

CHAPTER II



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CHAPTER II

Selection of nest-site and nesting material in the Eurasian Nuthatch *Sitta europaea*

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ABSTRACT. Selection of nest sites and nesting material may have important implications for avian reproductive behaviour and performance. Nest construction may involve costs arising from transporting material that may be reduced considerably if nest materials are located close to the nest-site. Nuthatch *Sitta europaea* nests in our nest-box study area are mainly composed of pine bark flakes or alternatively of strips of bark of the widespread shrub *Cistus laurifolius*, with variable amounts of mud being used for plastering the entrance. Several small streams run through the area, an oak *Quercus pyrenaica* forest with a few scattered pines *Pinus sylvestris*. Here we show that nuthatches collected pine bark only when nest-sites were situated close to pines, used more mud when breeding close to streams, and selected nest-sites closer to streams than a sympatric species not using mud, the Pied Flycatcher *Ficedula hypoleuca*. Nuthatches used pine bark only when there was a pine-tree less than 100 m away from the nest-box and selected *Cistus* bark when transport distance is greater. We suggest that the selection of nest sites and nest materials in this species may be constrained by costs of transport of nest material.

INTRODUCTION

Hole-nesting bird species vary in the characteristics of their nest sites (Li & Martin 1991) and build their own characteristic nests (Hansell 2000). Nest construction may be influenced by factors such as the availability of nest materials (Moreno *et al.* 2009) and involves a large expenditure of time and energy (Collias & Collias 1984) due to the costs of transporting material to the nest site (Putnam 1949). These costs may be reduced by using old nest material (Nores & Nores 1994) and/or if nesting material is located close to the nest site (Collias & Collias 1984). Availability plays an important role in the selection of nest materials. Birds typically make use of local materials but some birds are nest material specialists (Hansell 2000), although for many species the functional properties of nests remain unknown.

Nuthatches *Sitta* spp. use nests made of loose material without any structure (Matthysen 1998). The base of the nest consists of pieces or rotten wood or bark covered by a layer of lining material, typically bark flakes of Scots pine or other trees (Matthysen 1998). Nuthatch *Sitta europaea* nests were composed in our study area mainly of pine *Pinus sylvestris* bark flakes or strips of bark of *Cistus laurifolius* (Cantarero *et al.* 2013). In several cases, Nuthatches are known to travel more than 100 m to obtain this material (Löhr 1958, Bohr 1962). One nest in a large cavity contained no fewer than 11440 bark fragments (Olsson 1957).

Besides bark flakes, Nuthatches use mud in nest building by narrowing the entrance of cavities (Matthysen 1998) in order to exclude nest site competitors (Collias & Collias 1984). The total amount of mud may weigh up to 1 - 2 kg and is collected by the female in small pellets (Matthysen 1998).

In the present study we have attempted to elucidate if selection of nesting material and the amount of mud in Nuthatch nest-boxes can be explained as a trade-off between requirements for nest construction and availability as a function of transport distance. We have explored whether:

- (1) The selection of nest-boxes by Nuthatches depends on the distance to streams where mud can be collected;
- (2) This relation is stronger for Nuthatches than for another sympatric cavity-nesters, the Pied Flycatcher *Ficedula hypoleuca*;

- (3) Selection of Nuthatch nesting material (pine or *Cistus* bark) depends on the availability of pine, in particular the distance to the nearest pine;
- (4) The amount of mud in Nuthatch nest-boxes is negatively associated with the distance to streams.

MATERIAL AND METHODS

Study area and species

We conducted the study during the springs of 2011, 2012 and 2013 in a population of Nuthatches and Pied Flycatchers breeding in artificial nest-boxes in a montane forest of Pyrenean oak, *Quercus pyrenaica*, at 1200 m.a.s.l. in Valsaín, central Spain (40° 54' N, 4° 01' W). Scattered pines are found among the oaks while the shrub layer consists mainly of *Cistus laurifolius* (Moreno *et al.* 2009). Several seasonal streams cross the study area.

Breeding activities in nest-boxes are followed routinely every year. There are 300 nest-boxes erected in the study area, each hanging from a branch attached to a metal hook. Pied Flycatchers occupied 73 nest-boxes in 2011, 61 nest-boxes in 2012 and 66 nest-boxes in 2013. Nuthatches occupied 13 nest-boxes in 2011, 21 nest-boxes in 2012 and 17 nest-boxes in 2013.

