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NEST SITE SELECTION OF THE MAGPIE *PICA PICA SERICEA* IN BEIJING OF CHINA

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Nest building and nest site selection of the Black-billed magpie *Pica pica sericea* were studied in Beijing, China, during 2004–2006. A total of 814 Magpie nests have been checked and measured. The results showed that the first nest building occurred at the end of December, but most pairs started in February. Mostly, a new nest was built for each nesting attempt; sometimes an old nest was renovated. Magpies mobbed potential predators very intensively during the breeding season, especially congeners. Magpies build nests in strong and tall trees (51% of all nests in *Populus* sp.). If there is no suitable tree for building, they also build their nests on man-made constructions, such as telegraph poles, water towers, etc. Nests were always located in the upper part of the crown, domed and with one or two entrances. Four types of habitat were identified in this study: urban residential area, urban park, suburban area, and exurb. Analysis of the factors that may affect nest site selection in different habitats indicated that the height of the nesting tree was the most important one. From the outer exurb to the city centre, with the increasing number of people and cars, the height of the trees Magpies chose for nesting increased accordingly. Magpies can find enough food and face less predation pressure in the urban area, which enables them to breed successfully in the urban environment of Beijing.

Key words: Black-billed Magpie, *Pica pica*, nest site selection, principal component analysis, breeding, Beijing.

INTRODUCTION

The nest site is the place where birds bring up their offspring during the breeding season. The quality of the nest site has a direct impact on the breeding activities and the fledging success, and it subsequently affects the population dynamics and the community constitution [3, 4, 12]. Some studies indicate that birds have behavioral mechanisms to select a specific spot as nest site. They prefer habitats that ensure a minimal

investment and a maximized livability [16, 24, 52]. Nest site selection is a component of habitat selection [14]. Through nest site selection, birds can find a comparatively suitable place to breed, that will guarantee/enhance the success of breeding. So, this is helpful for understanding the basic characteristics of a bird's breeding place, and can also show the main factors affecting determining habitat selection.

The Black-billed Magpie (*Pica pica*), a species in Corvidae of Passeriformes, is widespread in Eurasia [25]. Magpies have been studied for a long time, concerning numerous aspects in many other countries [6, 18, 21, 27, 31, 34, 38, 42, 43, 47, 55, 58] including nest site selection in farmland [17, 22, 30, 53] and in urban environment [5, 7, 32, 49, 50, 54]. In the second half of the XXth century, Magpies showed a spectacular colonization of Eurasian towns [33]. Studies on urbanization of bird populations provide important information about the causal factors behind the regulation of bird numbers [41]. Beijing is one of the vastest cities in the world, so, studies on animals' urbanization mechanisms are very important here.

Magpies are widespread in most parts of China, both urban and suburban, except in some areas of Tibet and in the Neimenggu Autonomous Region [11]. There are some reports about Black-billed Magpies in China [15, 20, 59–61, 69], but the research on nest site selection is very limited.

The Black-billed Magpie is a common resident bird in Beijing [23], where it lives close to humans. The distribution and habitat use of the Magpie may be strongly connected to human activities. Nest site selection of Black-billed Magpies has been investigated in some countries in Eurasia, but the research on nest site selection of urban Magpies in large city habitats is not common [33, 50] and never done earlier in Beijing. So, we took the Magpies in Beijing as the object of our research. The purposes of this study are: 1) to find out basic characteristics of Magpie nest sites in Beijing; 2) to determine major factors that influence nest site selection of Magpies in urban areas.

STUDY AREA

Beijing (located from E115°20' to 117°32', N 39°23' to 41°05') is a large city with a total area of 16.808 km², comprising the hilly country (62%) in the west, north and north-east and the plain (38%) in the south and southeast. Beijing is the capital of China. The total population numbers about 11.500.000 inhabitants; the strictly urban population about 8.000.000. The average temperature is 11.8°C ranging from 40.2°C to -22.9°C. The average rainfall is 507mm.

