

Seasonal variations in numbers and levels of activity in a communal roost of Choughs *Pyrrhocorax pyrrhocorax* in central Spain

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Abstract — This paper presents an analysis of number and activity rates throughout year in a large communal roost of Choughs *Pyrrhocorax pyrrhocorax* in Central Spain. Number of Choughs attending the roost varied along the year, the greatest gatherings occurring during the winter. In the breeding season the roost is occupied mostly by non-breeding Choughs staying a short time in pre-roosting activities. Communal roosting in the area is interpreted as a behaviour related with socially organised foraging. After comparing variations among roosting numbers, activity patterns and duration of the roosting activities in the different periods of the year, we suggest that communal roosting may serve to facilitate mating.

Introduction

The existence of large communal roosts is a fact common to all populations across the Chough's range, provided there are individuals in sufficient number (Lovari 1978 Roberts 1985, Farinha 1988, this study). Communal roosting sites have been highlighted for their biological importance as social and information centres from where the daily activities are organized (Still *et al.* 1987, Bignal *et al.* 1989). Understanding the function and variation of communal roost is essential for interpretation of the importance of this behaviour on the structure and regulation of populations. This point is especially important for the Chough which is a rare European bird requiring specific management in most parts of its range (Bignal and Curtis 1989). Detailed information on communal roosting is very scant (Still *et al.* 1987) and we know of no analysis of numbers and activity in large roosts of Choughs throughout the year. This paper presents such an analysis in one of the main Chough roosts in southeastern Madrid, Central Spain.

Study area and methods

The Chough population in southeastern Madrid is composed of 1000-1100 individuals distributed across a wide area devoted to cereal, vine and olive cultivation. Caves, crevices and recesses in gypsum and clay river cliffs are used by Chough for nesting and roosting. A detailed description of the area and

more information on the Chough population is given in Blanco *et al.* (1991). The roost is located in a sheltered, roofed vertical crevice formed by water erosion, and it is 4.3 Km from the nearest other communal roost of Choughs.

During each month in 1990, 4 to 6 (mean 4.7) censuses were made by observing the movements of Choughs from the pre-roost gathering sites. Counts were made from vantage points, the location of which changed in relation to changes in the areas selected by Choughs for feeding at different times of the year.

During the breeding period (16 March to 15 June) the start of activity in the roost was determined by recording the time when there were more than 10 individuals present, in order to avoid confusion with the activity of those birds breeding at the roosting site (5 pairs). In the non-breeding season the roosting activity was defined to have started by observing the behaviour of the birds in the roost area. At this time the presence of Choughs either entering into the cavity, making flights or simply perching on the cliff was considered signs of roost-linked behaviour. In most cases, the start of activity was instigated by the arrival in the roost area of a flock of variable size, the Choughs then returning in either a gradual or "burst" manner, depending on the time of year and weather conditions (Blanco *et al.*, in press). On a few occasions an already established roosting group left the site and then returned. We did not rerecord the roosting activity of these birds if the time elapsed before they returned was less than 5 min. The end of activity was defined as the time of arrival to the roost of the last Chough (normally pairs or solitary

birds). On the only occasion when the roosting group returned in a single flock, we considered the time when the last Chough entered the crevice as the end of activity. Two types of sites of origin of returning flocks were considered, namely the main feeding site and other areas.

The treatment of the seasonal changes of the different parameters was made on a monthly basis, and also by grouping the data into four periods that allow a more realistic interpretation of the data (Macdonald and Whelan 1986), namely: (A) winter period (16 November to 14 February), (B) just before breeding: nuptial undulating flights, nest building and nest occupation (15 February to 15 March), (C) breeding (16 March to 15 June), and (D) offspring independence and moult (16 June to 15 November).

Results

Size and origin of the roosting group

The changes in the size of the group attending the roost are highly significant across months (Kruskal-Wallis one-way ANOVA, $H=49.7$, 11 d.f., $p<0.001$; Fig. 1a), as well as across periods ($H=46.9$, 3 d.f., $p<0.001$; Fig. 1b). Chough numbers varied between 52 (April minimum) and 281 (January maximum). The largest roost gatherings occur in winter, the numbers dramatically decreasing across the prebreeding months. The lowest numbers are reached in the breeding season. The end of the breeding season marks the start of a slow but steady increase in Chough numbers in the roost. Two other communal roosts in the area, which have been surveyed less intensively, show a similar dynamics, with maximum numbers of 367 and 205 Choughs in December and January respectively. These roosts are separated 1.5

Km distant from each other and are mostly used by birds feeding in different areas (as demonstrated by records of colour-ringed birds).

In any particular day almost 95% of Choughs belonging to the roosting group attended the same feeding site, with little seasonal variation (89.4-95.6%, $n=28$). The percentage regularly feeding in that zone which continued flight to other roosting sites ranged from zero to 21.9%, with the highest values in December.

