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Roost Characteristics and Roosting Behaviour of Black-billed Magpies, *Pica pica*, in Edmonton, Alberta

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From November 1983 to April 1985, observations were made of the communal roosting activity of Black-billed Magpies (*Pica pica*) at 12 sites located near or within the North Saskatchewan River valley in Edmonton, Alberta. The earliest occurrence of communal roosting following the breeding season took place in late June. The birds then roosted in dense (10 870–14 510 trees/ha) thickets of deciduous trees (mainly *Populus* spp.). Such roosts were used inconsistently until permanent snow cover was established (October-November). Thereafter, and until the end (March-April) of the communal roosting season, magpies regularly spent the night in dense (2200–14 900 trees/ha) stands of spruce trees (*Picea glauca*). The number of roosting magpies reached a small peak (up to 78 birds) around December, and a larger peak (up to 150 birds) in February-March. This second peak coincided with, and may have been caused by, the occurrence of conspicuous social displays at the largest roosts. The birds arrived daily at the roosts during the hour preceding sunset, and departed from them during the 45 min preceding sunrise. Arrival and departure spanned 35–71 min and 2–23 min, respectively. While in the roosts, magpies were never seen to huddle, even under the coldest temperatures (–23°C). Extensive (> 50%) overhead cover and important (> 70%) reduction of wind in the coniferous roosts probably helped the birds to cope with cold in winter. Magpies also tended to sleep amid dense networks of branches in both deciduous and coniferous roosts, a possible adaptation against nocturnal avian predators such as Great Horned Owls, *Bubo virginianus*.

Key Words: Black-billed Magpie, *Pica pica*, roosting behaviour, roosts, urban river valley, Edmonton, Alberta.

The Black-billed Magpie, *Pica pica*, is a medium-sized corvid whose distribution range extends from Alaska to central California and western Texas (Lindsdale 1937). Throughout this range, the magpie is an opportunistic beneficiary of human settlement (Linsdale 1937; Salt and Salt 1976). It is particularly abundant in Edmonton, where it is a year-round resident. Here it finds appropriate nesting trees in summer, and an abundance of food sources resulting from human activity (e.g. garbage, bird feeders) that help it survive in winter.

Habitat requirements of the magpie also include suitable roosting cover. This is particularly critical in winter, when nights are long and cold. Dense thickets of deciduous trees or scrub are the magpie's preferred habitat for roosting (Goodwin 1976). However, northern populations have been reported to roost in coniferous stands in winter (Gyllin and Källander 1977; Mugaas and King 1981). This is probably an important behavioural adaptation to cold, yet no quantitative data exist on the nature of these coniferous roosts and their seasonal use by magpies. The magpie's roosting behaviour itself is poorly documented.

To quantify the roosting habits of magpies in winter, I studied 12 roosting sites located in central Edmonton over a period of two years. The study had three objectives: (1) to quantitatively describe the habitat used for roosting, (2) to assess the seasonal use of the roosting sites by counting the number of magpies present in them throughout the year, and (3) to describe the general behaviour of magpies at the roost.

Study area and methods

Edmonton (53°30'N, 113°30'W) receives on average 314.4 mm of rain and 132.1 cm of snow annually. Average daily minimum and maximum temperatures are –19°C and –10°C in January, and 12°C and 23°C in July. Sub-freezing night temperatures occur regularly from October to April. Day length (sunrise-sunset) decreases from a maximum of 17.0 h in June to a minimum of 7.5 h in December.

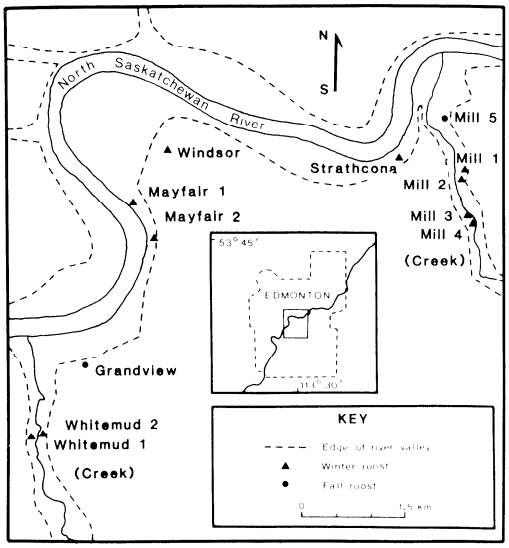

FIGURE 1. Location of the study area and the magpie roosts in central Edmonton, Alberta.

