

Nest-site characteristics and breeding biology of the Black Woodpecker in north-western Lombardy, Italy

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Riassunto - Caratteristiche del sito riproduttivo del Picchio nero nella Lombardia nord-occidentale, Italia.

Nel periodo 2008-2012 abbiamo studiato le caratteristiche del sito riproduttivo del Picchio nero *Dryocopus martius* in 3 aree di studio in provincia di Varese (Lombardia nord-occidentale). La specie, di recente insediamento nella provincia e nelle adiacenti fasce prealpine, seleziona piante-nido con diametro di grandi dimensioni, prevalentemente latifoglie, specie alloctone incluse; l'intorno (0,12 ha) della pianta nido presenta una minore densità di fusti con diametro medio più elevato rispetto ai cerchi random ubicati nel raggio di 500 metri dalla pianta nido. Abbiamo seguito 21 nidificazioni in 10 territori: 18 di queste hanno portato all'involo di 42 giovani, con un tasso d'involo pari a 2,33 juv - coppia, mentre 3 nidificazioni hanno avuto esito negativo. Il Picchio nero può essere considerato come uno specialista nella scelta del sito di nidificazione e generalista a livello di *home-range*, come dimostrano alcuni territori adiacenti a trafficate strade asfaltate ed aree urbanizzate. L'espansione della specie, dalla zona montana, prosegue verso le aree collinari centrali e nell'alta pianura occidentale, lungo il corridoio ecologico forestale adiacente al Lago Maggiore e al fiume Ticino.

Parole chiave: Picchio nero, sito riproduttivo, successo riproduttivo, espansione dell'areale.

Abstract - In the years 2008-2012 we studied the nest-site characteristics of the Black Woodpeckers *Dryocopus martius* in the Varese province, in 3 study-areas in north-western Lombardy. The Black Woodpecker is a recent immigrant in our study area and in the surrounding pre-Alps; it selects wide-diameter trunk of mainly broadleaf trees, and the forest structure near the nest is significantly different from that of random spots within 500 m from the nest, with less dense trees of greater Diameter at Breast Height. We monitored 21 nesting events, of which 18 were successful and fledged 42 young, while 3 were unsuccessful; the overall fledging rate is 2,33 young/pair. The Black Woodpecker may be considered a habitat specialist for the nest site and habitat generalist in the home-range, with some territories very close to busy paved road and urbanized areas. From the origi-

nal mountain sector, the Black Woodpecker expanded its range to the lower hill and, and, further south towards the plain, through the ecological corridor of the forests adjoining Lake Maggiore and the Ticino river.

Key words: Black Woodpecker, nest site, reproductive success, range expansion.

INTRODUCTION

The Black Woodpecker in Europe is considered the best studied species among Picidae (Pasinelli, 2006), at least in term of population biology (Cuisin, 1968; Rudat *et al.*, 1981; Lang & Rost, 1990; Lange 1996, Meyer & Meyer, 2004, Kunzmann *et al.*, 2008), habitat and nest selection (Blume 1996, Rolstad *et al.*, 1998; Rolstad *et al.*, 2000; Bocca *et al.*, 2007, Brambilla & Saporetto, 2014). Most publications refer to central and northern Europe (Pasinelli, 2007), while for Italy a large gap in knowledge exists about range, population size and demographic parameters, and no data are available on breeding success (Brichetti & Fracasso, 2007). The population of the species was estimated at 1300-3700 pairs for whole Italy (Brichetti & Fracasso, 2007): the breeding range is limited to the Alps and to mountain forests in central and southern Apennines, which holds a very tiny population (100-150 pairs; Gustin *et al.*, 2009); in the northern Apennines only a few pairs breed in the Foreste Casentinesi Monte Falterona e Campagna National Park (Ceccarelli *et al.*, 2008). Along the Alps of northern Italy the distribution range is more continuous, from west to east, and in the last decade the species has undergone a marked range expansion, into the pre-Alpine, hill, and even reached the sea level in Friuli Venezia Giulia (Utmar & Padovan, 2005). The range expansion was particularly noteworthy in Piedmont (Aimassi & Reteuna, 2007) and Lombardy (Saporetto & Pianezza, 2010). In the latter region, up to the eighties, the species was distributed only on the coniferous and mixed forests of the central and eastern mountain area, between 1000 and 1700 m a.s.l. (Brichetti & Fasola, 1990), whereas in the last decade it extended his breeding range in the western sector of Varese and Como's Province (Saporetto & Pianezza, 2010; Bonvicini, pers.comm.; Brambilla, pers. comm.). In the central part of this region the range expansion is evident in Bergamo Province, where the species now is spreading in a wide belt of the pre-alpine

