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## THE RED-HEADED WOODPECKER AND BROWN-HEADED NUTHATCH ON THE OAK RIDGE RESERVATION: RELATIONSHIP TO RECENT LANDSCAPE CHANGES

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### ABSTRACT

Prior to the mid-1990s, sightings of the Red-headed Woodpecker (*Melanerpes erythrocephalus*) on the Oak Ridge Reservation (ORR) were unusual, and the Brown-headed Nuthatch (*Sitta pusilla*) was not known to occur on the ORR. Since 1996, each of these species has been observed more than a dozen times at various localities on or adjacent to the ORR. Red-headed Woodpeckers are presumed, based upon sightings of juveniles, to have successfully fledged young on the ORR in 2000 and 2001. Although Brown-headed Nuthatches have been observed during the breeding season, their current breeding status on the ORR is not known. Anecdotal evidence suggests that landscape changes resulting from beaver (*Castor canadensis*) and southern pine beetle (*Dendroctonus frontalis*) activity may be important in the recent appearance of Red-headed Woodpeckers on the ORR. A potential increase in insect food resources resulting from such activities is presented as a possible argument for the recent occurrence of Brown-headed Nuthatches. A causal relationship, however, between beaver and pine beetle activity and the existence of Brown-headed Nuthatches on the ORR is less certain, and their appearance here fits a decade-long pattern of northward expansion of their range in Tennessee.

### INTRODUCTION

Recent sightings of Red-headed Woodpeckers (*Melanerpes erythrocephalus*) on the

Oak Ridge Reservation (ORR) have closely followed, both temporally and spatially, the activities of southern pine beetles (*Dendroctonus frontalis*) and/or beavers (*Castor canadensis*) (Table 1). Landscape changes that resulted from these two very different species (beetles and beavers) provided prime habitat, where none previously existed, for the Red-headed Woodpecker. Brown-headed Nuthatches (*Sitta pusilla*) also appeared on the ORR subsequent to pine beetle and beaver activity. We are less convinced, however, that a causal relationship exists between pine beetle and beaver activity and the recent appearance of this nuthatch species on the ORR. We postulate that the existence of relatively mature pine stands, and to a lesser extent an increase in insect food resources in dead and dying stands, has contributed to the recent discovery of Brown-headed Nuthatches on the ORR.

Studies of ORR birds through the mid-1990s (Howell 1958, Anderson and Shugart 1974, Kroodsma 1982, Kroodsma 1984a and b, Hardy 1991, Mitchell et al. 1996) rarely reported the Red-headed Woodpecker and did not report the Brown-headed Nuthatch. It was not until the comprehensive inventory by Mann et al. (1997) that the presence of the Brown-headed Nuthatch on the ORR was recognized. This report was based on the earliest known sightings of this species on the ORR in September 1996. Brown-headed Nuthatches had been discovered by Beth Schilling a month prior to this, in the pines at the Melton Hill Dam campground (MHDA site) just off the ORR on the Loudon County side of the Clinch River (Fig. 1). In the early 1950s, the Red-headed Woodpecker was listed as one of the species utilizing the White Oak Creek watershed (Krumholz 1954) on the ORR. We could find nothing in the literature regarding these woodpeckers on the ORR in the nearly 50-year period since the Krumholz study.

**Red-headed Woodpecker.** The Red-headed Woodpecker was listed "In Need of Management" in Tennessee from 1976 to 1994, and any sightings of this bird in east Tennessee are worth noting. It is not uncommon, however, to find veteran bird-watchers who remember seeing this species fairly regularly in the east end of the state through the 1960s. Howell observed Red-headed Woodpeckers on 122 of 372 trips (154 roadside censuses and 218 field trips) taken in Knox County in the years 1947-1953 (Howell and Monroe 1957). Christmas Bird Count (CBC) data show that Red-headed Woodpeckers have been found on 21 counts conducted in Knoxville (the closest CBC to the ORR) from 1902 to 2001, including the three most recent counts (1999, 2000, and 2001) (all CBC data can be viewed at the Cornell Lab of Ornithology website, <http://birds.cornell.edu/>). Red-headed Woodpeckers are fairly common on the Cumberland Plateau, in Cumberland County, approximately 60 km west of the ORR.