In Edmonton, magpies are found mostly near the North Saskatchewan River (Figure 1). The adjacent river valley is 1.0–1.5 km wide, 50 m deep, and consists mainly of steep wooded slopes and flat open spaces. White Spruce (*Picea glauca*) and Trembling Aspen (*Populus tremuloides*) are the main tree species in the valley. Some Balsam Poplar (*Populus balsamifera*) and Paper Birch (*Betula papyrifera*) are also present. The main shrub species are Hazelnut (*Corylus cornuta*), Chokecherry (*Prunus virginiana*), Pincherry (*Prunus pensylvanica*), Thinleaf Alder (*Alnus tenuifolia*), and Wild Rose (*Rosa acicularis*).

The study was restricted to the south side of the river between Whitemud Creek and Mill Creek (Figure 1). From November 1983 to April 1985 I followed magpies from their daytime ranges to their roosting sites. Twelve roosts were found (Figure 1). I noted the behaviour of the magpies as they arrived at the roosts in the evening and departed from them in the morning on numerous occasions throughout the study.

Two of the roosts were in well-delimited deciduous thickets (see results). I estimated tree density in these roosts with the point-centered quarter method (Cottam and Curtis 1956), using a total of 21 sampling points along seven equidistant parallel transects (three points at 10-m intervals on each transect line). Only trees over 2 m high were considered. The four trees used at each sampling point were also measured for height and DBH (diameter at breast height). Height was measured with an Abney level.

Nine roosts were in well-delimited coniferous stands on the slopes of the river valley or adjacent tributaries (see results). All trees present in the stands and higher than 2 m were counted and measured for (1) height, (2) DBH, (3) number of lateral branches longer than 15 cm in the lowest 6 m, (4) number of neighbouring trees within 1 m, and (5) height of the lowest 1-m interval that had at least five branches bearing needles. The latter measure was averaged for all trees within each roost to estimate the height of the lower boundary of the living canopy. Tree density was calculated by dividing the total number of trees by the horizontal surface area. Percentage of coniferous overhead cover was estimated visually (in classes 0–10%, 10–20%, etc.). Inclination of slopes was measured with an Abney level, and the direction slopes were facing was estimated with a compass. Another roost (Windsor) was not in uniform habitat (see results) and no extensive habitat analysis was conducted in it.

Temperature and wind speed were measured in one roost, Whitemud 2. This roost was chosen because it was intermediate in altitude between two unused coniferous stands which were located next to it on the slope and with which comparisons could be made. For 21 days in February 1985, temperature was recorded continuously and simultaneously in all three stands, using three Wilheim Lambrecht hygrothermographs, each one positioned 3 m high against the bole of a spruce tree. Wind speed was measured on three windy days in February 1985, using a hand-held vane airmeter (Negretti and Zambra Inc.). Single wind measurements were made successively, in a random order, in each stand as well as in an open field outside the valley. This was repeated twice each day, using a different random order each time, and those three daily measurements were averaged for each location.

Morning counts of departing magpies were made about once a week in the fall of 1984 and in the winters of 1983–84 and 1984–85 at Windsor, Grandview, both Mayfair roosts, and all Mill Creek roosts. These roosts were chosen because a vantage point was available from which all departing magpies could be seen. Data were pooled for the two Mayfair roosts and for the four Mill roosts, as movements from roost to roost often occurred within these two sites throughout the winter.

Results

Habitat features at the roosts

Grandview and Mill 5 were deciduous roosts. The Grandview roost was a dense thicket of young aspen

TABLE 1. Topographic and vegetative features of nine winter roosts used by Black-billed Magpies in Edmonton, Alberta.