The Nuthatch is a small cavity-nesting woodland bird that prefers to build its nest in existing cavities in trees, but it may also use nest-boxes for breeding. Nuthatches are territorial in pairs throughout the year (Matthysen 1998). Nuthatches are the first species to breed and to occupy nest-boxes in the spring, and are dominant over all other species using nest-boxes in our study area.

The Pied Flycatcher is a small hole-nesting passerine of European woodlands (Lundberg & Alatalo 1992), whose nest is composed mainly of strips of bark of *Cistus laurifolius* in our study area (Moreno *et al.* 2009).

To characterize the study area we marked each nest-box location with a Global Positioning System (GPS) waypoint, as well as the scattered pines and the permanent streams. The nearest distance between any two features was calculated using ArcGIS10 Desktop software (Redlands, CA: ESRI). From these distances we

calculated the average distance between the streams and all nest-boxes, the nest-boxes occupied by Nuthatches and the nest-boxes occupied by Pied Flycatchers. Furthermore, we have calculated the shortest distance between the nest-boxes occupied by Nuthatches and the nearest pine.

Differences in nesting material and amount of mud

All Nuthatch nests were collected after the end of breeding and subsequently disassembled into different components. Nest composition was defined as the nesting material occupying at least 80-90% of the total volume of the nest: pine bark flakes or strips of bark of *Cistus*.

In 2012 and 2013, the intensity of plastering with mud was assessed by visual inspection of the nest-box and classified on a binary scale: 0 = low amount of mud, mainly on the inside upper rim of the entrance tunnel; or 1 = abundant mud clearly visible on the outside (Figure 1).



Figure 1. Examples of the intensity of plastering of the nest-box with mud: 0 = low amount of mud on left image, and 1 = abundant mud clearly visible on right image.

Statistical analyses

The distance to the nearest stream for the occupied nest-boxes was normally distributed and was therefore analyzed with GLMM models (SAS 9.1, SAS Institute) assuming a normal error distribution with species as explanatory factor and nest and year as random factor.

We used generalized linear mixed models (Glimmix procedure) with nest and year as random factor to test whether nest composition (*Cistus* or pine bark) could be explained from the distance to the nearest pines and whether the amount of mud on nest-boxes (low or abundant) could be explained from distance to the streams.

RESULTS

The distance to streams between all the nest-boxes and nest-boxes occupied by Pied Flycatchers was similar while Nuthatches occupied nest-boxes significantly closer to streams ($F_{1,471}=7.12$, $P<0.001$, Fig. 2).

