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NEST SITES USED BY BROWN-HEADED NUTHATCHES IN THE VIRGINIA COASTAL PLAIN

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INTRODUCTION

The Brown-headed Nuthatch (*Sitta pusilla*), a cavity-nesting bird endemic to the southeastern United States, appears to be experiencing population declines. Breeding Bird Survey data gathered between 1966 and 1995 show a range-wide annual population decrease of 1.8% (Withgott and Smith 1998). The objective of this study was to determine if there is evidence of Brown-headed Nuthatch declines in Virginia and if there is evidence suggesting that the remaining birds are limited by a scarcity of desirable nest sites. This second objective was approached in three ways: (1) determining whether Brown-headed Nuthatches are selective in choosing nest sites, (2) determining whether nest sites used today differ from those favored historically and (3) determining whether an abundance of competitors for tree cavities is lowering the quality of nest sites.

Brown-headed Nuthatch habitat has been broadly defined as mature pine woodland with an open understory (Morris 1982, Haney 1981, Withgott and Smith 1998), though published details of habitat requirements are somewhat contradictory. While some studies characterize Brown-headed Nuthatches as a species that is restricted to mature pine woods (Conner et al. 1983, Johnston and Odum 1956), others describe populations of Brown-headed Nuthatches in cypress swamps and mixed pine-hardwood forests (Haney 1981, Slater 1997). Historical data suggest that Brown-headed Nuthatches tend to nest in highly decayed snags (standing dead trees) or stumps at low heights (< 3 m, Table 1).

Table 1. Nest heights reported in previous studies of Brown-headed Nuthatches.

	Nests	Location	Source
50	median 1.21 m	Georgia	Norris 1958
57	mean 2.3 m	Lousiana	Morris 1982
7	mean 2.4 m	Texas	O'Halloran and Conner 1987
309	mean 2.09 m	range-wide	McNair 1984

One possible limiting factor for Brown-headed Nuthatch populations is competition with other birds for suitable cavity sites. Many cavity nesters are larger and more aggressive than nuthatches, and some of them (secondary cavity nesters) acquire holes by usurping the excavating species (primary cavity nesters). Nuthatches are considered weak primary cavity nesters: they excavate nest holes but are not as strong as woodpeckers. A significant negative correlation was found between primary cavity-nesting bird (CNB) abundance and weak primary CNB (chickadee and nuthatch) abundance in British Columbia (Martin and Eadie 1999), suggesting that weak primary CNBs suffer from competition with other primary CNBs. CNB population densities have been positively correlated with snag density, suggesting nest site limitation at low snag densities (Land 1986, Zarnowitz and Manuwal 1985). Even with abundant snags, the quality of potential nest sites may vary substantially. Competition with other primary cavity nesters may be forcing Brown-headed Nuthatches to excavate their cavities in sub-optimal locations, leading to greater nest predation and reduced breeding success.

My study tested four specific predictions: (1) Virginia Christmas Bird Counts in Brown-headed Nuthatch habitat will show declining numbers in recent years; (2) nuthatches are selective in choosing cavity locations; (3) Brown-headed Nuthatch nest sites in Virginia will differ from historical descriptions of favored sites in terms of cavity height, cavity tree condition, and immediate nest environment; and (4) nuthatches will be relegated to lower quality nest sites where there are more competitors for nest trees.

Methods

Brown-headed Nuthatch populations in Virginia. - This study was carried out at five locations in the coastal plain of Virginia: Chincoteague National Wildlife Refuge (Accomack County), Jamestown Island National Historic Park (James City County), Hog Island Wildlife Management Area (Surry County), Guinea (Gloucester County), and Plum Tree Island Wildlife Management Area (Poquoson City). Each study location contained areas of pine-dominated woodlands bordered by marshes, a habitat that is typical of the Brown-headed Nuthatch (Withgott and Smith 1998).

I carried out nest searches from March - June in 1997 and 1998. Nests were located by listening for vocalizations while walking through the forest, and then following birds to the cavity. Nests which were under excavation when found were visited repeatedly until I observed birds making regular feeding visits to the cavity.