Roost	Area (m^2)	Slope angle	Slope facing[1]	Position of roost on slope	No. tress/ha total	No. tress/ha living spruce	Cover %	Cover height[2] (m)	Tree characteristics (X ± S.D.)[3] height (m)	DBH (cm)	branches[4]	neighbours[5]	n
Whitemud 1	140	39°	45°	middle	14900	9000	85	4.1	7.2 ± 2.5	6.8 ± 3.4	85.8 ± 16.2	4.7 ± 2.2	126
Whitemud 2	138	28°	290°	middle	12800	5100	75	7.4	12.3 ± 4.0	11.4 ± 5.2	83.1 ± 21.8	4.7 ± 2.3	70
Mayfair 1	139	0°	(216°)	bottom	4700	2600	55	5.5	9.9 ± 3.3	10.7 ± 3.4	84.7 ± 24.3	1.3 ± 1.1	36
Mayfair 2	291	25°	232°	top	3600	2700	55	6.4	11.3 ± 4.3	11.1 ± 5.3	56.3 ± 15.0	1.6 ± 1.4	79
Strathcona	244	20°	325°	top	4800	3300	65	4.3	8.4 ± 2.8	11.0 ± 4.4	61.0 ± 18.7	1.3 ± 1.0	81
Mill 1	169	16°	264°	middle	3300	2400	75	5.4	11.2 ± 3.6	13.1 ± 5.5	76.0 ± 16.4	0.8 ± 1.0	41
Mill 2	239	21°	288°	middle	3000	2500	65	7.3	12.9 ± 4.4	12.9 ± 5.2	60.3 ± 16.5	0.7 ± 0.7	60
Mill 3	540	30°	44°	bottom	2200	1800	75	6.3	12.5 ± 5.2	14.3 ± 7.0	70.5 ± 20.2	0.6 ± 0.7	96
Mill 4	158	28°	52°	bottom	4300	3000	75	5.2	9.0 ± 5.1	10.6 ± 8.1	81.9 ± 13.6	1.7 ± 1.1	47

[1]0° = north, 90° = east, 180° = south, 270° = west.
[2]Lower boundary of living canopy.
[3]Living spruce only.
[4]Number of branches in the lowest 6 m.
[5]Number of neighbouring trees within 1 m.

located on a flat expanse of terrain between residential houses and the edge of the river valley (Figure 1). The Mill 5 roost was a dense thicket of Paper Birch, Balsam Poplar, and various shrubs on the west-facing slope of the Mill Creek ravine (Figure 1). Tree density in the two deciduous roosts, Grandview & Mill 5, was estimated at 14 511 and 10 873 trees/ha, respectively. The trees averaged 6.1 ± 1.7 (S.D.) and 5.1 ± 2.4 m high, and 5.9 ± 2.7 and 5.2 ± 3.8 cm DBH at the same sites. Only a few trees were taller than 8 m.

The coniferous roosts (Table 1, Figure 1) consisted of tall and slim spruce trees whose crowns intermeshed to provide more than 50% overhead cover. Presumably because of this cover, the lower half of these trees was totally defoliated, leaving an extensive array of dead branches (Table 1) on which the birds could perch. Small spruce snags were also present in the roosts but did not appear to be used by magpies for perching, as no droppings were found on or below them. Total tree density (including snags) in the coniferous roosts varied from 2200 to 14 900 trees/ha but was mostly within the range of 3000–5000 trees/ha. Living spruce trees represented on average 67.2% of that total. All roosts were located on slopes facing either eastward or westward (Table 1, Figure 1).

Among these nine coniferous roosts, roost trees (spruce bearing droppings) represented 25–72% of all living spruce. Within each roost, the distribution of the individual values of DBH, height, number of branches in the lowest 6 m, and number of neighbouring trees within 1 m for roost trees greatly overlapped with that of non-roost trees. There was no significant tendency, among the nine roosts, for the mean values of roost trees to be consistently higher (or consistently smaller) and those of non-roost trees ($P > 0.02$, two-sided Sign test, $n = 9$).

