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INSERT MODIFICATIONS IMPROVE ACCESS TO ARTIFICIAL RED-COCKADED WOODPECKER NEST CAVITIES

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Abstract.—A design for a modified, artificial Red-cockaded Woodpecker (*Picoides borealis*) cavity insert is presented. This modification allowed eggs and young to be inspected easily, removed, and replaced throughout the nesting period. Modifications to cavity inserts are best done before installation, but can be easily retrofitted in existing artificial cavities. On the basis of our success, we believe this modification offers several advantages over original artificial cavity designs: (1) eggs and young can be easily removed for measurement, banding, or other scientific purposes, (2) debris and nesting material from other cavity users can be easily removed, and (3) modifications caused no apparent changes in adult behavior. This modification should encourage additional Red-cockaded Woodpecker research requiring access to eggs and nestlings.

MODIFICACIONES INSERTADAS MEJORAN EL ACCESO A CAVIDADES ARTIFICIALES DE ANIDAJE DE *PICOIDES BOREALIS*

Sinopsis.—Se presenta un diseño para cavidades artificiales de anidaje con inserciones para usarse en *Picoides borealis*. Esta modificación permitió que se inspeccionaran, removieran y remplazaran los huevos y pichones de forma fácil a través del período de anidamiento. Es preferible modificar las inserciones de cavidades previo a la instalación de estas, pero se peden retroajstar en cavidades artificiales ya hechas. En base a nuestro exito, entendemos que nuestra modificación ofrece algunas ventajas sobre diseños originales de cavidades artificiales: (1) los huevos y juveniles se pueden remover facilmente para medirlos, anillarlos, o para otros propósitos científicos, (2) se pueden remover fácilmente el debris y material de anidaje de otros inquilinos, y (3) las modificaciones no parecen causar ningún cambio aparente en conducta de los adultos. Esta modificación debe estimular estudios adicionales en *Picoides borealis* que requieran acceso a los huevos y pichones.

The Red-cockaded Woodpecker (RCW) is a federally endangered species endemic to the pine (*Pinus* spp.) forests of the southeastern United States (Jackson 1971). RCWs are cooperative breeders (Lennartz et al. 1987, Ligon 1970, Walters et al. 1988) that live in groups of 2–9 birds, each group having a single breeding pair (Haig et al. 1994, Hooper et al. 1980). Each group inhabits a home range consisting of foraging habitat and a cluster of cavity trees (Ligon 1970). RCWs excavate nest and roost cavities only in mature, living pines. Group members roost in these cavities year-round, each using a separate cavity. The breeding male's cavity is most often used for nesting (Ligon 1970). Suitable trees for natural cavity construction are often limiting (Copeyon et al. 1991, Costa and Es-

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cano 1989, Hooper 1988), and excavation of new cavities requires large investments of time and energy (Conner and Rudolph 1995).

To compensate for limited numbers of suitable cavity trees, Copeyon (1990) and Allen (1991) developed techniques for constructing artificial RCW cavities. Copeyon's (1990) technique involved drilling artificial cavities, while Allen's (1991) required the removal of a box-like section (15.2 × 25.4 × 10.2 cm) from a living pine tree, and insertion of a prefabricated cavity (insert) into the opening (see Copeyon 1990 and Allen 1991 for detailed instructions). Both techniques result in an artificial cavity resembling a natural cavity in placement, size of entrance hole, and interior dimensions.

As with natural cavities, inspection of nest contents in artificial cavities can only be made with a light and mirror, and removal of eggs and young for measurement and banding is challenging. Montague et al. (1993) developed a suction technique for removing eggs safely from a cavity, but it cannot be used to return eggs to a cavity once they are removed. RCW young can be snared from cavities for banding using nylon monofilament nooses at age 5–9 d (Jackson 1982). Extraction of older (10–24 d) young is difficult because of the configuration and diameter of the entrance hole, and the increased avoidance behavior of young once their eyes open. Noosing can result in broken wings and legs, damaged wing feathers (Jackson 1982, Walters et al. 1988) and death (Ralph Costa, pers. comm.). Because of these limitations, the repeated removal and replacement of eggs and young during the nesting season is impractical. Allen (1991), however, suggested that modifications to the artificial cavity may be possible to allow easier access to eggs and young.