Nest site characteristics. -The following characteristics were recorded at each nest: tree condition (alive or dead), number of branches remaining (in five classes: 0, <5, 5-10, 10-20, >20), state of tree top (broken or intact), percent bark cover (0, 25, 50, 75, 100), presence of other cavities, height of the cavity, and degree of vegetative cover around the cavity.

My analysis of nest site characteristics began with the hypothesis that nuthatches were selective in choosing cavity sites. Observed nest site characteristics were tested against a binomial distribution, with the binomial distribution

expected if nuthatches were not selective. Midpoints for the binomial tests were established *a priori*, when possible, based on published statements about Brown-headed Nuthatch nest sites and on published data from other cavity-nesting birds when details specific to Brown-headed Nuthatches were not available.

To evaluate whether Brown-headed Nuthatch nests were being built in less desirable sites, I compared characteristics of the nests I found with those of ideal nest sites based on descriptions in the literature (McNair 1984, Li and Martin 1991). I hypothesized that if nuthatches were unable to find ideal sites, the nests I found would differ significantly in one or more of the following characteristics: cavity height (<3 m); cavity free of vegetative cover; and nest tree in state of advanced decay as demonstrated by broken top, < 5 branches present, > 50% bark missing, and multiple cavities present.

Potential competitors for cavities. - If competition with other cavity nesting birds is forcing Brown-headed Nuthatches to nest in low-quality locations, there should be a negative correlation between the number of potential competitors in an area and the quality of the nest site chosen. In other words, nuthatches may be forced into sub-optimal locations when too many competitors are present. In order to test the hypothesis that nest site quality would decrease as the number of local cavity nesting birds increased, I carried out ten-minute, fixed-radius point counts (Bibby et al. 1992) at each of the 23 nest sites located in 1998. Center points for the counts were set at 10 m from the nest tree in a randomly selected direction (to minimize disturbance of active nests). I used a rangefinder to select four reference points each at 25 and 50 m from the nest. After selecting reference points, two minutes were allowed to pass before beginning the count. All individuals of a cavity nesting species, detected by sight or sound, were recorded. Point count sessions began at least 30 minutes after, and were completed within four hours of, sunrise. Each nest area was surveyed twice between June 12 and June 25, with count order within a study location chosen randomly.

I created a scale for evaluating quality of nest-sites, using site characteristics which have been found to be positively correlated with cavity-nesting bird diversity and/or nesting success. These characteristics include: presence of snags in an advanced state of decay (Land 1986), as indicated by broken tops, few remaining branches, and reduced bark cover (Schreiber and deCalesta 1992, Connor et al. 1975); nest height (Li and Martin 1991, Miller and Miller 1980); little foliage cover around the nest (Li and Martin 1991); and lack of a tall understory (Land 1986). A high score indicated a high quality nest site. Nests were ranked in the following ordinal categories: state of tree (live = 1, dead = 0), bark cover (0-25% = 1, 25-75% = 0.5, 75-100% = 0), remaining branches (0-10 = 1, 10-20 = 0.5, >20 = 0), broken top (yes = 1, no = 0), vegetation around cavity (open = 1, partially occluded = 0.5, occluded = 0), presence of other cavities (yes = 1, no = 0), and cavity height (> 5 m = 1, 3-5 m = 0.5, < 3 m = 0). Thus, the best possible nest site was ranked "7", and the worst "0".

Results

Brown-headed Nuthatch populations in Virginia. - I analyzed twenty-nine years of Christmas Bird Count data (1965 - 1994) from the nine counts in Virginia which regularly reported Brown-headed Nuthatches: Back Bay, Cape Charles, Chincoteague, Danville, Little Creek, Matthews, and Wachapreague. Four other counts in Virginia have reported Brown-headed Nuthatches (J. H. Kerr Reservoir, Martinsville, Philpott Reservoir, and Banister River Wildlife Management Area), but fewer than ten years of data were available for these counts, so they were not included in the analysis. My analysis showed significant declines at two locations (Back Bay: $r^2 = 0.369$ and $p = 0.0005$, Cape Charles: $r^2 = 0.503$ and $p < 0.0001$) and non-significant negative trends at three others (Chincoteague, Danville, and Newport News). Analysis showed a significant increase at Wachapreague ($r^2 = 0.081$, $p = 0.0164$).