The magpies occupied those sides of the roost trees with the longest and most numerous branches. The downslope side of most trees bore longer and more numerous branches than the upslope side. Under such trees, droppings were always found only on the downslope side of the trunk. In the case of a few trees with a uniform distribution of branches around the trunk, droppings could be found on all sides.

Wind speed in the Whitemud 2 roost was less than 10% of that recorded in the open field (Table 2). Wind reduction was greater in the roost than in the coniferous stand above it on the slope, but slightly less than in the stand below (Table 2). Temperature in the roost at night (0200 h) was also intermediate between the other two stands (Table 2).

The remaining roost (Windsor) was located in a residential area. No extensive deciduous or coniferous stands were present there, but the area included many spruce hedgerows (22 clumps or rows of three trees or more in a 4.03 ha area). The magpies roosted within these hedgerows in winter. Good cover and intricate networks of branches could be found within the hedgerows, as a dense growth of needles was born by the topmost branches and by the outer third of the

TABLE 2. Average temperature (°C, center) and wind speed (right) at three different altitudes on a west-facing slope entirely covered by coniferous stands in Whitemud Creek, Edmonton. The wind speed is expressed as a percentage of the speed that was recorded concurrently in an open field above.

Altitude above sea level (m)	Position in slope	Time (MST)				Wind direction and speed (km/h) in the open		
		08:00	14:00	20:00	02:00	SE 24.4	NE 26.1	NW 19.4
664	top	-5.4	2.7	-1.6	-4.3	28.7%	22.6%	33.0%
649	middle[1]	-6.6	0.1	-3.4	-5.6	9.8%	8.4%	26.8%
635	bottom	-8.4	1.3	-3.3	-6.6	4.9%	5.0%	29.9%

[1]Location of a magpie roost.

lower branches, leaving the innermost part of the trees with numerous bare, branching limbs.

Seasonal roosting activity

In 1984, the first signs of communal roosting activity following the breeding season were observed at the two deciduous roosts. Mostly family groups of 4 to 6 birds were involved. From June to October-November, communal roosting occurred inconsistently at these sites, with numbers fluctuating between 0 and 116 (Grandview, Figure 2) or 0 and 40 (Mill 5, Figure 2).

In both years the magpies abandoned the deciduous roosts and moved to the coniferous roosts a few days after the first important snowfall of winter left a permanent snow cover on the ground. In both cases, the establishment of a permanent snow cover was accompanied by a decrease of about 5°C in night temperatures. The nightly lows varied between 0 and 5°C before the snowstorm, and between -5 and -13°C during the first few days following it (data obtained from the Edmonton Weather Office). Before the snowfalls, the deciduous trees in which magpies were roosting had been leafless for 1 to 4 weeks.

The roosting populations at the winter sites were either small and slightly decreasing in size (Windsor and Mayfair, Figure 2) or large and generally increasing in size (Mill Creek, Figure 2). The data at Mill Creek suggest two annual peaks in the number of roosting magpies (Figure 2). The first appeared to occur in December of both years. The reality of this

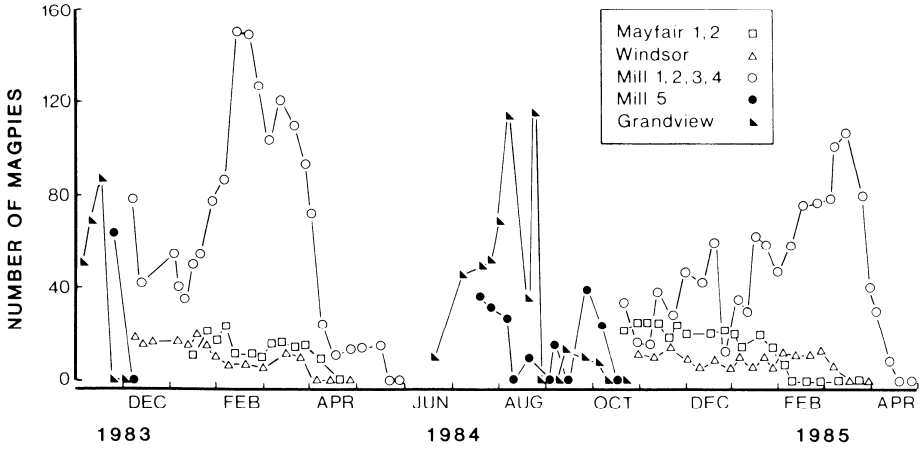

FIGURE 2. Number of magpies counted at five roosting sites in Edmonton, Alberta, from November 1983 to April 1985. The Mayfair data represent two roosts combined, and the Mill data represent four roosts combined. Solid symbols indicate fall roosting in deciduous thickets, while open symbols indicate winter roosting in coniferous stands or hedges.

