

Year-round used large communal roosts of Black-billed Magpie *Pica pica* in an urban habitat

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Abstract – Five roosts of Eurasian Magpie *Pica pica* have been studied in Siracusa city (Sicily, Italy). One of the roosts was monitored periodically, for a total of 34 visits. All these communal roost was used all year round, although the highest densities were detected during the non-breeding season. The following environmental characteristics of the wooded areas used as night roosts were registered: the location and the extent and composition of vegetation. Roosts features suggest an active preference for areas with a favourable microclimate during the cold season; Black-billed Magpies avoided north exposed areas as well as deciduous trees; on the other hand they selected safe areas (i.e. with scarce or no human presence). Significant correlations have been found between the mean daily temperatures and roost arrival time. In particular, roost arrival times are delayed during the coldest days, likely due to extended feeding activities. Significant correlations have also been found between the number of birds in the roosts and day length, temperature and wind speed. The data suggest that night roosting aggregations are influenced by environmental variables; long, cold and windy nights induce the birds flocking together, possibly also to reduce individual predation risk. At the same time, roosting behaviour could be advantageous at an individual level because these aggregations enable intraspecific interactions.

Key-words: Magpie, social behaviour, roost selection, thermal influence, urban habitat, Sicily.

INTRODUCTION

The Magpie *Pica pica* is a sedentary species distributed in Palearctic and Nearctic region, in natural, rural, urban and suburban habitats. Magpie breeding biology has been widely studied, but other aspects of its behaviour, like communal roosting, are poorly known. A large part of the ornithological literature deals with roosting behaviour in many bird species, and there are several hypothesis on the advantages provided by nocturnal aggregations. Coombs (1978) reported the presence of magpies forming winter roosts, mixed with other species of corvids, without specifying the size. Moreover, large roosts of more than 100 individuals have been reported in England (Birkhead 1991, Self 2014), Sweden (Gyllin & Kallander 1977), Denmark (Møller 1985), and Canada (Reeb 1987). Nevertheless, general studies on corvids, like Goodwin (1986) and Rolando (1995), do not give specific information on roost behaviour. Night roosting aggregation is not a widespread behaviour along the distribution area of this species, but occurs locally, possibly only in conditions of high population density.

In Sicily roosts of more 150 birds each are known both

on the western (T. & A. La Mantia pers. comm.) and eastern side of the island (Ientile 1999). The aim of this study is to analyze roost characteristics in Siracusa, to identify the environmental factors that are related to bird aggregations, and to place the results in the context of the current theories on its behavioral implications.

MATERIAL AND METHODS

The study was carried out in the South-East of Sicily, in the city of Siracusa (N 37°04', E 15°17') in an area of about 15 km². In this area the magpie is common, while the presence of other corvid species is more rare. The other corvids species in order of abundance are: the Eurasian Jay *Coracias garrulus*, the Western Jackdaw *Corvus monedula*, and the Hooded Crow *Corvus cornix* (pers. obs.). Between 1997 and 2006 five large roosts were found and identified observing magpie movements just before sunset. Exact location of each roost in the city, as well as reciprocal distance between roosts was registered. For each roost, the exact group of trees used by magpies was identified, through direct observation and by traces found under the trees. Roost

size was also measured (m^2), as well as the exposure of the site and vegetation structure. In the vegetation plots the number and the height of trees were registered (excluding trees below 2 meters), and the tree species were identified, discriminating between evergreen and deciduous.

The height of trees was recorded with an accuracy of 0.5 m ca., while horizontal distances were measured using a GPS with an error between 4 to 15 m.

Arrival of magpies at the roost was observed from a vantage point nearby each roost. Observations were performed using 10x50 binoculars, starting 90 minutes before the sunset and ending with total darkness, usually 10 minutes after the sunset. Arrival time at the roost was recorded for each bird or bird group.

In roost "A", in 1998, 34 censuses were performed, once every ten days, except for the first fifth ten days and the fifth ten days, due to unfavourable weather conditions. In the remaining four roosts, 8 censuses were carried out in 1999, two per site, in February and August.