Activity time at the roost

The period of activity usually starts 30 to 45 min before sunset, although it can be considerably earlier on days with bad weather conditions (Blanco *et al. in press*).

Seasonal changes in the duration of the period of activity are highly significant among both months and periods ($H=32.0$, 11 d.f., $p<0.001$ and $H=18.1$, 3 d.f., $p<0.001$, respectively; Fig. 2). Mean across-year duration was 51.5 ± 26 min; range 17-134 min, $n=52$ (four censuses days excluded by the impossibility of determinate the time of activity). Earlier arrivals and increases in activity under twilight conditions are responsible for the significantly higher values in March. On all censusing days in this month, weather conditions were mild. There is a sharp decrease of activity time in the first week of April of nearly one hour compared with the average activity times in March. If the 1 st day April is included, the difference amounts to 96 min. There are no significant differences between mean values at any other time of the year.

The increase in the duration of the activity period in prebreeding time is directly related to an increase of social activity in the roost. Fighting, contests and display flights, as well as a complex array of calls, involving a sizeable fraction of the roosting group,

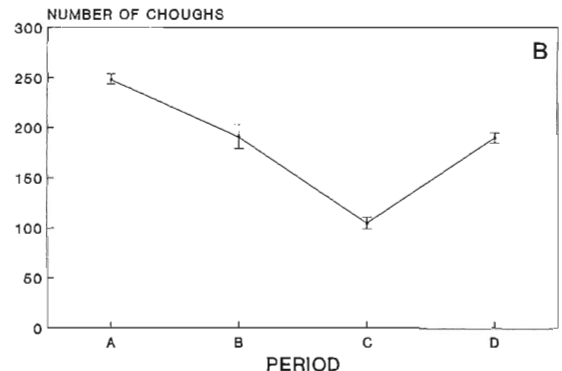
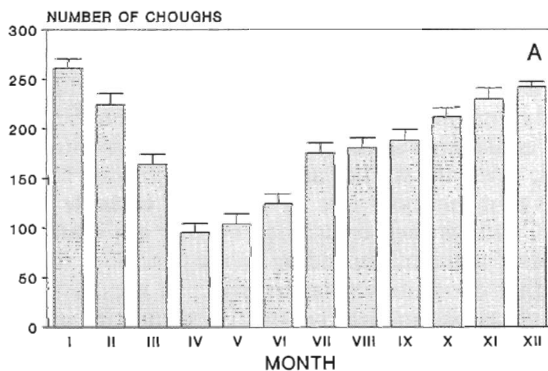


Figure 1 - Seasonal variation according to a) months and b) period (see methods) in the mean number (\pm SE) of Choughs attending the roost.

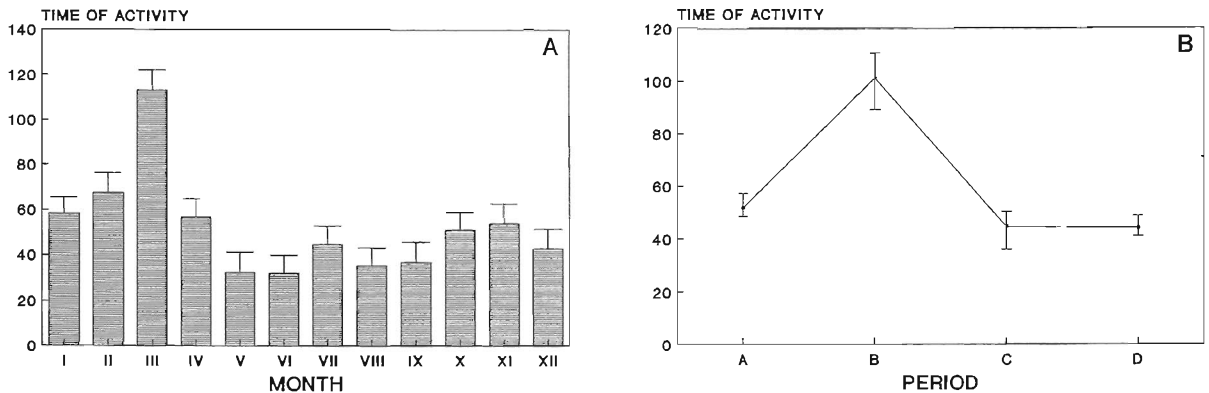


Figure 2 - Seasonal variation according to a) months and b) period (see methods) in the mean time (minutes) of activity (\pm SE) of a communal Chough roosting group in Central Spain.

are the rule in this period. These activities often continue after total darkness, but it is only during this prebreeding time that Chough activity continue after the last individuals have arrived. During the rest of the year, pre-roosting activity was normally confined to preening, allopreening and bill-wiping. There exists a highly significant negative relationship between the duration of the activity period and the number of birds attending the roost in January to March (Spearman's rank correlation, $r_s = -0.84$, $p < 0.002$, $n = 14$).

