INFLUENCE OF ARTIFICIAL CAVITY AGE ON RED-COCKADED WOODPECKER TRANSLOCATION SUCCESS

DANIEL SAENZ, Wildlife Habitat and Silviculture Laboratory, Southern Research Station, USDA Forest Service, Nacogdoches, TX 75962.

RICHARD R. SCHAEFER, Wildlife Habitat and Silviculture Laboratory, Southern Research Station, USDA Forest Service, Nacogdoches, TX 75962.

RICHARD N. CONNER, Wildlife Habitat and Silviculture Laboratory, Southern Research Station, USDA Forest Service, Nacogdoches, TX 75962.

D. CRAIG RUDOLPH, Wildlife Habitat and Silviculture Laboratory, Southern Research Station, USDA Forest Service, Nacogdoches, TX 75962.

DAWN K. CARRIE, USDA Forest Service, Sam Houston National Forest, New Waverly, TX 77358.

M. STEPHEN BEST, USDA Forest Service, Ozark National Forest, Clarksville, AR 72830.

Abstract: Red-cockaded woodpecker (*Picoides borealis*) translocations have been used to bolster woodpecker populations and to fill breeding vacancies. Artificial, insert cavities have been used to offset cavity shortages in woodpecker clusters and are the primary cavity type used in recruitment clusters in Texas and Arkansas, but inserts may lose their attractiveness to birds over time. Thirty-nine recruitment clusters received translocated birds on the Angelina, Davy Crockett, and Sam Houston National Forests in eastern Texas and 13 clusters in the Ouachita National Forest in western Arkansas were surveyed from March through June 1998 and 1999 to determine the success rate of translocations into recruitment clusters containing new and old inserts. Clusters with inserts installed within 1 year of woodpecker translocations (n = 26) were occupied by at least 1 bird at 77 % of the clusters, whereas clusters (n = 26) with older inserts had a lower success rate of 23 % (x^2 = 15.07, P > 0.001). If cavity inserts are the artificial cavity technique used, installation of new inserts just prior to woodpecker translocation should significantly improve the overall success rate of a red-cockaded woodpecker translocation program and facilitate the recovery effort.

Key words: red-cockaded woodpecker, *Picoides borealis*, new inserts, translocation success.

The endangered red-cockaded woodpecker is a cooperatively breeding species that is indigenous to the southeastern United States (Ligon 1970, Walters et al. 1988*a*). Red-cockaded woodpeckers live in small groups that excavate their roost and nest cavities in a "cluster" of living pines (*Pinus* spp.) that are generally in close proximity to each other.

James (1995) reported that red-cockaded woodpecker populations were in decline throughout most of the species' range during the 1980s. Habitat fragmentation caused by deforestation has been shown to negatively affect woodpecker group size and cause demographic isolation (Conner and Rudolph 1991*b*, Rudolph and Conner 1994). As a result, the rate of successful dispersal of subadult birds to other woodpecker groups, to fill breeding vacancies, has likely declined in most populations (Conner and Rudolph 1991*b*). A lack of suitable cavities was probably another major cause of woodpecker decline (Costa and Escano 1989). Conner and Rudolph (1995*b*) reported that cavity losses were exceeding new cavity excavation by the woodpeckers in eastern Texas and were likely a factor in causing cluster abandonment and subsequent population declines.

Techniques to construct artificial cavities were developed in the late 1980s to offset the cavity deficit (Copeyon 1990, Allen 1991). In national forests in Arkansas and Texas, the insert (Allen 1991) was chosen as the main artificial cavity type. The insert design consists of a nest box made of western redcedar (*Thuja plicata*) that is inserted into a living pine tree with the aid of a chainsaw. The insert has an advantage over the drilled (Copeyon 1990) cavity in that it can be used in trees with small heartwood diameters (typical of young trees) as long as the overall diameter of the tree is large enough to house the insert (>38 cm). Copeyon et al. (1991) demonstrated that clusters of artificial cavities placed in recruitment stands in the vicinity of existing red-cockaded woodpeckers could induce the formation of new social groups. In Texas, new group formation was rare despite the provisioning of artificial cavities in the early 1990s (D. Saenz et al., U.S. Forest Service, unpublished data). With the cavity deficit problem seemingly solved the problem of dispersal in very small and isolated populations still existed.

DeFazio et al. (1987) successfully translocated

subadult females to clusters containing solitary male red-cockaded woodpeckers. The successful translocation of pairs of woodpeckers into unoccupied clusters soon followed (Rudolph et al. 1992, Costa and Kennedy 1994, Carrie et al. 1999). New group formation in previously unoccupied habitat via translocation requires the use of artificial cavities for roosting sites for the birds because of the lengthy period of time required for natural cavity excavation (Conner and Rudolph 1995*a*) by red-cockaded woodpeckers.

