United States
Department of
Agriculture

Forest Service

Southeastern Forest
Experiment Station

General Technical
Report SE-73

An Insert Technique for

Constructing Artificial Red-Cockaded Woodpecker Cavities

David H. Allen

November 1991

Southeastern Forest Experiment Station
P.O. Box 2680
Asheville, North Carolina 28802

An Insert Technique for Constructing Artificial Red-Cockaded Woodpecker Cavities

David H. Allen*, *Wildlife Biologist*
USDA Forest Service
Southeastern Forest Experiment Station
Clemson, SC 29634-1003

Abstract

A complete guide is provided for excavating red-cockaded woodpecker (*Picoides borealis*) cavities. A hole 4 inches wide by 10 inches high by 6 inches deep is cut from a live pine (*Pinus* spp.) tree with a chainsaw, and a prefabricated cavity is inserted. Cavities can be excavated in pines of any age, but the diameter of the tree at the height of insertion must be greater than 15 inches. Over 300 cavities were inserted on the Francis Marion National Forest (n=280) and the Savannah River Site (n=28) in South Carolina. Over 60 percent of the cavities on the Francis Marion are now being used for nesting or roosting. None of the trees have broken at cavity height.

Keywords: Cavity excavation, cavity inserts, Hurricane Hugo, *Picoides borealis*, roost.

Introduction

The federally endangered red-cockaded woodpecker (*Picoides borealis*) constructs its cavities exclusively in mature, living southern pines (*Pinus* spp.) (U.S. Fish and Wildlife Service 1985). A cavity takes from several months to several years for the birds to complete (Baker 1971; Hooper and others 1980; Jackson and others 1979), and competition for these cavities is keen (Baker 1971; Carter and others 1989; Hooper 1983; Hooper and others 1980; Ligon 1970). Copeyon and others (in preparation) have shown that suitable cavities can be a limited resource, and Ligon (1970) states that cavities may be the single most important component of red-cockaded woodpecker (RCW) territories.

*Present Address: North Carolina Wildlife Resources Commission, 851 Perrytown Road, New Bern, NC 28562

This paper describes a technique for excavating RCW cavities initially developed for a remnant population of woodpeckers on the Savannah River Site in South Carolina. A hole 4 inches wide by 10 inches high, by 6 inches deep is cut from a live pine stem with a chainsaw, and a prefabricated cavity insert, containing an entrance hole and roosting or nesting chamber is inserted. Inserts can be placed entirely in sapwood but the tree at the point of insertion must be more than 15 inches in diameter. In the alternative methods (Copeyon 1990; Taylor and Hooper 1991) for providing RCW cavities, the nesting cavity must be drilled in heartwood.

Cavity excavation has wide applications. Just after the technique was initially developed, it was perfected on the Francis Marion National Forest, where a majority of existing cavity trees had been destroyed by Hurricane Hugo. Since then it has been used on seven other national forests.

Over 300 cavities have been excavated on the Francis Marion National Forest (n=280) and the Savannah River Site (n=28) by the technique described. Once a two-person crew was familiar with the technique, it took an average of about 45 minutes to construct each cavity.

Construction of Cavity Inserts

Inserts have been made from Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco), western redcedar (*Thuja plicata* Donn), basswood (*Tilia americana* L.), and southern yellow pine (*Pinus* spp.). Western redcedar has worked best and is easily available. It cracks, warps and swells less than the other woods tried. Although a harder wood than western redcedar would be ideal to minimize cavity enlargement by other species, this problem is overcome by placing a metal cavity restrictor over the insert. Wood for the insert should be dry but untreated. Treated wood should not be used because arsenic salts in the preservative are toxic to birds. We had professional woodworking shops (with large drill presses) make our inserts. The cost varied from $5 to $10 each.

Fig. 1 shows measurements for the cavity inserts. Cut rough quarter-sawn lumber 4 inches wide by 6 inches thick into 10-inch lengths. Drill a vertical 3-inch-diameter hole with a multi-spur machine bit (app.) from the top of the 10-inch-high block of wood down to within 2 inches of the bottom. Center the hole in the 4-inch dimension ½ inch from the back of the block in the 6-inch dimension. Make an entrance hole with a 1¾-inch multi-spur machine bit (available from Forest City Tool Co., P.O. Box 788, Hickory, NC 28603, 704-322-4266). Center this hole in the 4-inch dimension 1⅛ inches from the top of the block. As in naturally constructed entrance holes[1],

[1]Personal communication, C. Dachelet, USDA Forest Service, October 1988.