The total number of birds counted during each cen-

sus in roost "A" was correlated with environmental parameters, recorded the same day in a meteorological station near Syracuse (Belvedere). The following abiotic environmental factors were considered: mean daily temperature ($^{\circ}C$); wind speed (m/s); day length (minutes) from sunrise to sunset. The analysis of day length and number of birds at the roosts was performed dividing the year into two periods: the breeding season (between the second ten days of March and the third of August) and the non reproductive period (the rest of the year). The breeding season was determined following Massa (1985) and Pazzuconi (1997).

Spearman's r correlation coefficients were calculated to establish possible relationships between abiotic environmental factors (day length, temperature and wind speed) and the number of individuals present in the roost. Linear regression analyses, as well as Spearman's, r have been also calculated between environmental data (independent variable) and arrival time (dependent variable). For this analyses, arrival time was defined as the number of minutes previous to the darkness approximated to 5 minutes periods when half of the birds recorded on that day had arrived at the roosts. Analyses were performed using the statistical package Statistica 5.5.

RESULTS

Distribution of roosts

The five roosts found in Siracusa (Fig. 1) were located in the central and northern sectors of the urban area, in the new part of the city. The roosts were located in peripheral sites or in large urban green areas; in archaeological sites, in a 'latomia' (A), close to the Greek theatre (B), in private gardens (C and D) or outside the border of the urban area (E).

The selected sites were areas with limited human presence, especially after the sunset and during night, with acoustic and light sources scarce or absent, with the exception of roost B, located in the Greek theatre, which is very busy during the day and, during some periods of the year, also at night when theatrical performances are carried out. The mean distance among the roosts is 2120 m (min-max 1070-3030); single distances are reported in Table 1.

Vegetation characteristics of the roosts

All sites occupied as roosts showed a dense arboreal cover, often characterized by intricate undergrowth. The trees used as perches reached between 12 and 16 meters. Tree species used were mostly evergreen, the most frequent species were those of genus *Ficus* (*F. microcarpa*, *F. bengalensis*, *F. carica*), and few were deciduous (*Celtis aus-*

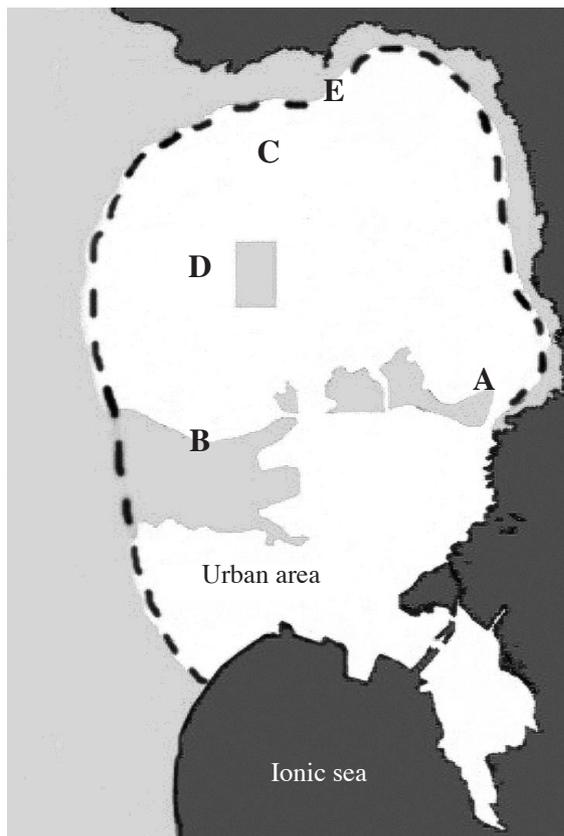


Figure 1. Map of Siracusa city. Study area, within dotted line, includes the urban area, main garden areas are light grey coloured. Capital letters indicate roosts positions.