We describe a modification to the Allen (1991) artificial cavity design that allows easy access to the interior chamber. This modification allowed eggs and young to be inspected and removed throughout the nesting period. Moreover, we observed no behavioral changes in adult male RCWs when implementing these modifications to previously installed, artificial cavities.

STUDY AREA AND METHODS

Study area.—We tested our design modification on artificial RCW cavities in active use on the Savannah River Site (SRS). SRS is a nuclear-production facility in Aiken and Barnwell counties in the upper coastal plain and sandhills of South Carolina. The U.S. Forest Service manages approximately 40,000 ha of SRS for RCWs (Gaines et al. 1995). Management practices include installation of artificial cavities, habitat enhancement, and development of recruitment clusters. Recruitment clusters are managed to attract RCWs and are provisioned with 3–4 artificial cavities (Allen 1991), each equiped with a metal restrictor plate to protect against damage and entrance hole enlargement by other woodpeckers. All RCWs on the SRS are banded with a U.S. Fish and Wildlife Service aluminum leg band and a unique three-band color combination for field identification. Group checks are conducted monthly to identify and locate all in-

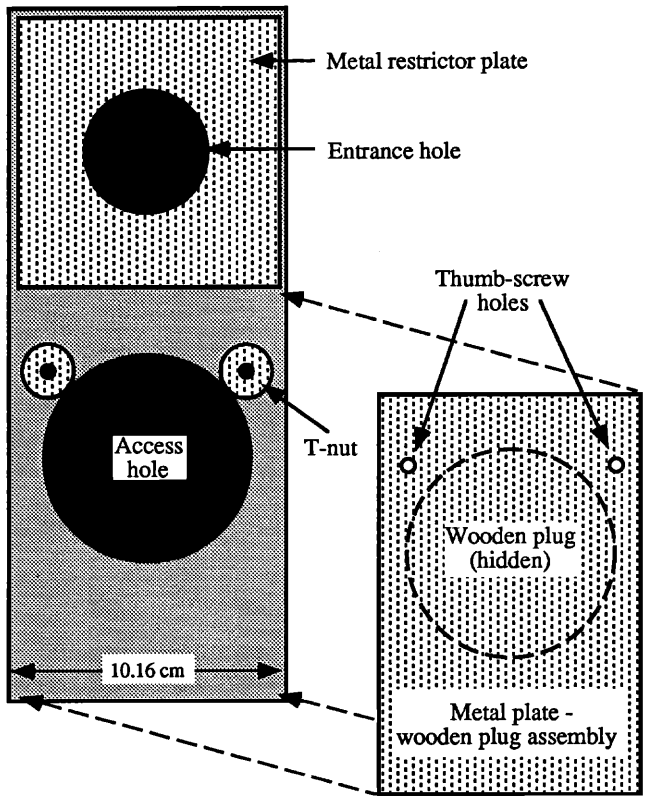

FIGURE 1. Front view of modified, artificial Red-cockaded Woodpecker cavity with a partial metal restrictor plate attached. Metal plate-wooden plug assembly is offset to show 7.7 cm access hole and placement of t-nuts in exterior of artificial cavity.

dividuals. RCW groups are monitored intensively during the breeding season to identify breeding adults, and number and sex of nestlings. There are currently 18 RCW groups on SRS.