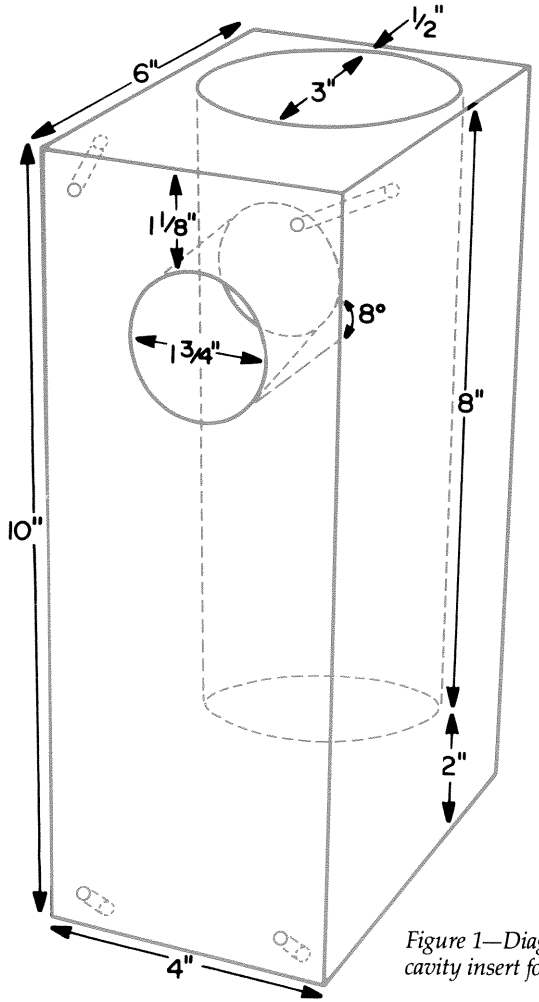

Figure 1—Diagram of cavity insert for RCW's.

it should be angled 8 degrees upward from horizontal to prevent rain from entering the chamber. Small holes can then be drilled in the corners of the insert to toenail the insert into the tree. To seal the chamber, spread silicone caulk on the top of the insert, and nail a 4- by 6-inch piece of ¼-inch plywood over it. Inspect each insert closely for checks or cracks. Discard poorly constructed inserts. Repair inserts with very small (paper thin) cracks by applying Acraglass gel (a rifle bedding material). Gouge a groove out of the crack and fill it with Acraglass. Painting a thick coat of Acraglass on the outside of the insert also helps seal the chamber. Cheaper sealants, such as fiberglass or acrylic resin, can be used. If the insert is not sealed, resin under pressure can leak through almost invisible hairline cracks. A sap-filled cavity can be fatal for RCW's as well as other wildlife.

Selection of Trees and Cavity Placement on Tree

Of primary importance is the diameter of the tree at the height the cavity is to be constructed. Diameter at cavity height must be at least 15 inches. Consider other tree characteristics only after that criterion is satisfied. RCW cavities may be used for as long as 20 years (Hooper and others 1990). Whenever possible, therefore, select a healthy tree with a large crown to help assure that the tree will outlast the cavity. A tree with a large crown will also exude more sap from resin wells pecked by the RCW's. This resin is thought to deter predators from climbing the tree (Steirly 1957). Avoid trees with excessive lean, because it is more difficult and dangerous to excavate cavities in these trees.

The habitat should have sufficient forage to support a clan of RCW's, and the colony site (or future colony site) should be relatively clear of a hardwood midstory (U.S. Fish and Wildlife Service 1985). If more than one cavity is to be constructed on a site (such as in a recruitment stand), the trees should be within about 100 yards of each other.

Cavities are always inserted about 2 feet above the top of a ladder section. Our Swedish climbing ladders come in 10-foot sections, so we always insert the cavity at a height of about 12, 22, or 32 feet. Cavities should be placed below the first live branch and ideally should be within the range of natural cavity heights in the area. The diameter of the tree is also a consideration, since the taper of the bole may preclude excavation above the third or even the second ladder. An attempt should be made to face the cavity toward the west because this is the prevalent direction for naturally constructed cavities (Locke and Conner 1983; Wood 1983). Imperfections in the tree or dead limbs may preclude this orientation. If no suitable tree can be found nearby in which the cavity can be oriented to the west, other orientations are acceptable. Cavities on leaning trees should be constructed so that the entrance faces in the same direction as the lean. An important safety note is to inspect each potential cavity tree for dead branches that may fall as a result of vibrations in the tree caused by the chainsaw or hammering. Dangerous limbs should be removed before excavation begins.

Figure 2—Scrape the tree to expose reddish bark, which simulates flecking by RCW's.