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mountains (Cairo and Facoetti, pers.comm. and preliminary results of the ongoing atlas of breeding birds). In the Province of Varese the Black Woodpecker has been a winter visitor for a long time (Bianchi *et al.*, 1973) and did not breed from 1983 to 1987 (Guenzani & Saporetti, 1988; Brichetti & Fasola, 1990). The reproduction of the very first pair was documented only in 1993 (Parnell *et al.*, 1994); from 2003-2005 its expansion was evident in the northern mountain sector (Gagliardi *et al.*, 2007). In 2006 the Black Woodpecker nested for the first time at 310 m a.s.l in the Regional Park of the Pineta of Appiano Gentile and Tradate (Varese and Como Provinces) where it had been up to then an uncommon winter visitor. With our work, we tried to assess the breeding biology, habitat selection, nest site and the timing of the reproduction of the Black Woodpecker in the pre-Alps, in order to understand the main environmental parameters affecting the choice of the forest patch.

MATERIALS AND METHODS

Study area

The study was conducted from 2008 to 2012 in north-western Lombardy, northern Italy, in the Province of Varese and, marginally, in the province of Como. We have selected three main study areas (Fig. 1), each one characterized by different landscape structure, vegetation cover and amount of urbanization:

A - Pineta of Appiano Gentile and Tradate Regional Park (coniferous, mixed and deciduous forests)

B - Site of Community Importance IT 2010016 Val Veddasca (mountain forest, mainly deciduous with low urbanization)

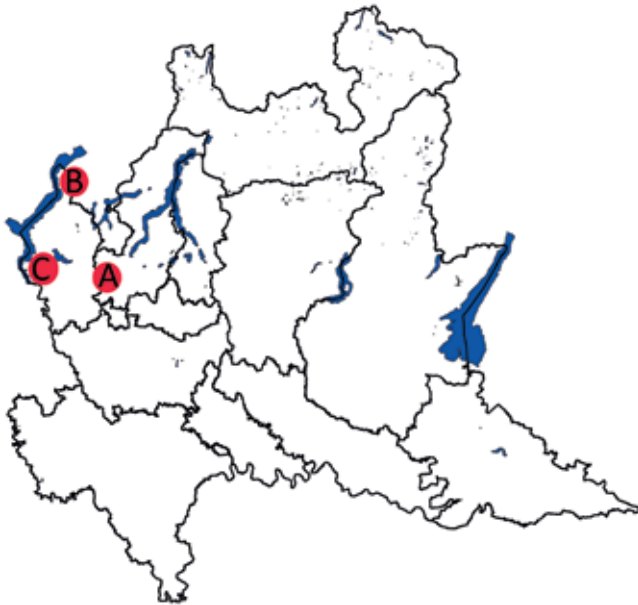


Fig. 1 - Nest area of first territory (n. 1, A area and Tab. 3) found in the Parco Pineta of Appiano Gentile and Tradate: the nest trees are the two spruce on the right (pointed with red arrows), felled after forestry sanitation operations. Photo by Silvio Colaone.