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Table 1. Distances in meters between roosts in Siracusa city (Sicily).

	A	B	C	D	E
B	1800		2340	1070	3030
C	2900	2340		1370	1150
D	2330	1070	1370		2280
E	2890	3030	1150	2280	

tralis, *Populus nigra*). The area covered by vegetation had a variable size, from 200 m² upwards. In four cases out of five, the sites were near natural (B, E) or artificial slopes (A, inside a quarry) or near high buildings (C), sheltered, in any case, from northern exposures. Table 3 shows roost location, exposure and size well as number of trees used and a list of arboreal species. Roost B was located in the middle of a vast wooded area, which hampered the possibility to establish the exact roost borders and the trees used, so that in this case some values were necessarily estimated.

Number of birds present in the roosts

Roosts have been regularly occupied during the years and the field seasons when the study was carried out (i.e. 1997 to 2006). In the roosts magpies were the only bird species observed. The roost A, periodically monitored throughout

Table 2. Results of censuses carried out in the five roosts, in 1998 (A) and in 1999 (B-E). Highest values were recorded during winter season.

Period\roost	A	B	C	D	E	Tot
Winter	180	68	43	170	91	552
Summer	31	42	14	136	43	266

the year, was actually used by birds during the whole year, in numbers oscillating from 31 to 180 individuals (Fig. 2). Between mid September and mid March, in particular from the first ten days of September to the third ten days of December, the number of individuals present at roost was always greater than 100. Between the third ten days of March and the third ten days of August, the number of birds at the roost ranged from 86 to 31. The trend was similar in the other four roosts, although we only collected data for the months of February and August (Tab. 2).

In the roost A, a small increase of the number of birds was also recorded during summer (Fig. 2). Between the third ten days of May and the first ten days of July there was an increase of 15-20 individuals. This increase coincides with the theatrical performance season at the Greek Theatre (dormitory B), which took place between May 16 and June 28 in 1998, during the sunset and first hours of evening. Although there were no direct observations to demonstrate this, it is very likely that in those days birds

Table 3. Environmental characteristics of the areas occupied by roosts. Height in meters is referred to single trees, plants lower than 2 meters were not considered.

	A	B	C	D	E
Location	Gorge	Slope	Lowland next to buildings	Lowland	Gorge
Exposure	-	E-S-O	E-S-O	E-S-O-N	E
Roost size (m ²)	1500	3000	1200	800	200
n° of trees	25	110	9	13	8
n° of tree species	6	5	4	2	4
Evergreen %	20	100	100	100	38
Deciduous %	80	-	-	-	62
Minimum height (m)	2	2,5	6	8	2
Maximum height (m)	16	14	14	12	15
Mean height (m)	8.9	8.5	9.7	9.5	6.3
Species	<i>Celtis australis</i> <i>Laurus nobilis</i> <i>Ficus carica</i> <i>Olea europaea</i> <i>Ficus microcarpa</i> <i>Ailanthus altissima</i>	<i>Quercus ilex</i> <i>Ficus bengalensis</i> <i>Cupressus sempervirens</i> <i>Casuarina equisetifolia</i> <i>Ceratonia siliqua</i>	<i>Casuarina equisetifolia</i> <i>Ficus microcarpa</i> <i>Cupressus sempervirens</i> <i>Ficus bengalensis</i>	<i>Pinus pinea</i> <i>Ficus microcarpa</i>	<i>Celtis australis</i> <i>Olea europaea</i> <i>Ficus carica</i> <i>Populus nigra</i>