Cavity Excavation

After the location on the tree has been selected, scrape loose outer bark from several feet of bole above and below the spot where the cavity will be inserted (fig. 2). Scraping exposes the lighter reddish bark under the brown-gray bark typical of trees containing natural active cavities.

The bark scraper, as well as other large equipment, can be raised to the climber on a rope with a large carabiner clip attached. A lineman's bucket is helpful for raising smaller items. The chainsaw should be relatively light with an antikick chain and a chain brake. We use the Stihl 009 with a 12-inch bar and an inertia chain brake.

Cut a rectangular hole to fit the insert exactly. First measure the insert and mark the appropriate sized rectangle (approximately 4 inches wide by 10¼ inches high) on the tree about 2 to 3 feet above the ladder (fig. 3). Using the chainsaw (see appendix for specifics on equipment), make two parallel, vertical cuts 6½ inches deep on the 10-inch lines (fig. 4). To exactly gauge the depth of these cuts, mark a line on the bar of the chainsaw 6½ inches from the tip. Pay particular attention to keeping these cuts parallel. There is a tendency to aim for the center of the tree, which produces an unwanted pie-shaped hole.

There are two important safety notes during this step: (1) the chainsaw should be started by ground personnel, and the chain brake should be engaged before the climber hoists the saw (the chain brake must be in working order before continuing), and (2) the position of the chainsaw is critical anytime the bar is nosed into the tree. Always

Figure 3—Tree marked for cutting RCW cavity.

Figure 4—Two vertical parallel cuts.

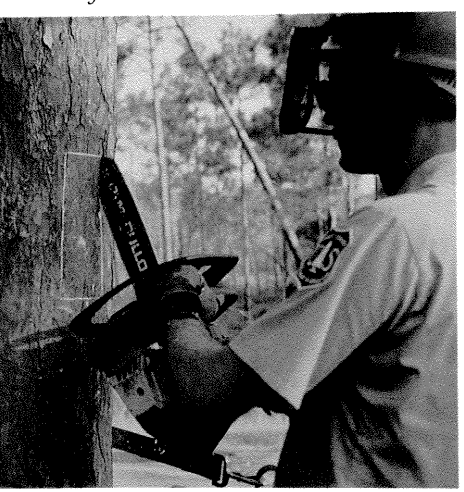

Figure 5—Correct method of nosing chainsaw bar into tree.

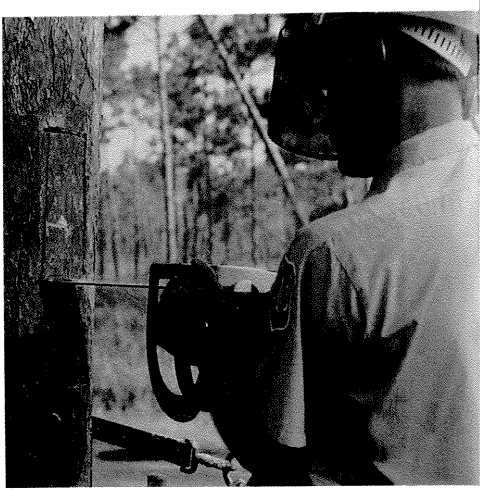

Figure 6—Two horizontal parallel cuts.

begin the cut with the lower half of the bar tip (fig. 5) or serious and dangerous kickback will occur. A sharp chain and full throttle will also minimize the risk of kickback.

Now make the two parallel horizontal cuts (fig. 6). Once again, be sure to start the cut with the lower half of the bar's tip. Once the four initial cuts are made, make an angled cut from the front of the left side to the back of the right side (fig. 7). Remove the right triangle-like wedge of wood and cut another angle from the middle to the back of the left side (fig. 8). This should enable you to remove another triangle of wood. Now there should only be a wedge of wood in the back of the hole still to be removed (fig. 9). This wedge can be cut up or "cross hatched" with the tip of the saw (fig. 10). Start all "cross hatch" cuts with the lower half of the tip of the bar. Remove small rectangles of wood with a long-handled chisel and a large wooden mallet (figs. 11 and 12). It is best to practice cutting cavity holes in dead trees at ground level before attempting to excavate a cavity while on the ladder.

Use a ruler to make sure that the hole is the right depth at all points. Square the back corners off with the chisel. Proper width should be tested by shoving the bottom of the insert into the hole. Do not attempt to push the upright insert over halfway into the hole yet. If the fit is as tight as it should be, the insert may get stuck. Measure to make sure the height of the hole is correct.

Figure 7—First angular cut to remove first triangle-like wedge of wood.

Figure 8—Second angular cut to remove second triangle-like wedge of wood.