C - A central sector, close to the western side of Lake Maggiore and Varese, (fragmented woodland, mainly deciduous, arable land, meadows with patchy urbanization)

Survey of breeding pairs

For each areas, from the end of February until the first half of April, we intensively searched for active territorial pairs (courtship with drumming and calling, mating, intra-specific fights) in mature stands of coniferous, mixed or deciduous forest: for any territorial pairs we tried to locate the cavities already available for nesting or the start of a new excavation. We never used play-back to stimulate the responses of the individuals. For each territorial pairs associated to a nest-hole, hereafter probably nesting, we checked for egg laying (entrance in the nest cavity and resting for incubation of female or male); then we checked for subsequent food delivery to finally assess the fledging rate.

Habitat variables

The forest stand parameters were measured for the nest tree, the nest site, and at home-range scale in five 0.12 ha circles ($r=20$ m), the central one centered in the nest tree and the other 4 randomly spaced within a radius of 500 m from the nest tree. In the 0,12 circles we recorded: number of trees and species, tree health (dead, partially rotted or alive), DBH > 8 cm in 9 classes (Diameter at Breast Height, Tab. 1), the vegetation type according to the Vegetation Map; from these data we obtained the number of trees/ha. We counted the number of logs (laying dead trunk) and the number of snags (standing dead trees with broken top). For every occupied territory we measured the forest stand parameters as soon as possible, at the end of the breeding period, in the first year of the discovery. For the landscape scale, within a radius of 1500 m from the nest tree, we derived a set of 5 land cover variables (Tab. 2) with ArcView 9.0, utilizing the Vegetation Map of the Province (Tosi & Zilio, 2002), based on the 1:10.000 Regional Technical Map of Lombardy Region, in 3 buffer area of radius of 500 m (78.5 ha), the first one centered on the nest tree and two other random. We used non-parametric statistical tests.

Tab. 1 - Diameter at Breast Height (DBH) classes (cm).

1	8.0 < DBH < 15.0
2	15.0 < DBH < 23.0
3	23.0 < DBH < 36.0
4	36.0 < DBH < 53.0
5	53.0 < DBH < 69.0
6	69.0 < DBH < 84.0
7	84.0 < DBH < 102.0
8	102.0 < DBH < 121.0
9	DBH > 121

Tab. 2 - Set of 5 land cover variables within a radius of 1500 m from the nest tree. Total forest cover is the sum of broadleaf and coniferous forest; total “open” habitat: this category includes all the herbaceous categories of the vegetation map, and cropland.

derived land cover variables (ha)
total forest cover
total broadleaf cover
total coniferous forest
total “open” habitat
total urban area

RESULTS

Breeding biology

Overall we monitored 21 nesting events in 10 different territories: 6 in area A, 5 in area B and the remaining 10 in area C, with 18 successful broods and 3 unsuccessful ones; in two territories (1 and 5) the breeding pairs were already known since 2006. Tab. 3 reports the numbers of years in which each of the 10 territories was occupied by a nesting pair (range 1-5 years, only for territory n. 1, we considered also the 2007 datum, Fig. 2), the number of successful broods (range 1-4) and the

Tab. 3 - Number of territories of each area, number of years in which each territory was occupied, number of successful broods and total number of fledged juveniles for each territory.

Territory number and area	Years	Number of successful broods	Fledged young	Number of unsuccessful broods
1 (A)	5	4	10	1
2 (A)	1	0	0	1
3 (B)	3	3	8	0
4 (B)	2	2	4	0
5 (C)	1	1	3	0
6 (C)	2	2	4	0
7 (C)	2	1	2	1
8 (C)	2	2	4	0
9 (C)	1	1	2	0
10 (C)	2	2	5	0
Total	18	42	3	



Fig. 2 - Nest area of first territory (n.1, A area and Tab. 3) found in the Pineta of Appiano Gentile e Tradate Park: the nest trees are the two spruce on the right (pointed with red arrows), felled after forestry sanitation operations. Photo by Silvio Colaone.

total number of young fledged (range 2-10) for each territory. The mean number of nesting events monitored each year was 3,6 (d.s.=1.52), with a minimum in 2008 (2 pairs) and a maximum in 2011 (6 pairs). The fledging rate was equal to 2.33 juveniles/pairs and the median fledging rate did not differ among 5 years (Kruskal-Wallis H test=2.222; P=0.549).