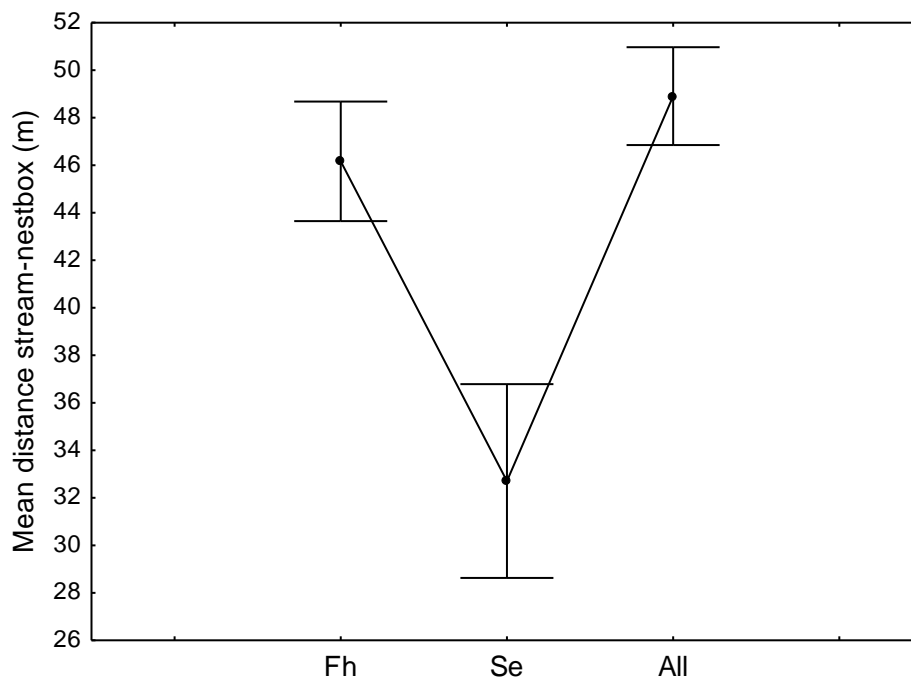


Figure 2. Mean (\pm SE) distance (m) between the nearest stream and nest-boxes occupied by Pied Flycatchers (Fh, $n=200$), and nest-boxes occupied by Nuthatches (Se, $n=51$) and all the nest-boxes available in the study area (All, $n=300$).

Nuthatches used pine bark as nesting material when there was a pine close to the nest-box (average distance to nearest pine of these nests 63 ± 44 m) and used *Cistus* barks when the distance to the nearest pine was long (average distance to nearest pine of these nests 222 ± 109 m; $F_{1,47}=17.1$, $P<0.001$). The maximum distance of a nest built of pine bark ($n=27$) to the nearest pine was 104 meters and

the minimum distance of a nest built of *Cistus* bark ($n=24$) to the nearest pine was 106 meters

Nuthatch nests used more mud as nesting material ($n=20$) when there was a stream close to the nest-box (average distance to streams of nests with mud 23 ± 21 m) and used lower amounts of mud no mud ($n=19$) when the distance to the nearest stream was long (average distance to streams of nests without mud 44 ± 35 m; $F_{1,35}=4.03$, $P=0.005$).

DISCUSSION

This study shows some clear patterns of nesting material and nest-box selection in Nuthatches. We found that Nuthatches used pine bark when there was a pine available within 100 m and selected *Cistus* bark when this distance is greater. We also found that Nuthatches selected nest-boxes closer to streams than Pied Flycatchers. The distance to the streams also explained the amount of mud used by Nuthatches for plastering the nest-boxes.

Nest building is one of the better-studied elements in the natural history of Nuthatches (Matthysen 1998), but the information about nesting material selection is limited. Do Nuthatches have preferences for particular nesting materials? While some studies found that certain bird species may have a preference for a particular nesting material, despite a high cost of collecting (Putnam 1949), other studies found that birds may simply use the first type of suitable material that they encounter (Surgey et al. 2012). The availability of nesting material and the distances travelled to collect them can impose a significant energetic cost and may also increase the risk of predation while the adult is searching for material (Hansell 2000).

Nuthatch nests in our study area were composed mainly of pine bark flakes or strips of bark of *Cistus* shrubs (Cantarero et al. 2013). *Cistus* bark was abundantly available throughout the study area, but this nesting material was replaced by pine bark when pines were available close to the nesting site. Several studies found that Nuthatches may leave the territory in search of pine trees (Löhrl

1958, Bohr 1962), travelling hundreds of meters, but the reason why Nuthatches prefer this nesting material remains unknown (Cantarero et al. 2013). Variation in the type of bark used for nest construction shows that Nuthatches are flexible in their choice of nesting material; particular materials may be preferable but may be hard to find or costly to transport. Flight is an energy demanding activity that imposes several physiological challenges on birds (e.g. Costantini et al. 2008). Before egg-laying, Nuthatch females spend 10-20 % of their time nest building and reduce resting time while devoting more time to foraging than males (Enoksson 1990). Obtaining pine bark from far away could lengthen the period of nest building, a stage that typically takes a few weeks (Matthysen 1998). Females may enhance their own fitness by reducing their effort on nest construction (Moreno et al. 2010). Furthermore, given the strictly territorial character of Nuthatches (Matthysen 1998), intruding into a foreign territory to find adequate nesting material may increase the risk of becoming involved in territorial interactions with neighbours.

To conclude, we found significant differences in the distance to streams of occupied nest-boxes by Nuthatches and Pied Flycatchers. Availability of nesting materials may act as a constraint on nest site selection (Hansell 2000). By selecting nest-boxes near streams, Nuthatches may reduce considerably the energetic costs of nest-building (Matthysen 1998). The higher amount of mud from nest sites near streams supports this suggestion, though based on this study we cannot exclude the possibility that other factors than transport costs contribute to the observed nesting patterns as well. Pied Flycatchers do not use mud as nesting material, which may explain why we found no preference for nesting near streams in this species.

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