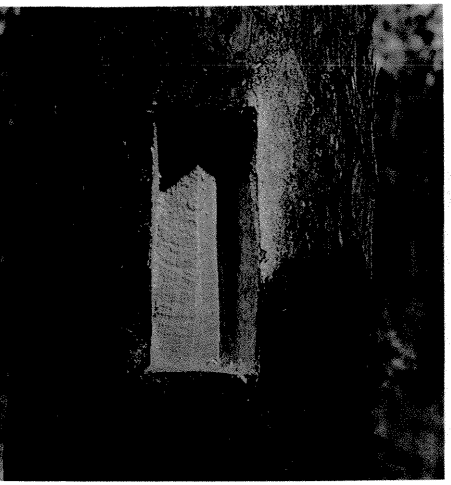

Figure 9—Insert hole after both angular cuts.

Figure 10—"Cross hatching" for removal of last wood.

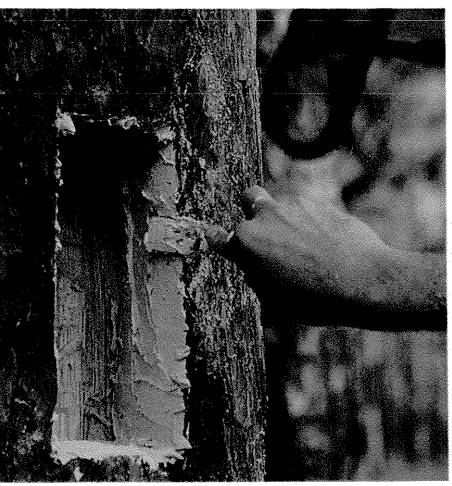

Figure 13—Coat the insert with non-toxic wood filler.

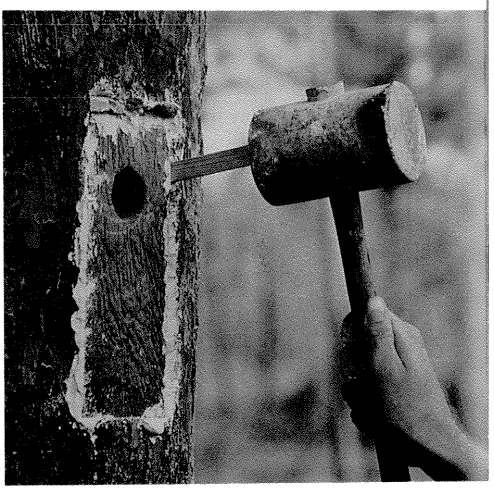

Figure 14—Drive wedges to tighten insert and fill gaps.

Once all measurements have been checked, coat the back of the insert as well as the sides, top, and bottom of the hole with a non-toxic wood filler (fig. 13). Push the insert into the hole. Since the fit should be tight, use the mallet to seat the insert all the way back. The front of the insert should be flush with the outer sapwood of the tree. RCW's will eventually peck away the bark and cambium, leaving the insert flush with the tree. Drive long slender wedges above the insert and along one side to further tighten the fit and to fill any small gaps (fig. 14). Once a particular wedge is driven in as far as possible, hit it

Figure 11—Chisel last wood from back of hole.

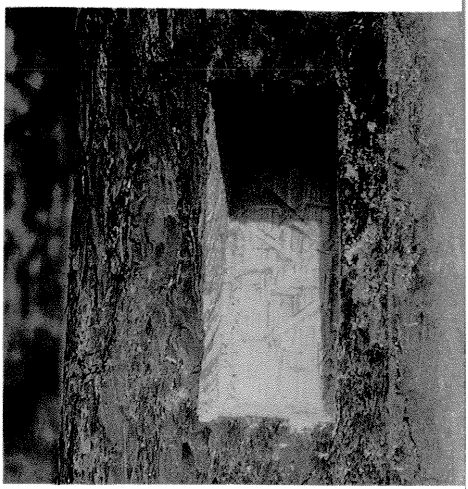

Figure 12—Completed chainsaw hole.

Figure 15—Smooth cracks with more wood filler.

Figure 16—Make resin wells to help attract RCW's.

on the side to snap it off flush with the insert. Now toenail the insert into the tree using the four predrilled holes. Use more wood filler to smooth over the cracks (fig. 15).

Resin wells are a conspicuous feature of natural cavity trees and may help RCW's locate the cavity insert. Cut resin wells in the tree with a curved-nosed chisel or a tree scribe. Slice off a piece of the outer bark just grazing the cambium layer (fig. 16). Make sure the tool

is sharp so it cuts the wood fibers cleanly instead of tearing them. A clean cut will provide the best resin flow. Put 8 to 10 or more resin wells around the cavity.