The fledging period ranged from the third decade of May (earliest date 21 May 2012, area A and C) to the second decade of June for the area B, with a peak in the third decade of June (mountain area B, above 900 m; latest date 25 June 2012), generally two weeks later than those of area A and C. Assuming an incubation period of 12-14 days (Blume, 1996; Cramp, 1985) and a fledging period of 24-28 days (Cramp, 1985), the start of the laying may be dated approximately between the first and the second decade of April (11-15th) for the areas A and C and between the last decade of April and the first decade of May for area B (from 30th of April till 6th of May). The first unsuccessful brood (territory n.2, area A) was found in 2009: the nest was deserted about ten days after the start of the incubation and both members of the pair abandoned the nest-site for unknown reasons; the others two were respectively territory number 1 in year 2010 and territory number 8 in year 2012 and both the nests were deserted with the young inside, when their growth rate was already in the third week of development. We do not know the reason of nest-desertion because both nest sites were not disturbed by people or forestry operation. In the territory number 1 (year 2012) we observed a Carrion Crow *Corvus cornix* trying to predate the two young at the hole entrance: subsequently we found the remains of one young at the tree base; in one mountain territory (n.3, year 2010) one young was predated by a Fox *Vulpes vulpes* soon after fledging

(Rinetti, pers. comm.). The sex ratio (male:female) of 27 sexed fledged young is 1.08:1 (14 males, 13 females). The extent of red color on the crown of the young woodpeckers is useful to determine the sex: for females is a little patch on the hindcrown while in males there is a stripe starting above the upper mandible and arriving to the hindcrown.

Selection of the nest tree

Among the 15 trees where we found nest holes with breeding pairs, 12 were excavated in deciduous tree (80.0%) and 3 in coniferous one (20.0%; only in area A), and the great majority were alive (12 or 80.0%). Only in two territories (n.1/ 2007/2011/2012 and n.5/2008) the trees were dead (respectively *Picea excelsa* and *Populus alba*) or partially decayed (n.1/2010, *Pinus strobus*). The Beech *Fagus sylvatica* was the most commonly selected deciduous trees (n=5; area B and C) above 500 m, while other 4 species were selected in area C (Tab. 4). The mean Diameter at Breast Height (DBH) is 59,5 cm (n=15, d.s.±20.96), whereas the nest height averaged 11.9 m (n=16, d.s.±2.86; Tab. 4). The mean height of the nest holes in deciduous trees is 11.0 m (d.s.±2.56; n=12), in coniferous trees is 14.5 m (d.s.±2.25; n=4); Mann-Whitney U test=40.0, P=0.0582, two-tailed. In one territory (number 3, 2009/10/11) the same nest hole was reused for 3 consecutive years, whereas in other five (n.1 2011/12, n.4 2011/12, n.7 2010/11, n.8 2010/11 and n.10 2011/12) for two consecutive years. In two territories (n.1 and n.4, 2011) we were able to monitor the number of days used by the pairs for the excavation of the nest-hole. For the first pair, at an altitude of 975 m, we found excavating male and female on 9th April, at about one week since the start of the cavity, because both members were again excavating on the external side of the hole, with only head

Tab. 4 - Number of territories, nest trees (dead or partially decayed and alive) for each territory, Diameter at Breast Height (DBH), tree species, number of nest holes, nest height and altitude of the nest trees. ^{a)} In the territory n. 1 the nesting pair used the same dead tree (*Picea abies*) in 2007 and 2011/12, excavating a different hole in 2011, reused in 2012. ^{b)} In the territory n. 3 the nesting pairs used the same nest hole for three consecutive year.