Cavity modification.—To access the interior chamber of the artificial RCW cavity, we removed the lower portion of the restrictor plate, if present, and drilled a 7.7-cm-diameter hole into the face of the cavity, centered approximately 12 cm below the entrance hole (Fig. 1). To protect the exterior of the cavity and maintain a continuous cavity chamber, we designed a metal plate and wooden plug that fit flush with the exterior of the cavity (Fig. 2). The wooden plug was 2–3 mm smaller in diameter than the access hole, and 5.5 cm in length. We inserted two threaded, t-nuts (5 mm) into the artificial cavity on either side of the access hole (Fig. 1). The metal plate-wooden plug assembly was secured to the front of the cavity using two thumb screws, tightened into the t-nuts (Fig. 2). We chose thumb screws over flat-headed screws because the former could be removed by hand and were less likely to be completely covered by resin.

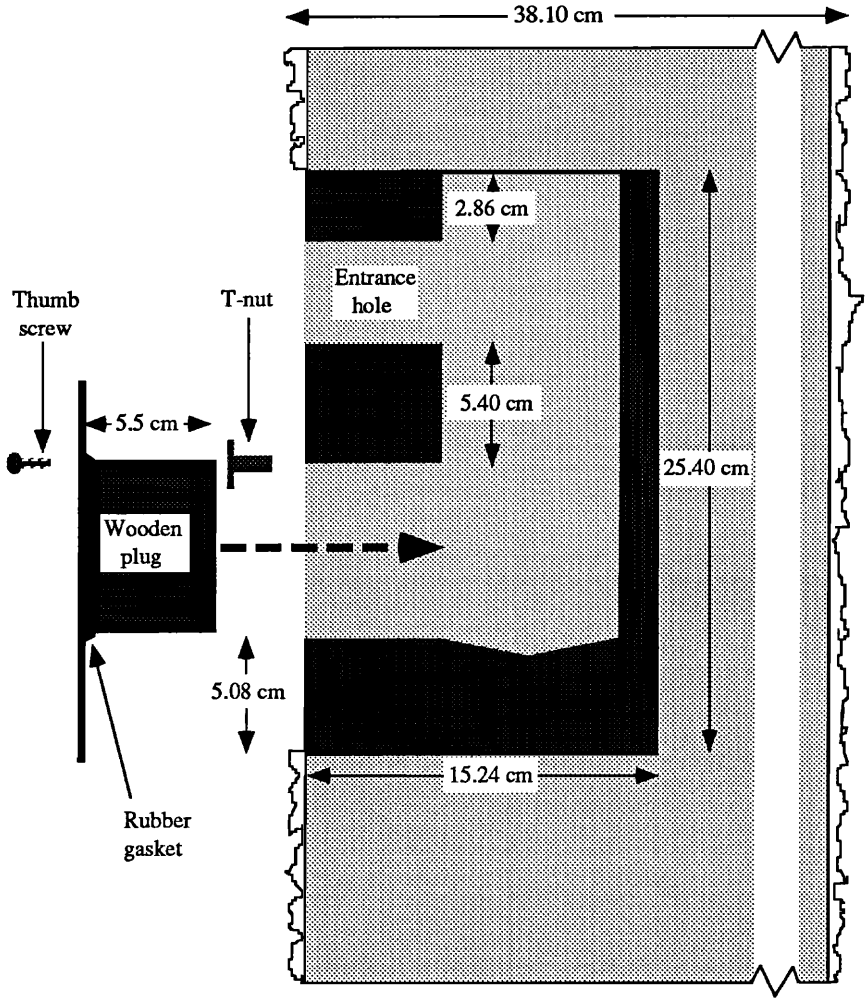

FIGURE 2. Cross-sectional view of modified, artificial Red-cockaded Woodpecker cavity. Metal plate-wooden plug assembly, t-nut, and thumb screw are removed from access hole and exterior of cavity to show their approximate placement.

In areas where rat snakes (*Elaphe obsoleta*) are common, use of thumb screws may aid snakes in their attempts to gain access to cavities and therefore use of flat-headed screws may be required (R. Conner, pers. comm.). To prevent water and insects from entering the cavity, we attached a rubber gasket (5 mm) around the wooden plug, positioned between the metal plate and the exterior of the cavity (Fig. 2). Authorization for cavity modifications and multiple handling of nestlings (see below) was granted under Federal Endangered Species Permit SA-93-18.