We conducted our research in the Qianmen street, the Qianmen residential area, Changan Street, the Zhongshan Garden, the Furen Campus and surroundings, the residential area adjacent to the Drum Tower, the Shuangxiu Park, the Beijing Normal University, the Lake Park, the Di Tan Park, the Ri Tan Park and its surrounding residential area, the Fuchengmen residential area, the Taoranting Park, the Longtanhu Park, the The Black Bamboo Park, the Beijing Zoo, the Yuyuantan Park, the Third and Fourth Ring Road, the Beijing University of Aeronautics and Astronautics, the residential areas and/or gardens of Shunyi, Shahe in Changping, Tongzhou, the Beijing Botanical Garden, the Fragrant Mountain, Changping, the Hongluo Temple, the residential area and farmland of Yanqing and the residential area, garden and nursery garden of Huairou (Fig.). Study sites cover the major habitat types of Beijing's urban and suburban area, including

different degrees of urbanization; they can be considered representative for the whole city of Beijing. The main tree species in the study area are *Populus canadensis*, *Populus tomentosa*, *Salix babylonica*, *Paulownia tomentosa*, *Platanus acerifolia*, *Sophora japonica*, *Pinus tabulaeformis*, *Sabnia chinensis* and *Platyclusus orientalis*.



Study areas in the city of Beijing

METHODS

We discovered that the timing of nest building is variable: the first activities start in December, and the latest occur in May. However, most Magpies build their nests between February and March. Therefore, we choose April and May to conduct the research on the nest sites, to begin a search for the nests. All the nests were located with GPS. Thirteen parameters were recorded: the height of the nest tree ([m], the distance from the ground to the top of the tree, eyeballing n.), the height of the nest ([m], the distance from the ground to the nest, eyeballing n.), the orientation of the nest (place of the nest in the tree), the amount of daylight (%), the percent of leaf cover over the nest,

eyeballing n.), the species of the nesting tree, DBH (diameter at breast height [cm], diameter of the nest tree at the height of 1.2 m), the species of the nearest tree, the height of the nearest tree [m] (from the ground to the top of the tree), the number of trees within 10 meters of the nesting tree (counted with a tape measure), the number of other Magpie nests within 10 meters (counted as before), DBH of the nearest trees ([cm], diameter of the tree at the height of 1.2 m), the embranchment of the nest (eyeballing n.), Kf (the height of the nest/the height of the tree).

Principal Component Analysis was used to analyse the major factors that affect nest selection (Transformation with VARIMAX). We used One Way ANOVA to analyse four different types of districts and compared the differences between them. All data are analyzed by SPSS for Windows10.0.

RESULTS

A total of 814 Magpie nests have been recorded: 163 – in the urban residential area, 252 – in urban parks, 305 – in the suburbs and 94 – in the exurb. The pair members build the nest together, and usually build it in tall and strong trees ($k=0.86\pm 0.07$). Sometimes they build nests on man-made constructions, such as telegraph poles, water towers, etc. More than 20 tree species were selected for nesting, *Populus sp.* being the most (51%) common in use (Table 1). The nests are always in the middle of the tree and in the uppermost branches of the crown (at the very top).

Table 1. The percentage of tree species used for nest building by the Magpies in Beijing during 2004–2006

Species	Nests (N)	Percentage (%)
<i>Populus canadensis</i>	236	29.0
<i>Populus tomentosa</i>	179	22.0
<i>Robinia pseudoacacia</i>	177	21.7
<i>Sophora japonica</i>	52	6.4
<i>Paulownia tomentosa</i>	50	6.1
<i>Fraxinus rhychophylla</i>	24	2.9
<i>Salix babylonica</i>	19	2.3
Human constructions	5	0.6
TOTAL	814	100.0

According to data in Table 2 and Table 3, the height of the nest trees and nests are strongly correlated to the first component, so we considered the first component to be the height factor. These data indicate that Magpies prefer to nest on high trees and particularly in the upper parts of the crown. The second component appears to be the tree factor and it contains the number of trees within 10 meters, the DBH of the nest tree and the DBH of the nearest tree. The factor of the number of trees within 10 meter is negatively related to the nest selection. The third component is named the light factor. The Magpie always build its nest on the top of the tree, where leaf cover is minimal. The fourth component is named the embranchment factor; the fifth one was called the nest density factor. It is positively related to the number of other nests within 10 meter, and negatively related to the height of the nearest tree (Table 3).

Table 2. The initial eigenvalues of the Component Analysis of the nesting habitats of the Black-billed Magpie in Beijing

Component	Eigenvalue	Ratio of contribution (%)	Accumulative ratio of contribution (%)
1	2.86	28.63	25.46
2	1.42	14.15	41.13
3	1.18	11.79	53.83
4	1.03	10.25	64.42
5	1.00	10.05	74.85

1, First feature vector; 2, Second feature vector; 3, Third feature vector, ...