Territory number	Nest trees	Dead or partially rotted	Alive	DBH (cm)	Tree species	Nest holes	Nest height (m)	Altitude (m a.s.l.)
1	3	2	1	45, 49, 73	<i>Picea abies</i> , <i>Pinus strobus</i>	4 ^a	12.3-13.2-15-17.4	305-310-320
2	1		1	34	<i>Robinia pseudoacacia</i>	1	13.2	360
3	1		1	105	<i>Fagus sylvatica</i>	1 ^b	8.5	1165
4	1		1	96	<i>Fagus sylvatica</i>	1	12.6	975
5	1	1		76	<i>Populus alba</i>	1	8	258
6	2		2	39, 48	<i>Quercus rubra</i>	2	15-15.1	290
7	2		2	46, 52	<i>Fagus sylvatica</i> , <i>Tilia cordata</i>	2	10-10	720- 699
8	2		2	59, 75	<i>Fagus sylvatica</i>	2	8.3-11	555-565
9	1		1	49	<i>Populus alba</i>	1	8.5	245
10	1		1	46	<i>Populus alba</i>	1	12	250

and neck penetrating the cavity, which was terminated in the first days of May: in this case we presumed an excavating lengths of 35 days at least; for the second one (altitude 320 m) the very start date began the 1st March and termed the 8th April, for a total of 39 days. All the nest holes in deciduous tree were excavated below the lowest branch. The spacing of successive nest tree, from year to the subsequent one in the same nesting territory in 4 nest-site (n.1, n.6, n.7, n.8) has a mean value of 76.0 m (d.s.±67.38), with a minimum of 18 m and a maximum of 203 m (n=6). In the Pineta of Appiano Gentile and Tradate Regional Park (territory n. 1) two nest tree were felled (in 2008 and 2010) during forestry sanitation operations, partly connected to the control of an outbreak of *Ips typographus* (family Scolitidae).

Nest site and landscape scale

The difference between DBH of the 15 nest trees and the mean DBH of the trees in the 0,12 circle (nest centered) is highly significant (Mann-Whitney U test=9.0, P=0.0022, two-tailed test) as significant is the number of trees/ha with random circles too (Mann-Whitney U test=80.0, P=0.021, two-tailed test): only in two territories (n. 2 and n. 10) the birds selected a higher tree density in the nest circle than in random ones. The value of mean nest tree diameter belongs to the 5th DBH class that, in the random 0,12 circles, collects only 1.34% of all the measured trunks (n=4168). In the nest circle, the number of dead trunks (log or snag) is remarkably lower than random circles (Sign test $r=13$, P= 0.000244). The nest site were located mainly (83.3%) in deciduous forest, with only two in coniferous ones (16,7%, in area A): the species composition of the forest stand in the 0.12 ha nest circle versus the random circles (mean values) is similar but with different percentages (Tab. 5) among tree species, particularly for *Fagus sylvatica* that is one of the preferred nest tree species above 500 m a.s.l. It is worth noting the high percentage represented for some invasive alien species as *Robinia pseudacacia*, *Quercus rubra* and *Prunus serotina*; the species composition indicates also a high percentage value of *Alnus glutinosa* stand (Tab. 5), corresponding to the alluvial forest, where the species frequently forages. In only one territory (n. 5, 2008) the nest tree (a dead one) was located in a small clump of 10 trunks isolated in a meadows, 200 m far away from the woodland edge: in winter of the same year the trunk fell down. Two nest trees were located in private park and 5 were excavated in large trees on the pathways border, often used for recreation walking and forest felling operations.

The mean distance of the nest trees from the nearest pathway was 26 m (d.s.± 35.5; min= 1 m; max=112 m): the parameter “distance from the nearest pathway” is strongly preferred (Mann-Whitney U test=119.5, P=0.0067, two-tailed test), as the distance from the nearest clearing (Mann-Whitney U test=115, P=0.0143, two-tailed test).