**Brown-headed Nuthatch.** The Brown-headed Nuthatch is among the species "Tracked in Tennessee" by the Tennessee Natural Heritage Program, a division of the Tennessee Department of Environment and Conservation. The "S2" state ranking assigned to this species indicates that it is "very rare and imperiled within the state, six to twenty occurrences, or few remaining individuals, or because of some factor(s) makes it vulnerable to extinction" (Natural Heritage website, <http://www.state.tn.us/environment/nh/>).

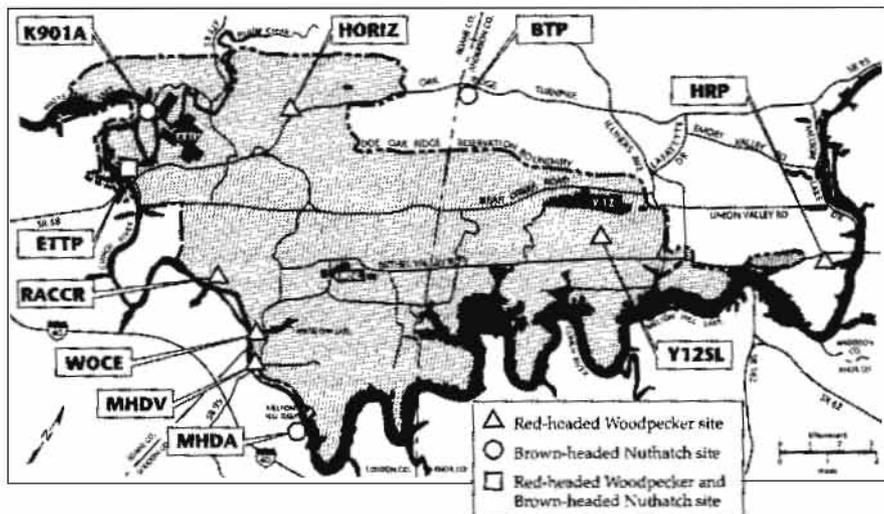


Figure 1. Oak Ridge Reservation showing locations of Red-headed Woodpecker and Brown-headed Nuthatch sightings.

Table 1. Primary habitat type, evidence of southern pine beetle (SPB) activity, and evidence of beaver activity in the immediate vicinity (~100 m radius) of sites where Red-headed Woodpeckers and Brown-headed Nuthatches have been observed on or near the Oak Ridge Reservation (site acronyms in bold type are located outside the ORR boundary).

Site <sup>1</sup>	Habitat Type <sup>2</sup>	SPB Activity	Beaver Activity	Species Observed <sup>3</sup>	Notes
<b>BTP</b>	PINE	No	No	BHNU	most trees healthy
<b>ETTP</b>	PINE	Yes	Yes	both	pinus killed by both SPB and beaver
<b>HORIZ</b>	MPHW	Yes	No	RHWO	most pines killed
<b>HRP</b>	MPHW	No	No	RHWO	trees healthy; predominately hardwoods
<b>K901A</b>	MPHW	No	Yes	BHNU	trees healthy
<b>MHDA</b>	PINE	No	No	BHNU	most trees healthy
<b>MHDV</b>	PINE	Yes	No	RHWO	extensive pine kill
<b>RACCR</b>	MPHW	Yes	Yes	RHWO	most pines killed by SPB, not beaver
<b>WOCE</b>	PINE	Yes	Yes	RHWO	most pines killed by SPB, not beaver
<b>Y12SL</b>	MPHW	No	No	RHWO	forest broken by extensive fields; trees healthy; predominately hardwoods

<sup>1</sup> Site: Big Turtle Park (BTP), Beaver impoundment south of East Tennessee Technology Park (ETTP), Horizon Center Industrial Park (HORIZ), Haw Ridge Park (HRP), Retention basin west of East Tennessee Technology Park (K901A), Melton Hill Dam campground (MHDA), Area north of Charles Vanden Bulck Bridge (S.R. 95 at Clinch River)(MHDV), Raccoon Creek Road (RACCR), White Oak Creek Embayment (WOCE), Y12 Sanitary Landfill (Y12SL)