Install a cavity restrictor to keep larger woodpeckers from enlarging the entrance hole of the insert and making it unsuitable for RCW's (fig. 17). This restrictor is similar to the one described by Carter and others (1989), except this one also covers the lower portion of the insert. It is made out of 22-gauge stainless steel. We had a professional sheet metal shop make our restrictors at a cost of $5 to $15 each. Fit the top of the restrictor hole flush with the top of the entrance hole in the insert. Screw the restrictor to the insert, and coat it with wood filler. The wood filler will eventually be pecked off the restrictor, but after this occurs the insert will still be used by red-cockades.

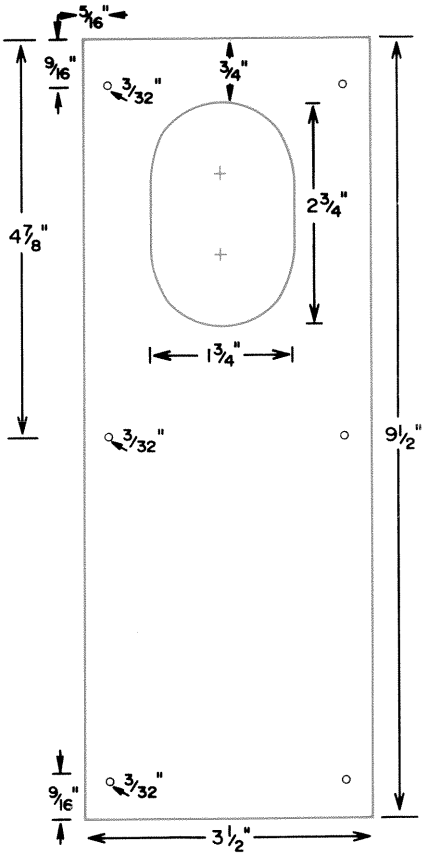

Figure 17—Diagram of full restrictor for RCW inserts.

Spray some brown paint to help the insert and wood filler blend into the tree. Vertical streaking seems to work best. Then heavily apply cream-colored paint in streaks below each resin well. This color appears to provide a strong visual stimulus for the birds (fig. 18). The completed cavity can be almost indistinguishable from a natural RCW cavity (fig. 19). A large amount of cream paint (fig. 20) seems to work best.

After the cavity is complete, always inspect the inside with a dental mirror and a small drop light to make sure the insert did not crack during cavity construction. It is also a good idea to inspect the cavity 1 week later for the presence of resin. Any cavity with moist resin in it should be sealed with ¼-inch hardware cloth to preclude use until the resin dries.

Photos: Scott Harke, Clemson University Communications Center

Figure 18—Streak paint to cover wood filler and dress resin wells.

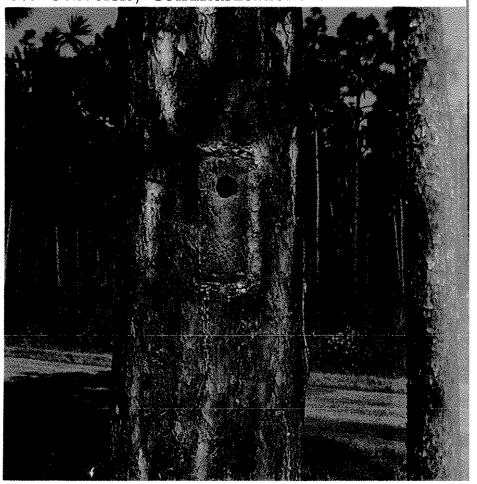

Figure 19—Completed insert cavities are almost indistinguishable from natural RCW cavities.

Figure 20—Excessive cream-colored paint seems to attract RCW's faster.

Use of Cavities

The techniques described were perfected and extensively tested in two areas — the Savannah River Site (SRS) and the Francis Marion National Forest. The Department of Energy's SRS is in west-central South Carolina. The RCW population on SRS decreased from 16 active colonies in 1977 to only 2 breeding pairs in 1984 (Jackson 1990). In 1985 the Southeastern Forest Experiment Station contracted with DOE to reverse the downward population trend on SRS. At that time, only five RCW's were present, including a single pair. Although recruitment stands had been designated, and midstory hardwoods had been controlled, almost all stands were younger than typical RCW nesting habitat. Furthermore, most existing cavities in abandoned colonies had been enlarged by other woodpecker species and were no longer suitable for RCW use. Moreover, in some colonies all existing cavity trees had died.