The six forest stand parameters are statistically significant (Tab. 6), with the number of trees/hectare and distance from the nearest pathway highly significant; three of the five derived variables (total forest cover, total co-

niferous forest cover and total open habitat) do not vary significantly among nest and random circles, whereas total broadleaf cover and total urban area are statistically significant.

Tab. 5 - Tree species composition in the 0.12 ha nest and random circles (mean value among 4 circles). * Other 11 tree species with percentage <1% to reach 100%; **other 22 tree species with percentage <1% to reach 100%.

N.	Tree species	% nest circle	% random circles
1	<i>Fagus sylvatica</i>	25.4	12.8
2	<i>Robinia pseudacacia</i>	11.8	12.9
3	<i>Castanea sativa</i>	11	15.6
4	<i>Quercus rubra</i>	10.2	2.8
5	<i>Platanus orientalis</i>	6.6	2.2
6	<i>Fraxinus excelsior</i>	6.4	4.9
7	<i>Pinus sylvestris</i>	5.5	8.8
8	<i>Prunus serotina</i>	4	1.3
9	<i>Populus alba</i>	2.9	0.2
10	<i>Alnus glutinosa</i>	2.4	10.7
11	<i>Quercus robur</i>	2.2	3.2
12	<i>Ostrya carpinifolia</i>	2.1	0.5
13	<i>Carpinus betulus</i>	1.7	1.1
14	<i>Tilia cordata</i>	1.6	0.2
15	<i>Betula pendula</i>	1.1	8.4
16	<i>Acer pseudoplatanus</i>	1.1	1.9
% total		98.1 *	88.7 **

DISCUSSION

The mean brood size of 2.33 young per successful breeding is a low value if compared with values available for central Europe (Tab. 7). We can hypothesize three main causes to explain such figure: A) the small sample of nesting events monitored, B) a low level of food resources in our sub-optimal study area, at the base of the main distribution belt of the Alps, where the colonization process is still in progress, and where the species maintains its population stronghold in the optimal habitat with mixed and coniferous forests, C) an unbalanced age-classes population structure with a high number of 1-yr old females, factor that is quoted (Rolstad *et al.*, 2000) as a cause of high desertion rate. In our sample the 14.3 % of the brood were deserted, one during the incubation period (territory n. 2, in *Robinia pseudacacia*) and two (territory n. 1 and n. 8) in the growing period: for the first one we can hypothesize the very small DBH of the selected trunk, then of the nesting chamber, to act as cue for abandonment; for the others, in particular for territory n. 1, we can't exclude the predation of a member of the pairs.

Tab. 6 - Results of the Mann-Whitney U test for the 5 derived cover variables and the 6 forest stand parameters. n.s., not significant; *P<0.05; **P<0.01; nest and random buffer (r=500 m) cover for the nest circle and random circles (mean value).

	Nest buffer cover	Random buffer cover	Mann-Whitney U test	Significance
Derived variables				
Total forest cover (ha)	60.21	45.73	U=52, P=0.2585	n.s.
Total broadleaf cover (ha)	44.08	23.07	U=36, P=0.0404	*
Total coniferous cover (ha)	15.23	5.43	U= 65, P=0.7039	n.s.
Total “open” habitat (ha)	12.48	15.36	U=75, P=0.8887	n.s.
Total urban area (ha)	3.76	12.80	U=107, P=0.0466	*
Measured variables				
Tree numbers/ha	391.30	716.40	U=128, P=0.0014	**
Numbers of trees in 1-4 DBH classes	48.08	137.90	U=117,5, P=0.093	*
Numbers of trees in 5-9 DBH classes	3.75	1.50	U=35,5, P=0.0375	*
Number of dead plants (snag/log)	3.75	13.58	U=114,5, P=0.0155	*
Distance from the nearest pathway	26 m	94.71 m	U=119,5, P=0.0067	**
Distance from the nearest clearing	55.75 m	205.70 m	U=115, P=0.0143	*

Tab. 7 - Breeding success among our study and central European data.