"winter" peak, however, may be questionable because of the relatively small numbers of birds involved and the late time of the year at which winter roosts were occupied in 1983–84. However, because a winter peak was clearly observable at a roosting site located outside the city (Reebs 1986), I believe the phenomenon to be real and widespread. A second peak was recorded in February of 1984 and March of 1985, involving maxima of 150 and 108 magpies, respectively. In both years, this "spring" peak was followed in late March-early April by a steady decline in numbers. Magpies in Edmonton initiate laying during the last two weeks of April (Hochachka 1985), by which time almost all winter roosts were empty. The only exception occurred at Mill Creek in 1984, where a small flock of 15 individuals (possibly non-breeding yearlings) continued to use one of the roosts until mid-May (Figure 2).

Communal roosting did not appear to be an obligatory activity, as I sometimes saw magpies, in both fall and winter, spending the night singly or in pairs away from regular roosting sites. Those magpies were perching in dense clumps of aspen (fall) or spruce (winter) outside the river valley, and may have been adults roosting on their usual breeding territories (C. Scharf, personal communication).

Behaviour of magpies at the roosts

Magpies went to the roosts throughout the hour preceding sunset. The arrival was gradual, spanning 35–71 min and involving lone birds, pairs, and a few small flocks of up to 30 birds (Reebs 1985). The first birds to arrive at the site usually perched in conspicuous places such as the tops of tall trees, where they were joined by later arrivals. Vocalizations were infrequent. The birds limited their activities to occasional movements from branch to branch and to preening. Exceptions to this quiet type of assembly were sometimes observed at Mill Creek and Whitemud Creek. All birds then flew around the site or moved about noisily at the tops of trees, sometimes chasing one another. This behaviour has also been reported and described for European magpies (Ward 1952). This group display often began suddenly, lasted for up to 20 min, and usually ended at sunset. I witnessed it only during the spring peak or on the first days of mild weather following long spells of cold temperatures.

Around sunset, the birds descended to the roosts. There, single birds appeared not to allow other individuals to roost in the trees they were occupying, or even in neighbouring trees. Likewise I never saw magpies huddling, even when the temperature was as low as −23°C. In contrast, I observed three aggressive interactions in which a magpie chased away another conspecific that had landed in a tree next to it. Such behaviour resulted in horizontal spacing of magpies throughout the whole roost.

All activity ceased 34–43 min after sunset. At that time, the magpies I could see were always 3–8 m high, on branches 0.5–1.5 cm in diameter, usually preening, scratching, stretching, and fluffing up their feathers. In the conifers they were usually next to the trunk, and most often at the level of the lowest branches bearing needles, immediately below the canopy. The birds apparently did not change place during the night, as any individual seen during the evening was invariably found in the same spot the next morning. The same perches were used repeatedly over successive nights (presumably by the same individuals), as witnessed by a few direct observations and by the very conspicuous piling-up of droppings on some lower branches.

Magpies appeared to be light sleepers and were wary at night. Most remained motionless but alert (neck stretched out, feathers sleek) when I approached them as silently as possible. If I touched their roost trees or turned on a flashlight, all would fly away, sometimes hitting thin branches in the dark. They also often gave one or two alarm calls (*see* Buitron 1984) while in flight.

Before leaving the roosts in the morning, magpies usually gathered again in dead trees or at the tops of tall spruce trees. Departure occurred during the 45 min preceding sunrise. It was more sudden than arrival, spanning 2–23 min and involving large flocks (up to 56 birds) followed by a few smaller flocks and straggling pairs (Reebs 1985). The birds vocalized frequently, especially when the first ones took to the air.