Table 3. The rotated component matrix of the nesting habitat variables of the Black-billed Magpie in Beijing

Variable	1	2	3	4	5
Height of nest tree (m)	0.94	0.09	-0.05	-0.06	0.00
Height of nest (m)	0.95	0.04	0.17	-0.02	0.01
DBH of nest tree (cm)	0.47	0.64	0.05	-0.13	0.13
Extent of sunshine (%)	-0.19	0.25	0.77	-0.15	0.01
Height of nearest tree (m)	0.32	0.08	-0.05	-0.35	-0.62
DBH of nearest tree (cm)	0.48	0.61	-0.04	0.01	-0.13
Number of trees within 10 m	0.16	-0.83	-0.12	0.05	-0.01
Number of nests within 10 m	0.19	0.07	-0.01	-0.22	0.79
Embranchment of the nest	-0.02	-0.02	-0.03	0.92	-0.45
Kf (height of nest/height of tree)	0.33	-0.11	0.79	0.12	0.03

We accomplished this research in urban residential areas, urban parks, suburbs and the exurb. The difference between the exurb and the three other areas is significant.

Further analysis shows that all the factors in the exurb are significantly different from three other types of study areas, except for the height of the nearest tree (Table 4). The difference between urban parks and the suburban area is not significant for the height of nest trees and nearest trees.

Table 4. Results of ANOVA of parameters in four types of study areas in Beijing

	<i>Urban residential area</i>	<i>Urban park</i>	<i>Suburban area</i>	<i>Exurb</i>	p
Sample size	163	252	305	94	
Height of nest tree (m)	14.06±0.23 ^c	11.28±0.18 ^b	11.80±0.19 ^b	9.96±0.32 ^a	<0.01
Height of nest (m)	12.32±0.22 ^c	9.73±0.16 ^b	10.09±0.17 ^b	8.37±0.32 ^a	<0.001
DBH of nest tree (cm)	53.76±1.14 ^c	53.31±0.95 ^c	48.21±0.97 ^b	31.24±1.26 ^a	<0.05
Extent of sunshine (%)	88.07±0.34 ^c	87.88±0.37 ^c	86.17±0.33 ^b	76.97±1.44 ^a	<0.05
Height of nearest tree (m)	13.56±0.26	13.59±1.68	10.71±0.20	9.50±0.32	0.21
DBH of nearest tree (cm)	47.85±1.11 ^d	40.98±0.97 ^c	30.83±1.08 ^b	25.05±1.26 ^a	<0.05
Number of trees within 10 m	5.63±0.24 ^{ab}	5.03±0.19 ^a	5.76±0.16 ^b	8.21±0.43 ^c	<0.05
Number of nests within 10 m	1.68±0.08 ^b	1.83±0.06 ^b	2.09±0.07 ^c	1.18±0.05 ^a	<0.05
Embranchment of the nest	4.06±0.07 ^b	3.79±0.05 ^a	4.31±0.06 ^c	4.30±0.07 ^{bc}	<0.05
Kf (height of nest/height of tree)	0.874±0.006 ^c	0.865±0.004 ^{bc}	0.850±0.004 ^b	0.858±0.003 ^{ab}	<0.05

Data are presented as Mean ±SE; the same superscripts in the same row indicate no significant differences.

DISCUSSION

Breeding is the most important part of bird life, since a success of breeding can directly affect population dynamics and the continuity of species [63]. The research on breeding habitat selection contains three aspects: territory selection, nest site selection and fledging habitat selection. Nest site selection occurs on a small scale of vegetation structure, such as cover and height of vegetation and the field of vision [9, 12, 40, 45]. Cody [14] suggests that microenvironmental fit, food supply and predator pressure are the most important factors that affect nest site selection in birds. The importance of each factor is determined by its effect on breeding success [14]. Bird nest site selection is optimized by building the nest in the habitat that ensures the highest breeding success. Human population density and disturbance are also important factors that affect bird nest site selection [35, 56]. Nest site selection is a protective breeding strategy during long-term evolution [2, 13]; it can minimize the disturbance of congeners, predators and pests/diseases to improve breeding success [1, 14, 36, 56].