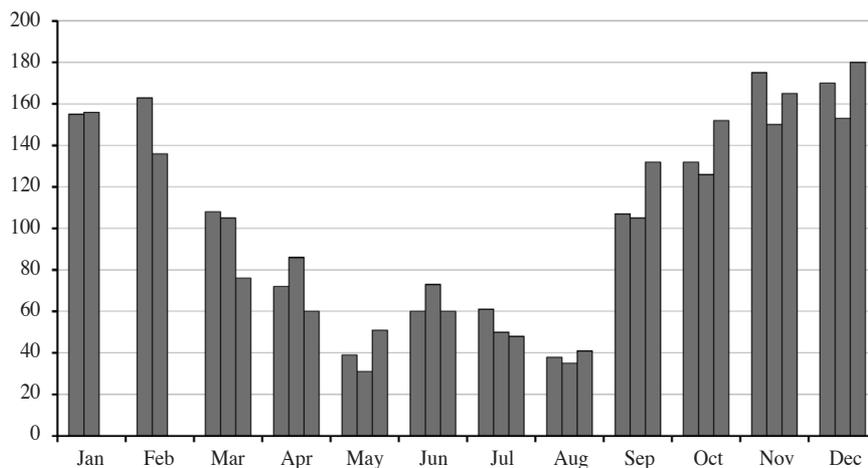


Figure 2. Number of magpies recorded every ten days in the roost A between January and December 1998.

moved from roost B to roost A. The close match between the periods of the performances at the theatre and the summer peak of observations support this hypothesis.

Individual site fidelity

Although it was not possible to analyse systematically the roost use at an individual level, the presence of three magpies with abnormal plumage, two partially albino individuals, observed in 1998 and between 1997 and 2003 (roost A), and a totally albino individual observed between 1999 and 2002 (roost E) indicated possible recurring site fidelity. It is probable that, without any disturbing factors, magpies show high fidelity to their roosts.

Abiotic environmental factors and their relation with the number of birds

Mean daily temperature in the area fluctuated between 10.5 °C (28/XII/98) and 30.3 °C (3/VIII/98). Wind speed ranged between 1.3 m/s (29/III/98) and 5.5 m/s (8/III/98), data for December are missing due to an instrument failure. Day length, expressed in minutes of daylight, ranged from 519 (19/XII/98) to 937 (20/VI/98).

During the non-breeding period we found a strong negative correlation between the number of birds and the day length ($r_s = -0.8303$, $p < 0.001$, $n = 17$); in periods with shorter days we observed an increase of birds at the roost. During the breeding season we did not find a significant relation between the number of birds and day length. The number of birds was significantly correlated with temperature ($r_s = -0.6409$, $p < 0.001$, $n = 34$) and with wind speed ($r_s = 0.6665$, $p < 0.001$, $n = 31$). Overall, the highest abundances of birds coincided with colder and windier days.

Arrival time at the roosts

During the year, the arrival time to the roosts was very variable. From January to April and in December birds arrived mainly during the last 20 minutes before darkness, while the rest of the year arrivals were mainly concentrated around 40-60 minutes before darkness (Fig. 3).

Arrival times are significantly correlated with temperatures ($r = 0.6902$, $p < 0.01$, $n = 34$) (Fig. 4). In cold days arrivals occurred mainly in the last 15-20 minutes before darkness, delayed in comparison with warmer days.

No statistical correlation was found between arrival time and wind speed ($r = 0.0703$, $p < 0.71$, $n = 31$) or day length ($r = 0.3731$, $p < 0.03$, $n = 34$).

DISCUSSION

There are known cases of big roosts of magpies associated with other corvid species in Denmark (Møller 1985) and in other countries of Europe (Coombs 1978), however the roosts found in Siracusa were monospecific, despite the fact that other species of corvids were present at low density in the area.

Distances among roosts in the study area and those known in literature are analogous: Gyllin & Kallander (1977) in Sweden found maximum distances of 4 km among roosts, Møller (1985) in Denmark found distances among roosts up to 1.5-2.5 km (average 1.9), Ponz Miranda & Monrós González (2000) in northern Spain reported a distance of 700 m between two roosts. Roosts characteristics suggest that roost site choice is mainly influenced by microclimate factors. Roosts locations, near slopes or in the bottom of small valleys, possibly represent a ther-