Recruitment clusters provisioned with inserts have proven to be an integral part of a large-scale translocation effort in the western range of the red-cockaded woodpecker, which includes Arkansas, Louisiana, Oklahoma, and Texas (see Saenz et al. 2002). Saenz et al. (2001*a*) provided evidence that newly installed inserts are more attractive to red-cockaded woodpeckers than older inserts within active clusters. It is reasonable to expect that the age of inserts used in recipient recruitment clusters could affect the likelihood of birds accepting the cavities and remaining in the cluster. In this study, we compare the translocation success rate of clusters with old inserts with the success of clusters that have recently installed inserts in Texas and Arkansas.

STUDY AREA AND METHODS

Six subadult, unrelated pairs of red-cockaded woodpeckers were translocated to the Angelina National Forest (ANF) in eastern Texas during the 1998 translocation season and 12 similar pairs were translocated during the 1999 season. Eight of the clusters had some inserts that were less than 1 year old, and 10 clusters only had inserts that were all older than 1 year. Five of the total 18 translocation clusters on the ANF were new (no existing cavity trees present) while the remaining 13 clusters were abandoned woodpecker clusters. The Davy Crockett National Forest (DCNF) received 4 subadult, unrelated pairs of translocated woodpeckers during the 1998 translocation season and 5 additional similar pairs were translocated in the 1999 season. Six of the clusters had some inserts that were less than 1 year old and 3 clusters only had inserts that were all older than 1 year. All of the recruitment clusters on the DCNF were new. Six subadult, unrelated pairs of woodpeckers were translocated into recruitment clusters with new inserts in the Sam Houston National Forest (SHNF) in 1998 and 1999 for a total of 12 pairs. Finally, the Ouachita National Forest (ONF) in Arkansas received 6 subadult, unrelated pairs of woodpeckers in 1998 and 7 similar pairs in 1999, all in recruitment clusters. None of the recruitment clusters in the ONF contained inserts that were less than 1 year old.

New recruitment clusters are selected and prepared, by midstory removal and insert installation, for new group formation where no woodpecker clusters have been known to exist. Abandoned clusters, usually containing old cavity trees, are sites where red-cockaded woodpeckers previously existed. All translocated birds were subadult (<1 year in age) birds moved from the SHNF in Texas and the Vernon Unit, Calcasieu Ranger District, Kisatchie National Forest in Louisiana from October through January.

All of the translocation clusters were surveyed for the presence of red-cockaded woodpeckers in the spring (March through June) immediately following translocation in 1998 and 1999. Translocations were considered a failure if no birds were present during the spring surveys. A fully activated recruitment cluster was one that contained at least a pair of birds during the spring survey while a partially activated cluster contained only a solitary bird of either sex. Birds present during the surveys may have come from several different sources that may or may not have included translocated individuals. The focus of the study was to quantify new group formation; therefore we did not attempt to determine the source of the birds present in the clusters. We used a chi-square analysis to test for differences in the success rate between translocation clusters where the newest inserts were ≤1 year of age and clusters with all inserts >1 year of age.

RESULTS

The ANF had 2 translocation clusters with solitary birds and 4 failed clusters in 1998. Of the clusters with new inserts, 1 retained a solitary bird and 1 failed. One site with older inserts retained a solitary bird and 3 failed. Six of the 12 recruitment clusters on the ANF were activated and contained a pair of woodpeckers while the remaining 6 translocation clusters failed to retain any birds in 1999. Four of the clusters with new inserts successfully retained a pair of woodpeckers and 2 clusters completely failed. The clusters with older inserts were not as successful. Only 2 clusters of 6 with only older inserts retained a pair of birds while the remaining 4 clusters completely failed. Overall, recruitment clusters with new inserts in the ANF had a success rate of 62.5% (5 of 8) while clusters with old inserts

only had a 30% (3 of 10) success rate over the 2-year period (Table 1).

In 1998, spring surveys revealed that 1 recruitment cluster of 4 was activated on the DCNF. The successful cluster contained inserts that were <1 year old and all of the failed clusters (n = 3) contained only old inserts. In 1999 all 5 recruitment clusters on the DCNF had inserts installed approximately 3 months prior to the release of the translocated birds. Two clusters were fully successful, 2 clusters contained solitary birds, and 1 cluster had no birds during the spring check. Thus, on the DCNF, clusters with new inserts were 83.3% (5 of 6) successful in retaining birds over the 2-year period, whereas clusters with only old inserts (n = 3) failed 100% of the time (Table 1).

Red-cockaded woodpeckers were only translocated into clusters containing new inserts in the SHNF in 1998 and 1999. In 1998, 3 clusters retained a pair, 2 clusters retained a solitary bird, and 1 cluster failed. In 1999, 4 clusters retained a pair, 1 cluster retained a solitary bird, and 1 cluster failed. The SHNF had an overall success rate of 83.3% (10 of 12) over the 2-year period (Table 1).