Author	Breeding success	Number of nesting events
This study	2.33	18
Rudat <i>et al.</i> 1981	2.83	70
Meyer & Meyer 2004	2.88	476
Lange 1996	3.04	140
Lang & Rost 1990	3.11	134
Cuisin 1981	3.17	23
Tjernberg 1993	3.70	35

We consider this species quite tolerant of anthropogenic disturbance as should be a taxon in the colonization process of our study area: some of the pairs we monitored had a nest we could define in prominent position, very close to well-known pathways; if we take into account the loudness of their vocalizations in the pre-laying period, which greatly increase the conspicuousness of the species, this view is furthermore supported. From our results the Black Woodpeckers may be considered a species halfway between a habitat specialist and habitat generalist, if we examine the territory preferences at different scales: specialist at nest scale and generalist at landscape scale for habitat selection. The nest tree, with his considerable diameter at breast height is statistically different from the available trees in the home-range, as well the tree number/ha in the nest circle, because the species requires a significant spacing of the trees in the immediate proximity of the nest, as confirmed also by close proximity to the nea-

rest pathway and to the nearest clearings. The nest found in area A (territory number 2) excavated in the smallest trunk (DBH=34 cm) among those selected by the monitored pairs, led to the desertion of the brood: generally the average DBH necessary to hold the nesting cavity is around 40 cm (Kosinski *et al.*, 2007; Gorman, 2011) and in literature the mean values range from 40 cm to 56.5 cm (Tab. 7). Our mean value (59.5 cm) is clearly very high if confronted with the cited literature. It should be noted that very low diameters are also known: Falcone (2007) reports a minimum value of 22 cm for the natural Park of Mont Avic, whereas Pynnönen (1939) cites an example of 27 cm. Rolstad *et al.* (2000) provides different measures for different trees, with the modal class corresponding to a diameter of 35 cm for the dead trees without bark, 45 cm for *Pinus sylvestris* and 45 cm for *Populus tremula*. The mean nest heights in our study area are also in the upper level, with respect of other studies (Tab. 7), and our lowest value (8 m) is higher than the mean value found by Colpi *et al.* (2009) and Ceccarelli *et al.* (2008) in beech-wood of respectively the Dolomiti Bellunesi National Park and Foreste Casentinesi National Park: if we consider only the mean height of holes (10.8 m, Tab. 4) in broadleaf forest, the difference with the Italian data (Tab. 8) remains substantially unaltered, indicating the selection of available old deciduous trees in the forest patch.

Two parameters, total cover forest and total coniferous forest (Tab. 6), didn't show significant differences between nest circles and random circles: this result also incorporates the vegetation formations that were pooled in our analysis to define broadleaf forest (twelve categories from the vegetation map) and coniferous forest (three categories from the vegetation map). The significance (close to the minimum level P<0.05) of the parameter total broadleaf forest refers firstly to the ordinal value

Tab. 8 - Mean Diameter at Breast Height (DBH) of the nest tree and mean nests height in our area in comparison with available bibliography. * Mean nest height for broadleaf trees.

Mean DBH (cm)	Author	Mean nest height (m)	Author
40	Bocca 2007	6.9	Bocca & Falcone, 1999
50.2	Campodron <i>et al.</i> , 2008	7.5	Ceccarelli <i>et al.</i> , 2008
50.9	Pirovano 2009	7.5	Colpi <i>et al.</i> , 2009
51.2	Kosinski <i>et al.</i> , 2007	9.1	Falcone 1998
53	Colpi <i>et al.</i> , 2009	9.1	Pirovano 2009
55	Ceccarelli <i>et al.</i> , 2008	11.4	Blume 1996
55.2	Henke 1996	11.9 (10.8)*	this paper
59.5	This paper	12.4	Kosinski <i>et al.</i> , 2007