The Francis Marion National Forest is on the coast of southern South Carolina. On September 21, 1989, Hurricane Hugo destroyed 87 percent of the red-cockaded woodpecker cavity trees there (Hooper and others 1990). Mature pine stands (> 80 years old) received the greatest damage (Hooper and others 1990), leaving many areas with no trees old enough to excavate cavities by drilling (Copeyon 1990; Taylor and Hooper 1991).

The SRS now contains a small, but growing, population of intensively managed RCW's. Since the cavities have been excavated, six of the first seven birds to disperse within the SRS have selected cavity inserts rather than natural cavities. On the Francis Marion National Forest where approximately 90 percent of the natural cavity trees were destroyed in September 1989 by Hurricane Hugo, over 60 percent of the inserts are now being used for roosting or nesting by RCW's.

The birds work the resin wells, the "plate," or area around the entrance hole where the birds peck the bark and cambium away, and the cavity as if the insert was a natural cavity (fig. 21). After several months of use, the inside of the cavity is sometimes enlarged by the RCW's to the point where the birds peck through the side or back of the insert. In these cases the inserts have not filled with resin, even though the insert may have been excavated almost entirely in sapwood. The lag time between cavity excavation and when the birds break through to the sapwood must be enough for some healing of the wound to occur.

Figure 21—RCW's use inserted cavities as if they were natural.

Weakening of the tree as a result of excavating the cavity is an obvious concern. However, none of the cavity trees have shown signs of damage as a result of cavity excavation that began almost 3 years ago, and most cavities have been in place for almost 2 years. In October 1989, a large tornado passed through three colony sites containing excavated cavities on the SRS. One excavated cavity tree was uprooted and blown over, but it did not break at cavity height. The other two excavated cavity trees withstood the wind while several nearby trees were uprooted or snapped off. On the Francis Marion National Forest, winds gusting to 60 mph have not caused trees to break at the level of the insert. Some have broken 10 or more feet above the location of the insert. Because many trees without inserts have broken at a similar location, we think that breakage was probably caused by initial damage to the trees from Hurricane Hugo.

Other techniques for excavating RCW cavities are available (Copeyon 1990; Taylor and Hooper 1991). Copeyon's method involves the use of a drill to construct cavities and start holes. Taylor and Hooper have developed a modification of Copeyon's method, which also uses a drill. Because the drilled cavities remove less wood, they damage the tree less and can be put in smaller diameter trees than the insert cavities. Drilled Cavities are also less likely to be enlarged or usurped by other species. The advantages of the insert technique are as follows: (1) insert cavities can be constructed in trees with no heartwood; (2) the insert technique is easier to learn; (3) inserts can be easily replaced if damaged; and (4) the technique lends itself to modification of the insert to enable the researcher to obtain easy access to the eggs and young. For example, until now studies involving marking or translocating eggs have been difficult because of problems with removing eggs from the cavity.

Excavating RCW cavities by any technique might be appropriate in several circumstances. Because of habitat fragmentation, many of the remaining RCW populations are small (< 50 pairs). RCW experts agree that a sense of immediacy is necessary to stabilize these populations (Southeast Negotiation Network 1990). Once steps have been taken to preserve old-growth pine and control hardwood midstory for nesting habitat, cavities will be needed to allow the population to expand as rapidly as possible. The longer a population stays small, the higher the chances it will show signs of inbreeding depression, and the less chance it has of recovering (Haig and others, in preparation).

Even large populations are not exempt from radical population declines after a natural disaster like Hurricane Hugo. Furthermore, hurricanes are not rare events in the RCW's range (Hooper and others 1990). Other natural disasters, such as tornadoes and ice storms also can reduce the number of cavities for RCW's. A large loss of natural cavities would probably be followed by a rapid population decline unless cavities were made for the birds.

Safety

It is assumed that the cavity excavator (climber) has experience with the safe use of Swedish climbing ladders and climbing belts. Do not attempt to excavate cavities from a free-standing ladder. Trees for excavation should be selected with safety in mind. Do not excavate cavities in trees with excessive lean or overhead dead branches. A ground crew member should always be present not only for safety but to supply the climber with equipment. A two-way radio should also be available in case an emergency should arise.

Hardhats, hearing protectors, and gloves should be worn by both crew members. The climber should also wear eye protection (goggles) and chainsaw chaps. Hardhats do not provide protection from large falling limbs, tools or the chainsaw, so the ground crew member should stand well away from the tree when not assisting the climber.

The chainsaw must have a chain brake that is in working order. The saw should be started by the ground crew member, and the brake should be set before the saw is hoisted by the climber. The saw should also have a sharp antikick chain. When initiating a cut, use full throttle and the lower half of the tip of the bar, or serious kickback will occur.