None of the recruitment clusters in the ONF contained inserts newer than 1 year prior to translocation. In 1998, all 6 recruitment clusters failed to retain any birds. In 1999, 3 clusters retained a pair and 4 failed. The overall translocation success rate in the ONF was 23% (3 of 13 sites) for the 2-year period (Table 1).

Overall in our study, clusters with inserts installed within 1 year prior to woodpecker reintroduction (n = 26) were occupied by at least 1 bird at 77 % of the clusters. Clusters (n = 26) with older inserts had a lower success rate of 23 % (c^2 = 15.07, P < 0.001).

DISCUSSION

A great deal of bird movement is known to occur after a translocation, movement that often produces combinations of birds different from that intended by managers (Carrie et al 1999). Limited information indicates that this was true in our study as well. Our successful translocation clusters contained 3 types of birds: (1) birds translocated to those clusters, (2) birds translocated to other recruitment clusters, and (3) resident birds that had dispersed from their previous

Table 1. Translocation results on the Davy Crockett, Angelina, Ouachita, and the Sam Houston National Forests in 1998 and 1999. A bird retained at a cluster implies that there were birds present in the spring surveys but not necessarily the same birds that were translocated to that site. Percentages from recruitment cluster with at least 1 insert ≤1 yr since installation are calculated separately from clusters with all inserts >1 yr since installation. NA indicates that no birds were translocated into clusters of a given treatment that year.

	Recruitment Clusters with At Least 1 Insert ≤1 yr Since Installation			Recruitment Clusters with All Inserts >1 yr Since Installation		
	Pair Present	Solitary Bird Present	Failed	Pair Present	Solitary Bird Present	Failed
Davy Crockett						
1998	1 (100%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	3 (100%)
1999	2 (40%)	2 (40%)	1 (20%)	NA	NA	NA
Angelina						
1998	0 (0%)	1 (50%)	1 (50%)	0 (0%)	1 (25%)	3 (75%)
1999	4 (67%)	0 (0%)	2 (33%)	2 (33%)	0 (0%)	4 (67%)
Ouachita						
1998	NA	NA	NA	0 (0%)	0 (0%)	6 (100%)
1999	NA	NA	NA	3 (43%)	0 (0%)	4 (57%)
Sam Houston						
1998	3 (50%)	2 (33%)	1 (17%)	NA	NA	NA
1999	4 (66%)	1 (17%)	1 (17%)	NA	NA	NA
TOTAL	14 (54%)	6 (23%)	6 (23%)	5 (23%)	1 (4%)	20 (73%)

clusters. Recruitment clusters often contained different combinations of bird types. In some cases red-cockaded woodpeckers settled into other nearby vacant clusters provisioned with inserts. The most consistent characteristic of the successful recruitment clusters was that most of them had recently installed inserts. However, in some cases the birds used older inserts in these clusters even when new inserts were available. These findings are consistent with evidence provided by Saenz et al. (2001*a*) suggesting that occasionally older inserts are attractive to red-cockaded woodpeckers.

Usually several pairs of woodpeckers are translocated in close proximity to each other and to resident birds, at the suggestion of Rudolph et al. (1992) and Carrie et al. (1999). This allows the birds to mix and choose their mates from a larger pool of potential mates. A reasonable explanation for the success of the translocation clusters with new inserts may be that woodpeckers choose their preferred mate from among the several translocated individuals or resident birds and settle into the cluster with the newest cavities. Conner et al. (1998*b*) found that red-cockaded woodpeckers tended to choose the newest cavities for nesting. They suggest that using newer cavities may reduce parasite loads and that cavities may be placed in trees with higher resin yields. The clusters with older inserts may be the last choice for the woodpeckers and are infrequently occupied because of the natural loss of some birds after their translocation. Simply, it is possible that the number of successful translocations is independent of the condition of the inserts, that the woodpeckers move to the clusters with the newest inserts, and that there are not enough birds left to fill the least desirable cavities.

However, the success rate of the total translocation effort for a given National Forest in a given year fluctuated greatly. These fluctuations in the success rate appear to be related to the number of clusters with new inserts. We suggest that translocation success may be greatly influenced by insert age. However, artificial cavities are not the only factor that influences success. The importance of providing quality habitat should not be diminished because without high quality habitat devoid of midstory, cavity quality would be irrelevant.