of the parameter (higher in nest circles than in random ones) and, again, incorporates all the broadleaf categories of the vegetation map: the species needs a minimum (threshold) amount of broadleaf cover as feeding area; on the contrary, the species avoids an excessive urban cover ($P < 0.0466$). It's worth noting the significance ($P < 0.0155$) of the parameter "number of dead plant (snag/log)": the deadwood represents an irreplaceable feeding substrate (Fig. 3) for the species and in all the territories we found

clear evidence of feeding holes and signs in the rotten wood (stumps, snags and logs); in Switzerland the increase of the populations (period 1990-2008) of several forest species such as Black Woodpecker, Middle and Lesser Spotted Woodpeckers, Willow and Crested Tit, has been directly related (Mollet *et al.*, 2009) to the increase of the quantity of deadwood, thanks to a "close-to-nature" approach to forest management. This species is increasingly adapting to the environmental mosaic of the central sec-



Fig. 3 - Feeding area in the mountain birch woodland of the SCI Val Veddasca: in foreground a wide feeding hole in a rotten log of birch, with wood chips scattered around. Photo by Fabio Saporetti.

tor of the province, which comprises an higher level of urban cover than sector A and B; precisely in the area of territory n.9 (Fig. 4), in the years 2000/2001 we studied (Saporetti & Guenzani, 2004) the whole bird community of a patch (15.9 ha) of unmanaged alluvial wood (*Alno-Padion - Salicion albae* formation): the species pool does not included the Black Woodpecker, although the mature wood already hosted a rich population of the commonest Picidae (*Dendrocopos major*, *Dendrocopos minor*, *Picus viridis*). In 2010, when we censused the successful breeding pair, the nest tree was only 160 m from the nearest



Fig. 4 - Nest tree (*Populus alba*) in territory n. 9 (C area), close to Lake Varese, at the altitude of 245 m a.s.l., the lowest one in which we found a breeding pair in the ash-alder forest. In the photograph are visible some of the ropes of 20 m used to delimitate the 0.12 ha circle, where we measured the forest parameters. Photo by Lorenzo Colombo.

paved road (a busy provincial one in Varese municipality) and from 170 m from the nearest urban area. In the same sector another successful pair (territory n.10, 2.3 km S/E from n. 9) in 2011/12, was at only 120 meters from the same busy paved provincial road and from 340 m from a shopping centre. The territories of the Black Woodpeckers were dispersed in quite different vegetation categories (Pignatti, 2003; Tab. 9), suggesting an increasing adaptability of the species: from the customary Scots pine and Beech forest, to the Ash-Alder forest of the lowest altitudinal range (around 250 m a.s.l.), further comprising cultivated formation of *Quercus rubra* (territory n. 6) and degraded wood with *Robinia pseudacacia* (territory n. 2). These environmental factors clearly can't indicate the Black Woodpecker as a habitat specialist, and his flexibility in term of ecological requirements explains the spreading of the species from the original Alpine forest to the Pre-Alps and lowland plain following maturing forests with increasing dead-wood resources, diffusion of protected areas, and better protection of the species.

The distribution of Black Woodpecker in Varese province, from the northern mountain area, now includes all the central sector, further spreading on the east side in the southern lowland sector, following the landscape corridor adjacent to the Lake Maggiore and, further south, to the Ticino river (Casale *et al.*, 2014). A recent analysis (Brambilla & Saporetti, 2014) of suitable nesting habitat, modeling with MaxEnt the distribution at 1×1 km scale, confirms a potential distribution throughout most of the provincial territory, with the exception of the southern and almost uninterrupted urbanized area, close to the Milan province.

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Tab. 9 - Vegetation categories relating to the territories of Black Woodpeckers.

Vegetation categories and category number according to Pignatti 2003	Territory number
Scots pine with <i>Quercus robur</i> and <i>Molinia</i> - 4	1
Spontaneous formation of <i>Robinia pseudacacia</i> - 14	2
Acidophilous and thermophilous beech forest - 8	3 - 4 - 7 - 8
Ash-alder forest - 13	5 - 9 - 10
Cultivated deciduous broad-leaved forest - 19	6

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