In the study areas in Beijing, the earliest nest building started in December, while most nest building occurred between February and April, which is consistent with other Chinese records [20]. Sometimes Black-billed Magpies renovate an old nest, or build a new one on top of the old one. Some pairs build two or more nests and use one in the end. Male and female build the nest together. Magpies are territorial. They expel almost all intruding birds out of their territory; in addition, they chase raptors intensively. However they don't attack dickybirds, like *Passer montanus*. The reasons for that may be:

- 1) These birds are potential predators of eggs or chicks, thus can cause the Magpie's breeding attempt to fail;
- 2) Magpie's food requirements are largest when they are feeding young, and the intruders might compete for the Magpie's food;
- 3) Crows and some other raptors may usurp the nest [3, 15, 46], Corvids (Jackdaws also) can reduce Magpie's reproductive success [28];
- 4) Raptors are potential predators to the young.

In our study in Beijing, most Magpie nests were built in the middle of the tree, in the upper part of the crown (canopy). It is pantoscopic, the amount of sunshine is large. The embranchments under the nest are usually 3–5 to support the weight of nest. However, in other Magpie studies in Eurasian towns, most nests were higher still, in uppermost part of trees [5, 19, 29, 32, 39, 49]. This difference may be a result of selection of other tree species, with another kind of canopy. Some authors describe a lower breeding success in lower nest sites [21, 26, 31]. This may explain why Magpies prefer long trees.

More than 20 tree species are commonly selected by Magpies for nesting; *Populus canadensis* (29.0%), *Populus tomentosa* (22.0%) are mostly preferred. Comparing the height and DBH of the nest tree with that of the nearest tree, the nest tree is significantly higher and thicker than the nearest one ($p < 0.01$); the species of the nest tree and of the nearest tree do not differ significantly ($p = 0.056$). *Populus sp.* was a common tree species planted in the XXth century in many towns of Eurasia. This provided many potential nesting places preferred by the Magpies. In Manchester, UK, about 38% nests were in *Populus sp.* [50], 44% nests in Zielona Góra, Poland, [32], and 49% in Cracow, Poland [5]. Many other authors describe that the Magpies often build nests in *Populus sp.*: in Bonn, Germany [57], Cuxhaven, Germany [38], Saratov, Russia [51], Voronezh,

Russia [47], Berlin, Germany [37, 58], Poznań, Poland [34], Cracow, Poland [27], Lublin, Poland [44] and Seoul, Korea [18].

Tall and strong buildings can be nest sites, too. It explains why the Magpies build nests on telegraph poles, water towers, etc., which was also observed in other parts of Eurasia [43, 55].

The PCA-analysis of 10 factors of nest site selection shows that height is the most important component, the ratio of contribution being 25.62%. The Magpies are common in cities, but they are sensitive to human disturbance. Studies have shown that Magpies tend to build nests near the top of tall trees [19, 32, 49].

A second component is the tree factor. The Magpies prefer to build their nest in tall, strong trees, probably to make the nest safe and steady. A number of trees within 10 meters is negatively correlated with nest site selection; that means that Magpies like to build their nest in a separate tree. The Magpies are territorial; pairs will intensely drive conspecifics out of their territory. We observed an intruder being chased so fast that it crashed on the ground and died. Suitable nest sites are limited, so potential nest trees must be at some distance from other nesting pairs. Jerzak [32] found in Zielona Góra, Poland, a positive correlation between the distribution of the Magpie breeding pairs and tree density. Similar observations were done in Manchester, UK, by Tatner [50] and in Lvov, Ukraine by Bokotey [8]. Birkhead et al. [7] in Sheffield, UK, found also that the Magpie density was related to/depended on the distribution of suitable nesting sites (high trees). Such observations are important for landscape architects and city government. Planting high trees in towns might favour the increase of a Magpie population. Similar observations were done by Charles [10] on Crows *Corvus corone* and *C. cornix*. Thus, we may easily facilitate a density decrease of these „conflict” species in our urban environment.

The third component is the extent of sunshine. Usually, it is high, because the nest is on the top of the tree. The nest has a roof that safely shades the eggs and chicks.

Comparing these factors within the four types of study area, the results show that the height of the nest tree and the nest gradually decrease from the urban area to the exurb. We found the lowest nest in the Fragrant Mountain, at 2 m, the highest in an urban area, at 18 m. In the urban areas, the human disturbance is higher, and to counteract this situation, the Magpies build nests on higher trees. This is consistent with the results of Górski and other investigators in Koszalin [26]. There are no significant differences between urban parks and suburban areas, but the significant difference between the exurb and the other three types of study areas is clear. This may be due to the different environment in the exurb, with less people and cars. Human influence in urban parks and suburban areas are similarly low, so the nest site selection factors are similar too.