Discussion

Magpies in the present study roosted in dense deciduous thickets in the fall, even remaining in them after leaf fall, but they switched to conifers after the appearance of snow cover and cold ($< -5°C$) temperatures. This suggests that magpies seek the presence of overhead and/or vertical cover when winter conditions prevail. All coniferous roosts had good overhead cover, which can minimize radiative heat loss to clear skies (Morse 1980). The birds' exposure to the sky was probably further minimized by their position immediately below the tree crown. Because most roosts were located on slopes, the overhead cover also acted as vertical cover. This probably contributed to wind reduction. The importance of avoiding wind exposure has been stressed by Mugaas and King (1981), who calculated that at −20°C a magpie could reduce its metabolic demands by as much as 8.3% by opting to spend the night in a dense fir grove where wind speed would be reduced from 14.4 km/h to 1.44 km/h. I observed

similar levels of wind speed reduction in the present study, and given the colder temperatures often experienced in Edmonton throughout the winter, the benefits magpies obtained by roosting in wind-sheltered coniferous stands could have been even more substantial.

Although coniferous hedges were present outside the river valley and appeared suitable for roosting (e.g. Windsor roost), most winter roosts were found within the river valley or its tributary creeks. Such a location has implications for the microclimatology of the roosts. As in many other river valleys, temperatures tend to be colder and winds tend to be weaker in the valley of the North Saskatchewan River than in the rest of the city above it (Klassen 1962; Paterson and Hage 1979). Strong inversions commonly occur at night, and this means that temperatures are often higher near the top of the slopes than near the bottom (*see* Table 2). Wind reduction shows a reverse trend, being greater near the bottom (*see* Table 2). At Whitemud Creek, the difference in temperature between top and bottom was rather small (2.3°C on average at night), but the difference in wind reduction was substantial when winds were blowing in the direction the slope was facing (Table 2). By roosting in the middle of the slope at Whitemud 2, the magpies may have been compromising between greatly reduced exposure to wind and slightly lower temperatures. However, magpies also roosted at the top or bottom of slopes in other locations (Table 1). Because of their patchy distribution in the valley, coniferous stands were not always available at all altitudes on the slopes, and this may have limited the birds' choice.

Magpies avoided north-facing slopes, at least within the study site. Because of the permanent lack of exposure to the sun, temperatures on these slopes were probably colder than on east- or west-facing slopes, especially at the end of the day when magpies went to roost.

Although Northern Goshawks (*Accipiter gentilis*) have been known to prey on magpies leaving the roost (Goodwin 1976), nobody has ever reported a case of predation in a roost at night. However, given the opportunity, Great Horned Owls (*Bubo virginianus*) would probably be able to kill magpies (*see* Buitron 1984). On three occasions, I observed Great Horned Owls present at dusk at two of the roosting sites. The tendency to perch in the midst of a dense network of dead branches and twigs may represent the magpie's defence against such a predator, as it may prove difficult for an owl to fly freely at night within such an environment. The year-round preference of Black-billed Magpies for very dense stands of trees or scrub appears in all references to roosting in this species (Linsdale 1937; Ward 1952; Goodwin 1976; Gyllin and Källander 1977; Mugaas and King 1981). Such a preference was also found in the present study and was further illustrated by the birds' tendency to perch on the densest side of trees.

The changes in the numbers of roosting birds showed a general increase at the larger roosting site throughout the winter. The cause of an assumed small peak in December is unclear but may be related to as yet unknown parameters of the magpies' ecology in Edmonton, such as the time of brood break-up and dispersal, or winter movements from one feeding ground to another. The spring peak, on the other hand, was concurrent with, and may have been an indirect consequence of, the occurrence of noisy social displays at the roosts. The noisiest displays probably occur at the largest roosts because of the larger number of birds involved, and they may attract individuals from other roosts. Consistent with this idea is the fact that the increase in size at Mill Creek took place concurrently with a decrease in size at two smaller roosts (Mayfair and Windsor; *see* Figure 2). However, the function of these displays, as well as whether or not they are causally related to roost size, is still unknown.

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