Fatigue can also cause accidents, especially if the climber is not used to working on ladders for extended periods. We used a climbing belt with the D-rings attached to a seat strap, such as the Klein or Miller tree trimmer's belt. The seat strap allows the climber to take weight off his/her feet, reducing fatigue. The climber should take a break (climb down) whenever he/she feels tired. Likewise, if the ground crew person sees signs of fatigue (shaking), he/she should call the climber down immediately.

Thick nylon webbing that extends about 6 inches from the climbing belt on either side provides plenty of room to work in front of the climber. Do not extend the tree belt with a rope, as it could be cut by the chainsaw.

This cavity excavation technique has proven to be very safe, but only because safety has been foremost at all times.

Permits

Construction of artificial cavities for RCW's is subject to provisions in the Endangered Species Act. If the artificial cavity project is considered a Federal action, Section 7 compliance (to ensure that any federally funded or approved program will not jeopardize an endangered species) is required. Section 9 compliance (prohibition against "take") is required on public and private lands. Those contemplating excavating artificial cavities are advised to contact the closest field office of the USDI Fish and Wildlife Service for specific requirements.

Acknowledgments

The initial development of this technique was funded by the Department of Energy as part of a cooperative effort by the DOE, the USDA Forest Service, the Savannah River Ecology Laboratory, and the Southeastern Forest Experiment Station to restore the red-cockaded woodpecker population at the Savannah River Site. Michael R. Lennartz initiated the project, and many improvements in the technique were suggested by Robert G. Hooper, Timothy C. Milling, William E. Taylor, and Charles A. Dachelet.

I would like to thank Lennartz, Hooper, Dachelet, Milling, and Taylor for advice during the many stages of this project. Sheryl Sanders, Timothy Milling, Douglas L. Short, Richard G. Lamma, and John H. Young excavated many of the cavities. Kathleen E. Franzreb, Ernest E. Stevens, William Taylor, and Robert Hooper reviewed this manuscript. Susan W. Mefferd, Clemson University Communications Center, Clemson University, drew the figures.

Literature Cited

Baker, W. Wilson. 1971. Progress report on life history studies of the red-cockaded woodpecker at Tall Timbers Research Station. In: Thompson, R.L., ed. The ecology and management of the red-cockaded woodpecker; Tallahassee, FL. Bur. Sport Fish. Wildl, U.S. Department of the Interior and Tall Timbers Research Station: 44-59.

Carter, J.H., III; Walters, Jeffrey R.; Everhart, Steven H. [and others]. 1989. Restrictors for red-cockaded woodpecker cavities. Wildlife Society Bulletin. 17:68-72.

Copeyon, Carole K. 1990. A technique for constructing cavities for the red-cockaded woodpecker. Wildlife Society Bulletin. 18:303-311.

Hooper, Robert G. 1983. Colony formation by red-cockaded woodpeckers: hypothesis and management implications. In: Wood, Don A., ed. Red-cockaded woodpecker symposium 2. Proceedings; 1983 January 27-29; Panama City, FL. Tallahassee, FL: State of Florida Game and Fresh Water Fish Commission: 72-77.

Hooper, Robert G.; Robinson, Andrew F., Jr.; Jackson, Jerome A. 1980. The red-cockaded woodpecker: notes on life history and management. Gen. Rep. SA-GR#9. Atlanta: U.S. Department of Agriculture, Forest Service, Southeastern Area, State and Private Forestry. 8 pp.

Hooper, Robert G.; Watson, Craig J.; Escano, Ronald E.F. 1990. Hurricane Hugo's initial effects on red-cockaded woodpeckers in the Francis Marion National Forest. In: Transactions of the 55th North American Wildlife and Natural Resources Conference; 1990 March 18-23; Denver, CO. Washington, DC: Management Institute: 220-224.

Jackson, Jerome A. 1990. Intercolony movements of red-cockaded woodpeckers in South Carolina. Journal of Field Ornithology. 61:149-155.

Jackson, J.A.; Lennartz, M.R.; Hooper, R.G. 1979. Tree age and cavity initiation by red-cockaded woodpeckers. Journal of Forestry. 77:102-103.

Ligon, David J. 1970. Behavior and breeding biology of the red-cockaded woodpecker. Auk. 87:255-278.