<sup>2</sup> Habitat Type: predominately pine forest (PINE), mixed pine-hardwood forest (MPHW)

<sup>3</sup> Species Observed: Brown-headed Nuthatch (BHNU), Red-headed Woodpecker (RHWO)

**Table 2.** Red-headed Woodpecker observations on or near the Oak Ridge Reservation.

Site	Date	No. Obs <sup>1</sup>	No. Trips <sup>2</sup>	Observers <sup>3</sup>	Notes
HRP	~1985	1	1	RLK	
Y12SL	Sep 97	1	1	MGR, WKR	
	Jan 00	2	2	JWE, WKR	-0.3 km east of original sighting
ETTP	May 00	1	1	MGR, WKR	adult moving to and from cavity
	Aug 00	2	2	JWE, WKR	1 juvenile observed
	May 01	1-3	3	JJB, JWE, MGR, WKR	also seen on public bird walk
	Jun 01	2	1	JWE, WKR	adults carrying food to cavity
	Jul 01	1-3	2	JWE, WKR	1 juvenile observed
	Aug 01	2	2	MGR, WKR	
	Sep 01	4	1	JWE, WKR	2 juveniles observed
	Oct 01	2	2	WKR	
	Nov 01	1	3	LKL, RHL, WKR	
	Dec 01	1	1	WKR	
	Jan 02	2	2	JWE, LKL, RHL, WKR	
RACCR	Jun 01	2	1	JWE	
HORIZ	Sep 01	1	1	BRC, JMC	
WOCE	Sep 01	3	1	JWE, WKR	1 juvenile observed
MHDV	Nov 01	3	1	MKM, WKR	

<sup>1</sup> No. Obs: Maximum number of Red-headed Woodpeckers observed per trip

<sup>2</sup> No. Trips: Number of visits during which Red-headed Woodpeckers were observed

<sup>3</sup> Observers: Jake J. Beaulieu (JJB), Betty Reid Campbell (BRC), James M. Campbell (JMC), James W. Evans (JWE), Roger L. Kroodsmas (RLK), Leigh K. Loveday (LKL), Robert H. Loveday (RHL), Mary K. McCracken (MKM), W. Kelly Roy (WKR), Michael G. Ryon (MGR)

**Table 3.** Brown-headed Nuthatch observations on or near the Oak Ridge Reservation.

Site	Date	No. Obs <sup>1</sup>	No. Trips <sup>2</sup>	Observers <sup>3</sup>	Notes
MHDA	Aug 96	2	1	EMS, WKR	
	Sep 96	1	1	MGR, WKR	additional bird(s) heard only
	Mar 97	2	1	EMS, WKR	
	Oct 97	1	1	EMS, WKR	additional bird(s) heard only
	Oct 01	2	1	WKR	
	Nov 01	2-3	2	LKL, RHL, WKR	
	Jan 02	1	1	LKL, RHL	
ETTP	Sep 96	1	1	EMS, WKR	additional bird(s) heard only
	Mar 98	1	1	MGR, WKR	
	Sep 99	2	1	WKR	
	Aug 00	0	1	JWE	1-2 birds heard only
	May 01	1	1	MGR, WKR	
	Jun 01	0	1	JWE, WKR	1-2 birds heard only
K901A	Feb 97	1	1	EMS	
BTP	May 01	1	2	JJB	

<sup>1</sup> No. Obs: Maximum number of Brown-headed Nuthatches observed per trip

<sup>2</sup> No. Trips: Number of visits during which Brown-headed Nuthatches were observed

<sup>3</sup> Observers: Jake J. Beaulieu (JJB), James W. Evans (JWE), Leigh K. Loveday (LKL), Robert H. Loveday (RHL), W. Kelly Roy (WKR), Michael G. Ryon (MGR), Elizabeth M. Schilling (EMS)