Discussion

Communal roosting in social foraging birds has been frequently interpreted as an adaptative behaviour related to the better localization and exploitation of food resources (Ward and Zahavi 1973, Weatherhead 1983, Rabenold 1987). In Spain Choughs are gregarious birds throughout the year, but especially so during the winter months (Soler 1987; pers. obs). Although Choughs form pre-roost gatherings, average size of roosting flocks seems to vary in parallel to the size of feeding flocks (Lovari 1978; authors' data, in Blanco *et al.* in press). The size of the roosting group was highest during the winter, hence it could be argued that it is the need for socially organised foraging that is stimulating the formation of large winter roosting flocks. In the study area, Choughs feed on olives all the year round with a major peak in winter (Blanco *et al.* in press); predictability, quality and dispersion of this food resource fit well to premises that may influence large group size in birds (Pulliam and Caraco 1984). The size of the roosting group decreases in the prebreeding season as a consequence of the dispersion of breeding pairs (Bignal *et al.* 1988, Farinha 1988). Nevertheless, some pairs stay in their home range all year as occurs elsewhere (Bignal *et*

al. 1989, Tella and Torre 1993). Numbers remain roughly constant across April and May because flocks are then composed mostly by cohesive, large groups of nonbreeding birds (Lovari 1978, Bignal *et al.* 1988, Blanco *et al.* 1991). A slight increase is seen from June onwards that seems to be caused by recruitment of unsuccessful breeding birds. The increase is more patent in July due to the arrival of family groups from nearby areas. Afterwards, numbers remain constant until October, when a further increase related with the incorporation of birds nesting in more distant areas is observed (Bignal *et al.* 1989, Monaghan 1989).

Due to its mainly rocky roosting habits and the lack of suitable buildings (Tella *et al.*, in press) Choughs are dependent on the existence of inaccessible cliffs on which to spend the night (Lovari 1978). In the study area this limits the birds to the cliffs along the river courses. The bulk of the roosting group forage together over a wide main area. Choughs that fly to other roosting sites are regarded as birds which are changing roost site (Ward and Zahavi 1973, Caccamise and Morrison 1986) in response to the large distances involved between feeding areas. Dispersion of feeding flocks and changes of roosting sites in response to food availability and other factors have also been observed elsewhere (Bignal *et al.* 1989, Monaghan 1989). Furthermore, the preferred use of particular roosts forces Choughs to cover long distances (>30 Km per one-way flight) from the feeding areas (see also Zuñiga 1989). While this may be costly on energy grounds, these costs might theoretically be compensated by the benefits of flock feeding and roosting. The high constancy in use of the same roosting site (for at least the last fifty years), demonstrates the over-riding importance of the choice of safe roosting site in this species and highlights the importance of roost-site protection in management programs for Choughs.

Roosting sites could also serve as a meeting point

facilitating pairing (Coombs 1961, Gaston 1978, Still et al 1987). The increase in the duration of the period of activity is related to a decrease in the size of the roosting group, beginning in January and lasting till the first week of April. Chough communal roosts are mostly formed by sub-adult and pre-breeding age birds, which do not reproduce until their third or fourth year of life (Bullock et al 1983, Roberts 1985, authors unpublished), and therefore it is probable that a variable number of birds will reach sexually maturity and attempt to breed each year. As a result the activities associated with searching for a mate would increase as breeding time approaches, and this could produce the observed increase in social activity and time spent in the roosting site. The timing of dispersion of the breeding pairs from January onwards could be related to the distance to their breeding sites, and the mating dates. This activity could perhaps serve as a signal for the still unmated Choughs. It is remarkable that the duration of the activity period sharply decreases from the first week of April, this being coincident with the start of egg laying by most pairs (authors' unpublished data). This suggests that the activity of mate-searching decreases or totally ceases after this time and this could either be because of the low prospects of successful breeding, or because all birds with breeding status have mated and dispersed.

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Riassunto — Sono stati analizzati, per un intero ciclo annuale, consistenza numerica e tassi di attività in un dormitorio di Gracchio Corallino della Spagna centrale. Il periodo di maggior affollamento è l'inverno. Nella stagione riproduttiva il dormitorio è occupato principalmente da Gracchi Corallini non riproduttori, che sostano per breve tempo in attività pre-riposo notturno. Questi posatoi comuni sembrano essere legati alla ricerca sociale del cibo. Dopo avere comparato le differenze di numero, attività e durata nei diversi periodi dell'anno, si deduce che le attività nel "communal roosting" possono essere considerate facilitatori sociali dell'accoppiamento.

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