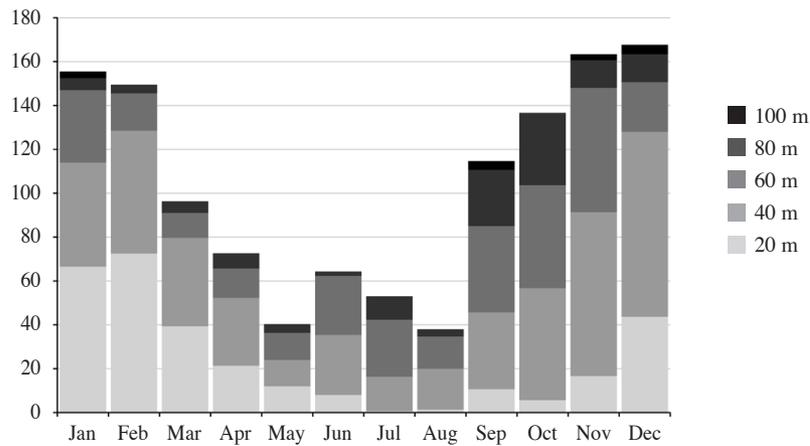


Figure 3. Monthly trend of bird arrivals to the roost A. In the y axis the number of individuals; data are referred to the monthly mean value for time interval (minutes before the total darkness).

mal advantage due to the reduction of wind speed (Walsberg 1986, Reeb 1987, Jenni 1991). In particular, avoiding northern exposure shelters from the coldest winds, it allows a better use of sun radiation for heating. The preference for evergreen compared to deciduous trees has also advantageous thermal effects (Reeb 1987, Jenni 1991). Seasonal roost shifts from deciduous to evergreen trees are known for magpies, when temperatures reach values lower than -5°C (Reeb 1987) and for the American Crow (*Corvus brachyrhynchos*) between summer and winter (Gorenzel & Salmon 1995). In Spain, gradual movements have been reported between two roosts, located 700 m apart and separated by 200 m of altitude, and were correlated with temperature changes (Ponz Miranda & Monrós González 2000). Moreover, site choice seems to be linked to safe-

ness due to the absence of human disturbance, as Gyllin & Kallandar (1977) pointed out. Shifts from one roost to another, due to human disturbance, have been reported by Ponz Miranda & Monrós González (2000). Heniksen (1992) observed that in a Magpie roost human disturbance was a contributing factor to the declining number of roosting individuals eventually leading to the complete abandonment of the roost.

In the coldest days birds delay arrival time at the roosts, regardless of day length. This could be due to the need to dedicate more time to food search. Observations in areas surrounding the roost carried out by Møller (1985) suggest a greater foraging activity during winter period. In Danish roosts Møller (1985) also found delays in arrivals during winter season. Moreover, he suggested differenc-

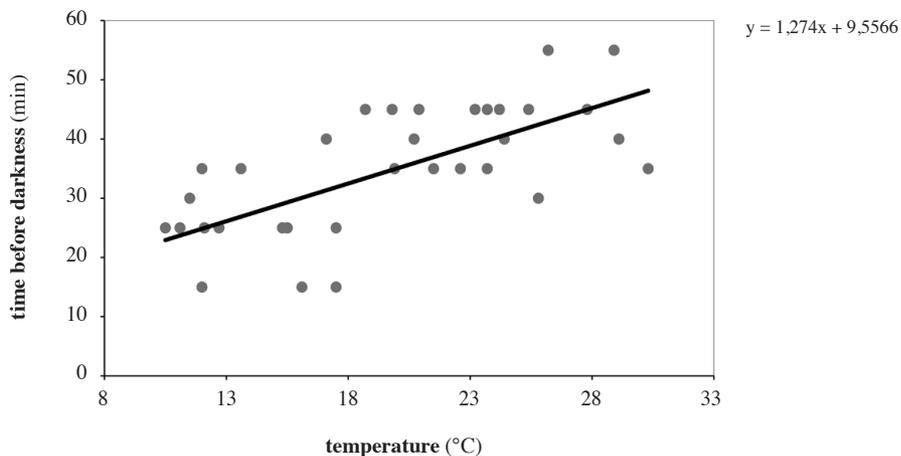


Figure 4. Correlation between arrival time and temperature at the roost A. In the y axis the minutes within half of individuals arrived are recorded, approximated to 5 minutes.