Nest site characteristics. - Nest site analysis was carried out on all 29 nests found in 1997 and 1998. Significant departures from the expected binomial distribution were found for cavity height, vegetative cover around cavity entrance, number of branches remaining on the cavity tree, and presence of other cavities (Table 2). In other words, nuthatches appear to be selecting nest sites which are high, free of vegetative cover, and have other cavities present. Nest trees had more branches remaining than were expected. No significant departures from the binomial distribution were found for whether the cavity tree was alive or dead, percent bark cover, or if the cavity tree had a broken top (Table 2), suggesting that these characteristics are not being used by Brown-headed Nuthatch in selecting nest sites.

Potential competitors for cavities. - The mean number of potential competitors at a nest site ranged from 1.8 birds at Jamestown to 5.2 birds at Hog Island. No relationship was found between the mean number of CNBs detected at each nest site and nest quality ($r^2 = 0.03$, $p = 0.37$). I carried out *post hoc* analyses of the point count data in which I evaluated nest site quality with only primary CNB numbers, and repeated the analysis with only secondary CNBs. No relationships were found (primary: $r^2 = .0007$, $p = .90$, secondary: $r^2 = .07$, $p = .21$). Further *post hoc* analysis showed no relationship between nest site quality and the number of small cavity nesting birds ($r^2 = .04$, $p = .34$), medium cavity nesting birds ($r^2 = .03$, $p = .40$), and large cavity nesting birds ($r^2 = .003$, $p = .79$) (See Table 2).

Table 2. Nest site characteristics compared to an expected binomial distribution.

Characteristic	Number of nests in category	Deviates from binomial distribution?	P
cavity height	<3 m = 2, >3 m = 27	yes	< 0.001
# branches	<5 = 9, >5 = 20	yes	0.03
other cavities	yes = 28, no = 1	yes	< 0.001
vegetative cover	open = 28, occluded = 1	yes	< 0.001
bark cover	<50 % = 16, >50% = 13	no	0.36
broken top	yes = 19, no = 10	no	0.07
tree condition	live = 10, dead = 19	no	0.07

Discussion

Nest site characteristics. - Loss of pine habitat has been linked to Brown-headed Nuthatch population declines in southern Florida (Slater 1997) and on Grand Bahama Island (Smith and Smith 1994). Even in areas where large tracts of pine forest remain, changes in forest character due to fire suppression or selective logging may have occurred. Snag density is commonly considered a limiting factor for cavity nesting birds (Conway and Martin 1993, Li and Martin 1991, Zarnowitz and Manuwal 1985). Short timber rotations are likely to lead to a reduction in snags, which could cause a shortage of nest sites. Even with adequate snags or cavity sites, increased deciduous cover resulting from fire suppression has been associated with reduced breeding success of cavity nesting birds in an Oregon study (Li and Martin 1991). The importance of fire to habitat maintenance was demonstrated in an Arkansas study in which the highest density of Brown-headed Nuthatches was found in burned (treatment) plots, while the unburned (control) forest plots had dense hardwood mid-stories, sparse ground cover, and greater canopy cover (Wilson et al. 1995).

The nest characteristics I observed in 1997 and 1998 were quite different than those predicted from data in previous studies. In marked contrast to reports that the majority of Brown-headed Nuthatch nests occur lower than 3 m, only two of the 29 nests I found were below 3 m. The mean height of 10.01 m (range: 2.2 m - 29.3 m) was much closer to a recently reported mean of 10.9 m for southern Florida (Slater 1997). Previous studies depended largely on data from amateur ornithologists who encountered nests haphazardly, rather than on data systematically collected by field researchers. The current understanding of Brown-headed Nuthatch nest site characteristics may be skewed by dependence on casual observations, as low nests in classic snags would be more likely to be spotted than would a nest in a dead branch near the top of a tall tree. In support of this explanation for biased historical records, the mean nest height observed in the field by Morris (1982) was 3.5 m, while the mean height he calculated from museum "nest card" records was 1.5 m (Morris 1982).