This nuthatch was first discovered in Tennessee in 1968 in Hamilton County, which, along with the adjoining counties of Polk and Bradley, continues to be the stronghold for breeding populations in the state (Nicholson 1997). In 1980, a site near Ooltewah (Hamilton County) was the only known regular location for this species in Tennessee (Bierly 1980). It has been observed once in Van Buren County at Fall Creek Falls State Park in 1974 (Nicholson 1997), as well as on the Natchez Trace Parkway near the Tennessee-Alabama state line (Bierly 1980). Very little is known regarding the distribution of this species in the area between Polk/Bradley/Hamilton Counties and the ORR, although Tanner (1988) has reported the species in southern Meigs County. Some of the northernmost records of this species in Tennessee are from sightings at Frozen Head State Natural Area (July 1995) in Morgan County (C. P. Nicholson, pers. comm.) and Anderson County Park (2000 Norris CBC result). Sightings in recent years have also come from Kingston Steam Plant (reliably since about 1994) in Roane County and Cookeville (2001 Cookeville CBC result) in Putnam County. This species has been recorded once (1914) on a Knoxville CBC, although some ornithologists question this record (C. P. Nicholson, pers. comm.).

**Recent Landscape Changes.** Natural landscape alterations that have occurred on the ORR in the last decade can be attributed, in part, to the southern pine beetle and to the beaver. Two major outbreaks of the southern pine beetle, one in 1993-1994 and the other in 1999-2001, have occurred on the ORR. Approximately 28% of the ORR was in pine or pine/hardwood forests prior to 1993. Since these two outbreaks, 790 ha of pines have been salvaged leaving approximately 1320 ha of standing dead pines and 1740 ha of living pine or pine/hardwood forests on the ORR (J. W. Webb, pers. comm.). Approximately 13% of the ORR is currently estimated to be in living pine or mixed pine forests. Fewer than 40 ha of pines have been replanted since these outbreaks, with no additional planting of pines scheduled. The latest outbreak is not expected to have significant impacts on the ORR in the 2002 season (J. W. Webb, pers. comm.).

The status and history of beavers on the ORR is not well documented. They were not present in the early 1950s, at least not in the White Oak Creek watershed, when Krumholz (1954) conducted his ecological survey of this region. Exactly when beavers recolonized the ORR after being extirpated from many east Tennessee counties is unclear. By the late 1980s and early 1990s however, their presence on the ORR was becoming evident, and by the spring of 1995 one of the longest (~50 m) beaver dams in the area was visible on upper White Oak Lake. Beaver activity that results in the stripping of bark from the entire circumference of trees, the felling of trees, and the flooding of forested areas, has led to an increase in standing dead trees and more open forest canopies on certain areas of the ORR. The areas of obvious beaver activity and impacts, though ecologically significant, are quite limited in size. With respect to beaver-killed and -downed trees, less than one percent of the ORR landscape has been impacted. We estimate 10-15 active beaver colonies (dams, lodges, or areas of significant beaver activity) were present on the ORR in late 2001.

## METHODS

**Site Description.** The ORR consists of approximately 13,900 ha of land in southwest Anderson and northeast Roane Counties in east Tennessee (Fig. 1). Aside from an abandoned reactor project, development and expansion of waste storage facilities and landfills, and relatively minor expansions of Department of Energy facilities, a core area of the ORR remained remarkably unchanged for the 50-year period from the mid-1940s to the mid-1990s. Since then, industrial development and new construction initiatives have resulted in less than five percent of ORR lands being converted to private holdings or dedicated to new government facilities.

**Monitoring Programs.** A waterfowl monitoring survey route has been driven routinely since 1990 at varying intervals that have ranged from once/mo to once/wk. In addition to waterfowl and aquatic birds, all birds of prey and unusual or rare birds were recorded by experienced observers. Most observations of both Red-headed Woodpeckers and Brown-headed Nuthatches on the ORR resulted from this regular monitoring program. Observations by non-project personnel and the public serve to further validate the presence of these species on the ORR. Neither of these species have been found on breeding bird surveys conducted on the ORR since 1995 in conjunction with the Partners in Flight Program.