es on arrivals according to the social rank of individuals, dominant birds being the last. On the contrary, a study carried out between September and April in Canada on roosts attended by 46-192 magpies, showed significant earlier arrivals during cold or cloudy afternoons, from January to March, and when few birds used the roost (Reebs 1986a). Roost use all year round, as reported in the present study, has not been previously documented for the roosts studied in the cited studies, which only report bird presence in the roosts during the non-breeding season. Magpies that roost during the reproductive period might be non-breeders, because breeding individuals are known to spend the night in their nests (Møller 1985, Birkhead 1991).

Throughout the year, the number of roosting birds is variable; assuming that shifts among roosts are occasional, it seems evident that some individuals choose to spend the night isolated and do not roost, even when they are not breeding. Thus, this shows the capacity of magpies to choose between roosting and passing the night isolated. Results showed that they are more abundant at the roosts during the longest nights, and coldest and windiest days of the year. These roosts may be used in accordance with the hypothesis of roosting as an antipredatory strategy (Lack 1968). Birds could be more numerous during the longest, coldest and windiest nights of the year, because during those nights some behavioural and physiological aspects increase their vulnerability. During the night magpies keep their eyes closed (Reebs 1986b), not like other birds, such as seagulls, ducks and doves, which live in open spaces, open their eyes and stay awake while resting (Amlaner & Ball 1983). Moreover, low temperatures reduce reactivity levels, as Reebs (1986b) reported for magpies and other authors for other species (Walsberg 1986, Doucette & Reebs 1994). These factors possibly lower the capacity of individual defense. If this is the case, sleeping in groups provides more chances of defense against possible predation risks.

However, according to Møller (1985), a communal roost does not really provide benefits in terms of predator avoidance, because roosting occurs where predators are absent and, if they are present, predation seldom occurs. Although inside urban area predation from raptors could be very rare, predation risk can be represented by other predators, for example domestic cats (Lepczyk et al. 2003, Woods et al. 2003, Baker et al. 2005, Siracusa 2008). Moreover, magpies in Europe have been directly menaced by man (Birkhead 1991); accordingly magpies in Sicily maintain great escape distances with humans (pers. obs.), and only if not disturbed, they might show more confidence with humans (Goodwin 1986).

Overall, roosting behaviour provides other advantag-

es; meeting in roosts allows remarkable intraspecific interactions (Ward 1952, Møller 1985). Pre roosts meetings are characterized by aggregations of more than 100 individuals; they may be important moments for a species, with a complex social behaviour, that is generally linked permanently to a territory (Bayens 1979, 1981, Birkhead 1991). Pair consolidation and formation may be also favored during these moments, as it has been suggested for other species of corvids (Blanco et al. 1993).

The hypothesis of roosting as information centre, proposed by Ward & Zahavi (1973), seems less convincing, due to the fact that Magpie is a territorial species (Møller 1985) and because it is not convenient for individuals that are effective foragers (Weatherhead 1983).

In conclusion, roost site formation is a complex social behaviour, for which is not possible establish a unique and determinant cause. In the case of Magpie it seems to have both advantages as an antipredatory strategy and act as a meeting site in order to favour intraspecific interactions.

Acknowledgements – I would like to thank very much Siobhan O'Connor, Sthepan Reebs, Carmelo Iapichino, Roberto Ientile, Santi Masciarò, Emiliano Torricelli for the help provided in different ways. The Provincia Regionale of Siracusa provided meteorological data. I also thank Bruno Massa, Alessandro Andreotti, Maurizio Siracusa and Diego Rubolini for the stimulating discussion on the subject.

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Associate editor: Arianna Aradis