According to the result of this study, the height of the nest site is the most important factor. From exurb to urban centre, with the increasing disturbance of people and cars, the height of the nest trees and nests are increasing too, and man-made constructions become one of their choice. The Black-billed Magpie can not only adapt well to the process of urbanization, but, at the same time, keep a suitable distance from humans. In addition, food resources are abundant in urban areas (e.g. garbage bins) and most raptors avoid cities [41]. These factors enable urban Magpie populations to increase steadily in future.

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ВИБІР СОРОКОЮ *PICA PICA SERICEA* МІСЦЬ ГНІЗДУВАННЯ В ПЕКІНІ (КИТАЙ)

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Досліджено гніздобудування та вибір гніздової території чорнодзьобою сорокою *Pica pica sericea* у Пекіні (Китай) протягом 2004–2006 рр. Переверено і виміряно 814 гнізд сорок. Результати досліджень показали, що перші гнізда будуються з кінця грудня, але найбільше пар розпочинає процес гніздобудування у лютому. Для кожного гніздування пари будують переважно нове гніздо, іноді ремонтують старе. Під час гніздового сезону сороки часто піддаються нападу хижаків. Сороки будують гнізда на міцних і високих деревах (51% усіх гнізд збудовано на *Populus* sp.). Якщо немає придатних дерев для будівництва, вони будують свої гнізда на конструкціях антропогенного походження, таких, як телеграфні стовпи, водонапірні башти тощо. Гнізда завжди розташовані у верхній частині крони, з куполом і з одним або двома входами. У даному дослідженні було виділено чотири типи біотопів сороки: міський житловий район, міський парк, приміський район і віддалене передмістя. Аналіз факторів, які можуть впливати на вибір місця гніздування у різних біотопах, виявив, що найважливішим фактором є висота дерев. У напрямку від віддаленого передмістя до центру міста, зі збільшенням кількості людей і машин, збільшувалася відповідно і висота дерев, які сороки вибирали для гніздування. Сороки в Пекіні можуть зібрати достатню кількість їжі та стикаються з меншим пресингом хижаків, що дозволяє їм успішно розмножуватися в умовах міського середовища.

Ключові слова: чорнодзьоба сорока, *Pica pica*, вибір гніздових місць, аналіз головних компонентів, гніздування, Пекін.

ВЫБОР СОРОКОЙ *PICA PICA SERICEA* МЕСТ ГНЕЗДОВАНИЯ В ПЕКИНЕ (КИТАЙ)

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Исследованы строительство гнезд и выбор мест гнездования черноклювой сорокой *Pica pica sericea* в Пекине (Китай) на протяжении 2004–2006 гг. Проверено и измерено 814 гнезд сорок. Результаты исследований показали, что первые гнезда появляются в конце декабря, но большинство пар начинает процесс строительства в феврале. Для каждого гнездования пары строят преимущественно новые гнезда, но иногда ремонтируют старые. Во время гнездового сезона сороки часто подвергаются нападению хищников, особенно сородичей. Сороки строят гнезда на крепких и высоких деревьях (51% всех гнезд находятся на *Populus* sp.). Если нет подходящих

для строительства деревьев, они строят свои гнезда на конструкциях антропогенного происхождения, таких как телеграфные столбы, водонапорные башни и др. Гнезда всегда размещены в верхней части кроны, с куполом и одним или двумя входами. В данном исследовании выявлено четыре типа биотопов сороки: городской жилой район, городской парк, пригородный район и отдаленное предместье. Анализ факторов, которые могут влиять на выбор места гнездования в разных биотопах, показал, что самым важным из них является высота деревьев. В направлении от отдаленного предместья к центру города, с увеличением количества людей и машин, увеличивается и высота деревьев, которые сороки выбирают для гнездования. В Пекине сороки могут собрать достаточное количество пищи и сталкиваются с меньшим прессингом со стороны хищников, что позволяет им успешно размножаться в условиях городской среды.

Ключевые слова: черноклювая сорока, *Pica pica*, выбор места гнездования, анализ главных компонент, гнездование, Пекин.

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