Locke, Brian A.; Conner, Richard N. 1983. A statistical analysis of the orientation of entrances to red-cockaded woodpecker cavities. In: Wood, Don A., ed. Red-cockaded woodpecker cavities. In: Wood, Don A., ed. Red-cockaded woodpecker symposium 2. Proceedings; 1983 January 27-29; Panama City, FL. Tallahassee, FL: State of Florida Game and Fresh Water Fish Commission: 108-109.

Southeast Negotiation Network, Georgia Institute of Technology (compilers). 1990. Summary report. Scientific summit on the red-cockaded woodpecker. Live Oak, FL. 36 pp.

Steirly, C.C. 1957. Nesting ecology of the red-cockaded woodpecker in Virginia. Atlantic Naturalist. 12:280-292.

Taylor, William E.; Hooper, Robert G. 1991. A modification of Copeyon's drilling technique for making artificial red-cockaded woodpecker cavities. Gen. Tech. Rep. SE-72. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 31 pp.

U.S. Fish and Wildlife Service. 1985. Red-cockaded woodpecker recovery plan. Atlanta. 88 pp.

Wood, D.A. 1983. Foraging and colony habitat characteristics of the red-cockaded woodpecker in Oklahoma. In: Wood, Don A., ed. Red-cockaded woodpecker symposium 2: Proceedings; 1983 January 27-29; Panama City, FL. Tallahassee, FL: State of Florida Game and Fresh Water Fish Commission: 51-58.

Appendix

Equipment List
(in order of use)

Diameter tape
Compass
Swedish climbing ladders
Climbing belt with tree belt
Rope with large carabiner clip attached
Tool pouch
Lineman's bucket
Bark scraper
White marking crayon
Ruler
Chainsaw (we used a Stihl 009 with an inertia chain brake, an antikick chain and a 12″ bar)
Gas and oil
Long handled wood chisel (12″)
Large wooden mallet (4″ diameter head)
Wood filler, Elmer's carpenters' non-toxic
Cavity insert
Putty knife
Wedges cut from dry, brittle wood (various sizes)
Curved nosed wood chisel
Tree scribe (can be bought from Forestry Suppliers)
Spray paint, brown and cream
3″ nails
Hammer
Metal cavity restrictor
Screws
Screwdriver
Dental mirror
Droplight with battery

Safety Equipment

Hard hat
Chainsaw chaps
Eye protection
Ear protection
Two-way radio
Gloves

Tradenames are mentioned in this publication solely to identify materials and equipment that have been successfully used to make artificial woodpecker cavities. Mentioning tradenames does not imply endorsement by the U.S. Department of Agriculture or suggest superiority over other comparable products.

Allen, David H. 1991. An insert technique for constructing artificial red-cockaded woodpecker cavities. Gen. Tech. Rep. SE-73. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 19 pp.

A complete guide is provided for excavating red-cockaded woodpecker (*Picoides borealis*) cavities. A hole 4 inches wide by 10 inches high by 6 inches deep is cut from a live pine (*Pinus* spp.) tree with a chainsaw, and a prefabricated cavity is inserted. Cavities can be excavated in pines of any age, but the diameter of the tree at the height of insertion must be greater than 15 inches. Over 300 cavities were inserted on the Francis Marion National Forest (n=280) and the Savannah River Site (n=28) in South Carolina. Over 60 percent of the cavities on the Francis Marion are now being used for nesting or roosting. None of the trees have broken at cavity height.

Keywords: Cavity excavation, cavity inserts, Hurricane Hugo, *Picoides borealis*, roost.

Allen, David H. 1991. An insert technique for constructing artificial red-cockaded woodpecker cavities. Gen. Tech. Rep. SE-73. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 19 pp.

A complete guide is provided for excavating red-cockaded woodpecker (*Picoides borealis*) cavities. A hole 4 inches wide by 10 inches high by 6 inches deep is cut from a live pine (*Pinus* spp.) tree with a chainsaw, and a prefabricated cavity is inserted. Cavities can be excavated in pines of any age, but the diameter of the tree at the height of insertion must be greater than 15 inches. Over 300 cavities were inserted on the Francis Marion National Forest (n=280) and the Savannah River Site (n=28) in South Carolina. Over 60 percent of the cavities on the Francis Marion are now being used for nesting or roosting. None of the trees have broken at cavity height.

Keywords: Cavity excavation, cavity inserts, Hurricane Hugo, *Picoides borealis*, roost.

The Forest Service, U.S. Department of Agriculture, is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives—as directed by Congress—to provide increasingly greater service to a growing Nation.

USDA policy prohibits discrimination because of race, color, national origin, sex, age, religion, or handicapping condition. Any person who believes he or she has been discriminated against in any USDA-related activity should immediately contact the Secretary of Agriculture, Washington, DC 20250.