainen 1968), especially since the new nesting cells were constructed on the sites most favoured by the Jackdaws (Antikainen 1978:6). These cells were probably occupied by the strongest pairs (not breeding for the first time). In general, Jackdaws with eggs or young are prone to reproductive fighting and supplant non-nesting individuals (Brown 1963, Tamm 1977, cf. Lorenz 1931, 1938, Lockie 1956).

Jackdaw nestlings start moving around at the age of about 24 days, and

TABLE 2. Results of *t*-tests applied in comparisons of the clutch size and breeding success of the Jackdaw between the study colony in nesting cells (Laitila) and three open-attic colonies in SW Finland in 1969 and 1971—74. Primary data for tests in text.

	Clutch size			Breeding success		
	df	*t*	*P*	*df*	*t*	*P*
Large, open colony (Mynämäki)	107	1.98	0.1	100	4.24	0.001
Small, open colony (Rusko)	39	1.13	0.1	21	3.26	0.01
Small, open colony (Lohja)	26	4.97	0.05	21	3.25	0.01

TABLE 3. Egg parameters of the Jackdaw clutches in nesting cells (Laitila) in 1969 and 1973—74 compared with the data from the total SW population (Antikainen 1978).

	Egg length ±*SD* (mm)	Egg breadth ±*SD* (mm)	Egg shape index ±*SD*	Egg volume ±*SD* (cm^3)	No. of eggs
Study colony	34.33 ±1.93	24.53 ±0.54	139.95 ±7.65	9.57 ±0.75	25
Antikainen (1978)	34.10 ±1.53	24.47 ±0.76	139.44 ±6.04	9.84 ±0.86	682

in open attics they may get lost and die (Antikainen 1978, Röell 1978). These losses are eliminated in nesting cells which, being sheltered on all sides, are comparable in safety to tree holes and nesting boxes. In addition, in the cells the pairs only have to defend the nest entrance, and owing to the lack of the outer nest rim, the food is probably divided more evenly among the young. The material and structure of the nests in the nesting cells were the same as in open nests in attics (Antikainen 1974b, 1978), and the nest cup index, i.e. inner diameter × 100/depth (236—300 cm, mean 267±22.0 cm, $N = 6$), was almost the same as in Kulczycki's (1973) data from Poland.

The above circumstances explain why the breeding success in the nesting cells is higher than in open attics. The value, 67 %, is typical of hole-nesters (Kluyver 1951, Perrins 1965). Lockie (1955) in England and Ejgelis (1958) in the Ukrainian SSR have reported values ranging from 55 to 70 % for Jackdaws in tree holes and nest boxes. In my earlier paper the corresponding value was 59 % (Antikainen 1978, cf. Zimmermann 1951, Folk 1968).

The Jackdaw colonies studied here are situated within a rather limited area in SW Finland, and their overall genetic structure seems to be uniform (Voipio 1969). Both clutch size and egg size are hereditary characteristics, which have normal variability, being influenced to some extent by the environmental conditions (e.g. Cody 1966, Klomp 1970, Väisänen et al. 1972). Their variation is consequently small in the Jackdaw populations studied in SW Finland (Antikainen 1978:23, cf. Ryder 1976), and is unlikely to be responsible for the superior breeding success in the nesting cells.

K. Hildén (1914) observed many years ago that the clutch or brood size of the Jackdaw is lower in large than in small church colonies, which suggests that density is a factor regulating the populations in open attics. This effect may have been eliminated by the provision of safe nesting cells. This appeared to be the case in Cracow in 1980, where I observed that open church attics were generally not inhabited by Jackdaws. The same is true of the open bird room (6.2×5.8 m fitted with shelves) built specifically for Jackdaws at Lohja Church.

Acknowledgements. I wish to express my sincere thanks to Ossi V. Lindqvist, Assoc. Prof., University of Kuopio, and Prof. Erkki Haukioja, University of Turku, for their valuable guidance and suggestions. I am also grateful to Dr. Habil. Doc. Zbigniew Głowacinski, Polska Akademia Nauk, Cracow, to Dr. Tomasz Wesołowski, University of Wrocław, and to Dr. Olavi Hildén, University of Helsinki, for helpful criticism, and to my wife, Mrs. Ritva Antikainen, M.A., for assistance with the English language.

Selostus: Naakan pesimätulos pesäkopeissa

Restauroinnin yhteydessä 1967 rakennettiin Laitilan kirkon ullakolle naakkoja varten erityiset pesäkopit päätyseinien, katon ja räystäiden muodostamiin lokeroihin. Kopit, joiden tilavuus oli 19—47 dm^3, varustettiin 8×6 cm:n lentoaukoilla ja pesähavaintojen tekoa varten avattavilla luukuilla. Naakat pääsivät siis pesäkoppeihin vain ulkoapäin. Muualla avoimen ullakon tiloissa pesiminen ei ollut mahdollista. Näistä kopeista vuosina 1969 ja 1971—74 kertynyttä aineistoa verrataan Mynämäen, Ruskon ja Lohjan kirkkokolonioista lähes vastaavilta vuosilta tallennettuihin tietoihin ja kirjoittajan aikaisempiin Lounais-Suomesta kokoamiin tuloksiin (Antikainen 1978).