It is widely accepted that Brown-headed Nuthatches require snags in an advanced state of decay (McNair 1984). Indicators of such snags include the presence of other cavities, broken tops, few remaining branches, and little bark remaining. I expected to find Brown-headed Nuthatches nesting in low pine snags with few branches and bleached white trunks without bark, but the majority of my nest trees did not fit this search image. Ten of twenty-nine nests were not in snags, but were in dead portions of live trees (with three of these being deciduous trees). Previous accounts of the Brown-headed Nuthatch indicated that the vast majority of nests would occur in snags. The prevalence of live nest trees partially explains the deviation from expected cavity tree characteristics: fewer than expected had broken tops, fewer than expected had < 50% bark cover, and more than expected had more than five branches remaining.

The results support the hypotheses that Brown-headed Nuthatches are being selective in choosing cavity sites and that characteristics of nest sites in Virginia

differ from historical descriptions. Cavity sites were high and predominantly free of vegetative cover, characteristics of a high quality site.

Potential competitors. - Both primary cavity nesters (red-bellied woodpeckers) and secondary cavity nesters (eastern bluebirds) have been reported to usurp Brown-headed Nuthatch nests (Slater 1997). On several occasions I observed aggressive encounters between other cavity-nesting birds and a nuthatch on the nest tree. These encounters were most commonly with red-bellied woodpeckers, but I also observed two conflicts with tree swallows.

No correlation was found between number of cavity nesting birds at a nest site and apparent nest quality, suggesting that nuthatches are not being driven into lower quality nesting habitat by competitors. However, this does not allow a firm conclusion that competition with other cavity-nesting birds has no effect on nest site choice in Brown-headed Nuthatches. It could be that the indicators of a quality nest site which I used are not what the Brown-headed Nuthatch uses to assess quality. Despite failure to find evidence of competition, further evaluation of species abundance of potential competitors could reveal informative patterns. I recommend carrying out point counts throughout the entire breeding season, as my point counts were done once all Brown-headed Nuthatch nests were active. Competitors present only during excavation or later in the breeding season may have been missed.

Many (34%) of the nests in this study were found in dead portions of live trees, suggesting that traditional snags may not be a resource critical to Brown-headed Nuthatches. While snags were available near each of the nest sites in this study, they may not have been chosen because of some shortcoming of snag or location or it may be that Brown-headed Nuthatches do not differentiate between dead wood in a snag or dead wood in a live tree. The small size of Brown-headed Nuthatches (length 105 - 110 mm, Withgott and Smith 1998) may allow them to nest more readily in branches and small diameter snags, in contrast to woodpeckers which require snags with a diameter at breast height of at least 20-30 cm (Conner et al. 1975).

In conclusion, Brown-headed Nuthatches in the coastal plain of Virginia appear to be declining in keeping with the range-wide trend. They are using nest sites that differ from those described in the literature, most notably higher cavities in live trees, including deciduous species. However, I found no empirical support for the hypothesis that these non-traditional nest sites are being used to avoid competitions with more aggressive cavity nesting species such as woodpeckers. Some of the discrepancy between observed and expected nest sites could be due to inaccuracies in the literature, but further study is necessary before the hypothesis that Brown-headed Nuthatches have shifted to sub-optimal nest sites can be rejected.

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Appendix

Potential competitor species for Brown-headed Nuthatch breeding sites.

Small species (<15 cm): Tree Swallow *(Tachycineta bicolor)*, Carolina Chickadee *(Poecile carolinensis)*, Carolina Wren *(Thryothorus ludovicianus)*, House Wren *(Troglodytes aedon)*

Medium species (15-24 cm) Downy Woodpecker *(Picoides pubescens)*, Hairy Woodpecker *(Picoides villosus)*, Great Crested Flycatcher *(Myarchus crinitus)*, Eastern Bluebird *(Sialia sialis)*, European Starling *(Sturnus vulgaris)*, Tufted Titmouse *(Baeolophus bicolor)*, House Finch *(Carpodacus mexicanus)*

Large species (>24 cm): Northern Flicker *(Colaptes auratus)*, Pileated Woodpecker *(Dryocarpus pileatus)*, Red-bellied Woodpecker *(Melanerpes carolinensis)*, Red-headed Woodpecker *(Melanerpes erythrocephalus)*.