## RESULTS

**Red-headed Woodpecker.** A Red-headed Woodpecker was observed in the Haw Ridge Park area (Fig. 1) just east of the ORR, in the mid-1980s by Roger Kroodsmas (R. L. Kroodsmas, pers. comm.). Approximately 13 km southwest of the ORR, in the Roane County town of Kingston, Jason Mitchell reported seeing adult and juvenile Red-headed Woodpeckers in the summer of 1997 (J. M. Mitchell, pers. comm.). At about this same time (22 September 1997), the first ORR sighting from a waterfowl survey occurred at the Y-12 Sanitary Landfill (Y12SL site) off Clear Spring Road in Anderson County. Since then, this species has been observed more than twenty times from six different localities on the ORR (Fig. 1, Table 2).

Considerable time elapsed between the authors' initial sighting of a Red-headed Woodpecker in September 1997 and our next sightings in January 2000 (Table 2). By the summer of 2001, however, Red-headed Woodpeckers could be observed reliably at a beaver-impounded area south of the East Tennessee Technology Park (ETTP site). Jim and Betty Reid Campbell report seeing them regularly at this location, and also found one at Horizon Center (HORIZ site, Fig. 1), a new industrial park development on the northwest end of the ORR (J. M. and B. R. Campbell, pers. comm.).

A stand of large (average diameter at breast height (dbh) ~25 cm) loblolly pine (*Pinus taeda*) at the ETTP site was flooded in the early- to mid-1990s by the construction of a beaver dam. In late 2001, these pines were in standing water, and would best be characterized as standing snags, void of most bark and of all but the largest branching. European Starlings (*Sturnus vulgaris*), Prothonotary Warblers (*Prothonotaria citrea*), and Red-headed Woodpeckers have been observed utilizing cavities in these snags. A contiguous stand of loblolly pine (mean dbh = 23 cm, n =

10) just west of the flooded snags was invaded by southern pine beetles during the most recent outbreak, resulting in ~90% kill of these trees. This is the only site on the ORR where both Red-headed Woodpeckers and Brown-headed Nuthatches are known to occur (Table 1).

Prior to 2000 there were no known nesting records for Red-headed Woodpeckers on the ORR. Nesting behavior and sightings of juvenile Red-headed Woodpeckers on the ORR have since been documented through the waterfowl monitoring program. Juveniles were observed on 24 August 2000, 11 July 2001, and 10 September 2001 at the ETPP site. A single juvenile was also observed with two adults on 10 September 2001 near the mouth of White Oak Creek (WOCE site), south of Oak Ridge National Laboratory. Although 10 September is within the species' fall migration period (Nicholson 1997), the presence of juveniles and adults together in suitable breeding habitat strongly suggests that these birds nested locally. Observations of juveniles and the carrying of food to tree cavities by adult Red-headed Woodpeckers at the ETPP site strongly indicate breeding on the ORR in 2000 and 2001 (Table 2).

Nicholson (1997) did not report any breeding activity by Red-headed Woodpeckers in either Anderson or Roane Counties for the 1986-1991 period covered by the Atlas Project. However, pre-1980 nesting records do exist for Roane County (Alsop 1980). Red-headed Woodpeckers are double-brooded throughout much of their range, but data from the ORR are insufficient to determine if that is the case here. Red-headed Woodpeckers probably now occur year-round on the ORR, though the months of known occurrence are May through January. Because of the conspicuous nature of this species, it is unlikely that it is considerably more widespread on the ORR than currently reported. It will not be surprising to find increased breeding activity by this woodpecker on the ORR, particularly if the area's forests become more open, and snag density continues to increase.

**Brown-headed Nuthatch.** We believe that Brown-headed Nuthatches were absent from the ORR until sometime very near our original observation in 1996. This species has been reported several times in recent years north of its historic range in Tennessee, in seemingly disjunct tracts of habitat. Many of these sightings have occurred outside the breeding season, although a pair with fledglings was discovered near Kingston in 1995 (Nicholson 1997). No breeding behavior or fledglings have been observed on the ORR. The occurrence of adults here during the breeding season (late February to May) however, is an indication that such discoveries may be forthcoming.

Brown-headed Nuthatches have been observed on or near the ORR more than a dozen times since they were originally discovered at the MHDA site in August 1996 (Table 3). The Brown-headed Nuthatch is known from two localities (ETPP and K901A) on, and two localities (MHDA and BTP) just off the ORR (Fig.1). Like the Red-headed Woodpecker, the Brown-headed Nuthatch is expected to occur year-round on the ORR, as it does in other parts of the state from which it has been reported.