Ensimmäinen muna ilmaantui tutkimusvuosina pesäkoppeihin keskimäärin 26.4. eli samana päivänä kuin vastaavina vuosina muualla Lounais-Suomessa (kuva 1). Keskimääräisessä pesyekoossa (4.91 ± 0.18, $N = 23$) ei ollut eroa koko Lounais-Suomen aineistoon ja samoin pesyekoon jakautuminen oli yhdenmukainen sen kanssa ($R_s = 0.90$, taul. 1). Myöskään yllämainittuihin vertailukolonioihin ei ilmennyt tilastollisia eroja pesyekoossa (taul. 2) eivätkä munamitat poikenneet merkitsevästi Lounais-Suomen vertailuaineistosta (taul. 3). Sen sijaan kokonaistappiot, 1.61 ± 0.22/pesye eli 32.8 %, jäävät pesäkopeissa selvästi pienemmiksi kuin avoimien ullakoiden pesissä (esim. Mynämäki, taul. 2). Lentoon lähti 3.30 poikasta/pesye eli 67.2 % ($N = 18$). Tulos on kolopesijöiden luokkaa.

Pesinnän käynnistymisessä, pesyekoossa ja munamitoissa ilmenevien yhdensuuntaisuuksien katsotaan johtuvan Lounais-Suomen naakkapopulaatioiden suhteellisen homogeenisestä perintöaineksesta ja samankaltaisista ympäristötekijöistä. Pesimätuloksen erittäin merkitsevään eroon pesäkoppien ja avoullakoiden välillä vaikuttanevat pesäkoppirakennelmista johtuva pesien häirinnän ja kannibalismin puuttuminen, poikasten ullakolle eksymisen estyminen ja voimistunut, hierarkiassa ylinnä oleviin yksilöiden suosintaan johtanut kilpailu pesäkoloista.

References

ANTIKAINEN, E. O. 1968: Naakan suosittuudesta kirkoissamme. — Suomen Luonto 27:115—119.

ANTIKAINEN, E. O. 1974a: Some aspects of the nesting habits of the Ferald Pigeon Columba livia domestica. — Ornis Fennica 51:122—125.

ANTIKAINEN, E. O. 1974b: Naakan pesämitoista eri pesäpaikkatyypeissä. — Savon Luonto 2:20—22.

ANTIKAINEN, E. O. 1978: The breeding adaption of the Jackdaw Corvus monedula L. in Finland. — Savonia 2:1—45.

BORCZYNSKI, I. & J. SOKOŁOWSKI, 1953: Influence of nesting boxes on the distribution of some forest birds (in Polish with English summary). — Ochrony Przyrody R XXI:1—32.

BROWN, J. L. 1963: Aggressiveness, dominance and social organization in the Steller's Jay. — Condor 65:126—153.

CODY, M. L. 1966: A general theory of clutch size. — Evolution 2:174—184.

EJGELIS, J. K. 1958: The biology of breeding of the Jackdaw Coleus monedula L. in the oak forest "The wood on Worskla" (in Russian with English summary). — Vestnik Leningrad. Univ. 15, Biol. 3:93—101.

FOLK, C. 1968: Das Nisten und die Populationdynamik der Dohle Corvus monedula in der CSSR. — Zool. Listy 17:221—236.

GILLET, W. H., J. L. HAYWARD & J. F. STOUT, 1975: Effect of human activity on egg and chick mortality in a Glaucous-winged Gull colony. — Condor 77:492—495.

GLUTZ VON BLOTZHEIM, A. 1962: Die Brutvogelfauna der Schweitz. — Aarau.

HILDÉN, K. 1914: Några bidrag till kännedomen om kajans häckningsförhållanden och födoämnen. — Fauna och Flora 1914: 84—88.

HÖGSTEDT, G. 1980: Prediction and test of the effects of interspecific competition. — Nature 283:64—66.

KLOMP, H. 1970: The determination of the clutch size in birds. — Ardea 58:1—124.

KLUYVER, H. N. 1951: The population ecology of the Great Tit, Parus major L. — Ardea 39:1—135.

KULCZYCKI, A. 1973: Nesting of the members of Corvidae in Poland. — Acta Zool. Cracow. 18, 17:583—666.

LOCKIE, J. D. 1955: The breeding and feeding of Jackdaws and Rooks with notes on Carrion Crows and other Corvidae. — Ibis 97:341—367.

LOCKIE, J. D. 1956: The food and feeding behaviour of the Jackdaw, Rook and Carrion Crow. — J. Anim. Ecol. 25:421—428.

LORENZ, K. 1931: Beitrage zur Ethologie sozialer Corviden. — J. Ornithol. 79:122—127.

LORENZ, K. 1938: A contribution to the comparative sociology of colonial-nesting birds. — Proc. VIII Int. Ornithol. Congr. pp. 207—218.

O'Connor, R. 1978: Growth strategies in nestling passerines. — Living Bird 16:209, 238.

Perrins, C. M. 1965: Population fluctuations and clutch size in the Great Tit, Parus major L. — J. Anim. Ecol. 34:601—647.

Ryder, J. P. 1976: Egg laying, egg size and success in relation to immature — mature plumage of Ring-Billed Gulls. — Wilson Bull. 87:534—542.

Röell, A. 1978: Social behaviour of the Jackdaw, Corvus monedula, in relation to its niche. — Behaviour 64, (1—2): 1—122.

Tamm, S. 1977: Social dominance in captive Jackdaws Corvus monedula. — Behavioural Processess 2 (1977): 293—299.

Tinbergen, N. 1957: The functions of territory. — Bird Study 14:14—27.

Voipio, P. 1969: Geographical variation in Corvus monedula in Finland. — Ardea 57: 48—63.

Väisänen, R. A., O. Hildén, M. Soikkeli & S. Vuolanto 1972: Egg dimension variation in five wader species: the role of heredity. — Ornis Fennica 49:25—44.

Yom-Tov, Y. 1974: The effect of food and predation on breeding density and success, clutch size and laying date of the Crow Corvus corone L. — J. Anim. Ecol. 43: 479—498.

Zimmermann, D. 1251: Zur Brutbiologie der Dohle, Coleus monedula L. — Ornithol. Beob. 73—111.

Received January 1981, revised April 1981