The estimated annual cost for the Western Range Translocation Cooperative effort in 1998 was approximately $128,000 (B. Bartush, U S Forest Service, personal communication). The donor and recipient populations must be monitored and the birds must be banded. The birds must also be captured and transported to the release cluster where post-release monitoring and evaluations are completed. Seventy-seven birds were moved in 1998 at an estimated $1,662 per bird. The cost of installing an insert can be as low as $100, which is a mere 6% of the cost to move a bird. New inserts could potentially increase the success rate 300%. We recommend that in addition to providing high quality habitat, the installation of new inserts just prior to woodpecker translocation become a standard practice because of the potential benefits and relative low cost. We recommend at least 1 new insert per translocated bird be installed no earlier than 1 year prior to translocation. Ideally, inserts should be installed in September since the birds are usually moved from October through January. It is possible that inserts remain attractive to translocated red-cockaded woodpeckers for longer than 1 year, but at this time, adequate data are unavailable. However, it still remains unclear how cavity maintenance and cleaning might extend the length of time a cavity remains attractive (W. Montague and J. Neal, U. S. Forest Service, personal communication). Further research is still needed to determine a cutoff age at which inserts should not be used for translocations. In addition, other artificial cavity techniques such as drilled cavities should be considered and further research also is needed to determine the length of their usefulness for translocations.

LITERATURE CITED

Allen, D. H. 1991. An insert technique for constructing artificial cavities for red-cockaded woodpeckers. U. S. For. Serv. Gen. Tech. Rep. SE-73.

Carrie, N. R., R. N. Conner, D. C. Rudolph, and D. K. Carrie. 1999. Reintroduction and postrelease movements of red-cockaded woodpecker groups in eastern Texas. J. Wildl. Manage. 63:824–832.

Conner, R. N., and D. C. Rudolph. 1991. Forest habitat loss, fragmentation, and red-cockaded woodpecker populations. Wilson Bull. 103:446–457.

Conner, R. N., and D. C. Rudolph. 1995. Excavation dynamics and use patterns of red-cockaded woodpecker cavities: relationships with cooperative breeding. *In* D. L. Kulhavy, R. G. Hooper, and R. Costa, eds. Red-cockaded woodpecker symposium: recovery, ecology and management. Center for Applied Studies in Forestry, College of Forestry, Stephen F. Austin State University, Nacogdoches, Tx.

Conner, R. N., D. Saenz, D. C. Rudolph, W. G. Ross, and D. L. Kulhavy. 1998. Red-cockaded woodpecker nest-cavity selection: relationships with cavity age and resin production. Auk 115:447–454.

Copeyon, K. C. 1990. A technique for construction of cavities for the red-cockadedwoodpecker. Wildl. Soc. Bull. 18:303–311.

Copeyon, K. C., J. R. Walters, and J. H. Carter III. 1991. Induction of red-cockaded woodpecker group formation by artificial cavity construction. J. Wildl. Manage. 55:549–556.

Costa, R., and R. E. F. Escano. 1989. Red-cockaded woodpecker status and management in the southern region in 1986. U. S. Department of Agriculture, Forest Service, Technical Publication R8-TP 12.

Costa, R., and E. Kennedy. 1994. Red-cockaded Woodpecker translocations 1989-1994: state-of-our-knowledge. Pages 74-81 in Annu. Proc. Am. Zoo and Aquar. Assoc. Zoo Atlanta, Atlanta GA.

De Fazio, J. T., Jr., M. A. Hunnicutt, M. R. Lennartz, G. L. Chapman, and J. A. Jackson. 1987. Red-cockaded Woodpecker translocation experiments in South Carolina. Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 41:311–317.

James, F. C. 1995. The status of the red-cockaded woodpecker in 1990 and the prospect for recovery. *In* D. L. Kulhavy, R. G. Hooper, and R. Costa, eds. Red-cockaded woodpecker symposium: recovery, ecology and management. Center for Applied Studies in Forestry, College of Forestry, Stephen F. Austin State University, Nacogdoches, Tx.

Ligon, J. D. 1970. Behavioral and breeding biology of the red-cockaded woodpecker. Auk 87:255–278.

Rudolph, D. C. and R. N. Conner. 1994. Forest fragmentation and red-cockaded woodpecker population: an analysis at intermediate scale. J. Field Ornithol. 65:365–375.

Rudolph, D. C. and R. N. Conner., D. K. Carrie, and R. R. Schaefer. 1992. Experimental reintroduction of red-cockaded woodpeckers. Auk 109:914–916.

Saenz, D., K. A. Baum, R. N. Conner, D. C. Rudolph, and R. Costa. 2002. Large-scale translocation strategies for reintroducing red-cockaded woodpeckers. J. Wildl. Manage. 66:212–221.

Saenz, D., R. N. Conner, C. S. Collins, and D. C. Rudolph. 2001. Initial and long-term use of inserts by red-cockaded woodpeckers. The Wildl. Soc. Bull. 29(1):165–170.

Walters, J. R., P D. Doerr, and J. H. Carter III. 1988. The cooperative breeding system of the red-cockaded woodpecker. Ethology 78:275–305.