## DISCUSSION

**Red-headed Woodpecker.** There is considerable evidence for decreased numbers of Red-headed Woodpeckers throughout North America dating back to at least the 1930s (Bull 1964, Mengel 1965, Nicholson 1997). The widespread decline has been attributed to a number of factors including highway mortality (Bull 1964, Mengel 1965, Potter et al. 1980), nesting habitat loss (Nicholson 1997), and exposure to chemical preservatives in wooden poles (Harrison 1975, Mengel 1965, Potter et al. 1980). In many areas, reduction in Red-headed Woodpecker numbers coincided with the establishment of European starlings, and nest-site competition by starlings is frequently mentioned as a cause for the woodpecker's decline (Bull 1964, Mengel 1965, Nicholson 1997, Potter et al. 1980, Snyder and Alsop 1991). However, breeding survey data in Tennessee show an increasing trend of 6.5% ( $p < 0.05$ ) for the Red-headed Woodpecker from 1966 to 1994 (Nicholson 1997). The recent sightings on the ORR corroborate this trend.

Because of the timing and localities involved in the ORR sightings (Tables 1 and 2), we believe that both the influx of beavers and the two most recent outbreaks of southern pine beetles were significant factors in the appearance, and apparent breeding, of Red-headed Woodpeckers on the ORR. This species most often nests in open areas in dead trees from which the bark has fallen (Nicholson 1997). Both localities where juvenile Red-headed Woodpeckers have been observed contain such trees, and both localities bear evidence of beaver and southern pine beetle activity (Table 1). Bull (1964) notes that Red-headed Woodpeckers breed in two distinct habitat types: (a) river bottoms and open wooded swamps, with nests most often situated in dead trees standing in water, and (b) open park-like woods, golf courses, and roadsides with large scattered trees and poles. The combination of beavers moving onto the Reservation and major pine kills as a result of southern pine beetle infestations has created several areas of the former habitat type on the ORR.

The utilization of southern pine beetles as a food source by Red-headed Woodpeckers may be limited. This woodpecker's tongue is much less extensible, compared with tongues of other woodpeckers, and has hairlike processes (rather than barbs) near the tip - apparently an adaptation for a more general diet (Henderson 1927 as cited in Smith et al. 2000). Martin et al. (1951) specifically mention that few wood-boring beetle larvae are taken by the Red-headed Woodpecker, and Conner et al. (1994) state that Red-headed Woodpeckers do not normally excavate in trees for food as do other woodpecker species. While direct predation on pine beetles may be limited, Red-headed Woodpeckers do feed rather extensively on insects and arboreal invertebrates, species which are likely to thrive in dead and dying trees. They are reported to be the most omnivorous North American woodpecker and the most adept flycatcher in the woodpecker family (Smith et al. 2000).

It is interesting to note that most observations of Red-headed Woodpeckers (Table 2) and Brown-headed Nuthatches (Table 3) have occurred at localities adjacent to the Clinch River (Fig. 1). Breeding habitat for both species is sometimes associated with water. It is possible, however, that sightings have been more prevalent in these areas because most observations occurred during waterfowl surveys, or subsequent

visits to known localities that were initially discovered while surveying waterfowl. Further investigations into suitable habitats in the interior of the ORR are needed.

**Brown-headed Nuthatch.** The Brown-headed Nuthatch is a pine-obligate species. Although mature longleaf pine (*Pinus palustris*) forests are considered its prime habitat (Nicholson 1997), the bird's distribution virtually mirrors the distribution of native loblolly pine (compare distribution maps from Fowells 1965 and NGS 1999). Perhaps the most significant factor regarding the recent arrival of Brown-headed Nuthatches on the ORR is related to the maturity of the planted loblolly pines on the Reservation. Though they utilize younger stands, it has only been in recent years that most of these stands were sufficiently mature to be considered optimal habitat. The occurrence of Brown-headed Nuthatches on the ORR demonstrates the ability of this species to extend its range beyond the distribution of native loblolly pine, provided that suitable cultivated stands exist.