Field tests.—We chose seven RCW groups in which the breeding male

roosted in an artificial cavity to test our cavity modification. Prior to the breeding season (13–15 Mar. 1995), we modified the existing cavities to accommodate the metal plate-wooden plug assembly. Modifications required approximately 1 h per cavity and were completed between 1000 and 1600 h to minimize disturbance of the birds. We conducted evening roost checks at three of the seven cavities on the day of the modifications to determine if the changes had caused the males to abandon their roosts; the four remaining cavities were checked within 2–3 d after modifications.

We climbed each of the seven cavity trees every other day, beginning in early April, until completed clutches of RCW eggs were recorded. We resumed climbing on day 10 of incubation and continued daily inspections until all eggs hatched or were removed by the adults. We inspected each nest 11–15 times during egg laying and incubation. We determined number and condition of eggs through visual inspection or by gently turning them with our fingers. None of the eggs were damaged as a result of our handling. Mass and tarsal length were recorded for seven young in three nests. Measurements commenced at time of banding (day 6) and continued until fledging was imminent (day 21). At age 6 d, we removed young from their cavities through the plugged opening, banded and weighed them, and recorded their external characteristics (e.g., tarsal length, feather development). We repeated this procedure, except for banding, every 3–4 d until fledging.

RESULTS AND DISCUSSION

Adult male RCWs exhibited no apparent behavioral changes attributable to our modifications of their cavities. During evening roost checks on three of seven cavities on the day of the modifications, we observed that males worked resin wells and entered their cavities with little or no hesitation. None of the seven modified cavities was abandoned. We experienced only one mechanical problem in the modified cavities during the 10-wk study. Approximately 5 wk after modification, we were unable to remove the plug from a cavity because resin from an active resin well had seeped between the metal plate and exterior of the cavity; no resin entered the cavity, however. This problem can be avoided by periodic removal of resin from the metal plate and rubber gasket, particularly during times of excessive resin flow. All cavities remained dry during rain.

RCWs successfully nested in five of seven modified cavities. Incomplete clutches in two groups were believed to have resulted from an unstable male-female pairing and/or disruption by other RCWs and was not believed to be attributable to cavity modifications. Removal, measurements, and replacement of young of all ages was uneventful, and required approximately 20 min to complete. All nestlings fledged successfully.

Although noosing of young RCWs is a well established and extensively used technique, it is not without limitations. The noose technique involves the insertion of a multi-noose, rubber hose device into the nest with the loops of the noose open, placing a hand over the entrance hole to elicit the begging response, and then quickly but carefully pulling the loops

closed. Young <10-d-old are usually snared around the neck and/or head, whereas, older (>10 d) nestlings are often caught by a wing or foot (Jackson 1982). Noosing can result in broken wings and legs, damaged wing feathers (Jackson 1982, Walters et al. 1988), and death (Ralph Costa, pers. comm.). Walters et al. (1988) reported injury or death associated with removal and banding of nestlings to be minimal, 2.1% (36 of 1745). However, most of their banding occurred before age 10 d. Jackson (1982) advised against noosing young >10-d-old because of the risks associated with this technique. Removal and replacement by hand is quicker, less traumatic, and should decrease the possibility of injury to the young. In addition, the opportunity to examine older (>15 d) young for the presence/absence of a small red crown patch (Chapman 1929) allowed the sex of individually banded young to be determined prior to fledging, and eliminated the need for time consuming searches for recently fledged chicks.

On the basis of our reported success, we feel that our modification offers several advantages over original artificial cavity designs: (1) eggs and young can be easily removed for measurement, banding, or other scientific purposes, (2) debris and nesting material from other cavity users can be easily removed, and (3) modifications caused no apparent changes in adult behavior. This modification should encourage additional RCW research requiring access to eggs and nestlings. However, further testing of this modification is necessary to determine any long-term effects to cavity structure and possible leakage of resin and rain into cavities. Prior to such testing, this modification should only be used in experimental research and not as a general management tool.

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