Brown-headed Nuthatches feed rather extensively on insects and tree-dwelling invertebrates, and they are known to consume wood-boring insects (Kale 1990). About half of their diet consists of pine seeds (Martin et al. 1951), although Withgott and Smith (1998) report that pine seeds can comprise 0-95% of food taken depending on the time of year and cone crop. More than half of the animal matter consumed by these nuthatches consists of beetles, with bark beetles [Scolytidae] noted as being particularly prevalent (Withgott and Smith 1998). Southern pine beetles belong to the family Scolytidae, so it is not unreasonable to expect these nuthatches to follow southern pine beetle outbreaks. While extensive loss of pines from beetle kills may eliminate a significant vegetable component (pine seeds) of this nuthatch's diet, it may also provide a significant animal component (bark beetles). It is interesting to note that southern pine beetle activity was also in evidence at both the Anderson County Park (C. P. Nicholson, pers. comm.) and Cookeville (S. J. Stedman, pers. comm.) locations where Brown-headed Nuthatches have been observed. The presence of these birds at some locations, including the MHDA site and Kingston Steam Plant, is known to precede periods of recent pine beetle activity at those locations. In any case, there can be little doubt as to the increased insect food resources that result from southern pine beetle activity.

Brown-headed Nuthatches generally excavate their own nest cavities, though they occasionally utilize existing cavities of nuthatches or woodpeckers, as well as artificial nest boxes (Withgott and Smith 1998). Because these birds favor partially rotted pine snags as nest-sites (McNair 1984) and because bark beetles are a known food source (Withgott and Smith 1998), the area's southern pine beetle outbreaks cannot be ruled out as an influential factor in the recent appearance of these birds on the ORR. The girdling of trees by beavers may also provide potential nest-sites for this species, and as McNair (1984) notes, this bird frequently selects nest sites over ponds.

**Summary.** The effects of beavers and southern pine beetles on forest habitats have been postulated here to be a possible factor in the return of Red-headed Woodpeckers to the ORR. These landscape-altering species have created much-improved nesting habitat for the Red-headed Woodpecker (and possibly for the Brown-headed

Nuthatch) on the ORR. Such activity opens densely forested habitats making them more suitable for the Red-headed Woodpecker, a bird that is known for its frequent associations with beaver ponds (Snyder and Alsop 1991), bottomland hardwoods (Shackelford and Conner 1997), open park-like forests (Bull 1964), and mature and standing dead trees (Nicholson 1997). Evidence of southern pine beetle and beaver activity in the immediate vicinity of known Brown-headed Nuthatch and Red-headed Woodpecker localities is summarized in Table 1.

We cannot establish a clear link between beaver and beetle activities and the appearance of the Brown-headed Nuthatch on the ORR, and any evidence linking these activities to the occurrence of either bird species is largely anecdotal. Clearly, there are numerous sites on the ORR that bear evidence of southern pine beetle and/or beaver activity that are not inhabited by either of these birds. Because both southern pine beetles and Brown-headed Nuthatches are pine-obligates, a sympatric relationship (between pine beetles and nuthatches) does not infer a causal one as well. In fact, the loss of pines may be one of the factors contributing to Brown-headed Nuthatch dispersal.

Although southern pine beetle outbreaks may provide an increased number of suitable nest-sites and temporary food sources for the Brown-headed Nuthatch, these outbreaks are not believed to be instrumental in the extension of this species' range onto the ORR. Instead, this expansion may be due to the maturation of pine plantations established since the 1930s between Hamilton County and the ORR. These plantations may have provided a corridor for the nuthatch's northward expansion. Ultimately, the potential benefits of beetle outbreaks are likely to be outweighed by the extensive loss of pines upon which this species thrives. A continued die-off of Reservation pines would likely make conditions increasingly untenable for any local Brown-headed Nuthatch colonies. The preservation of remaining healthy pine stands on the ORR is critical if the Brown-headed Nuthatch is to retain its status as a "Reservation bird". Limited Red-headed Woodpecker habitat should remain available on the ORR for at least the next five to ten years, a period during which local populations should remain stable or slightly increase.

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