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A bark-shaving technique to deter rat snakes from climbing red-cockaded woodpecker cavity trees

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Abstract We developed a bark-shaving technique to deter rat snakes (*Elaphe obsoleta)* from climbing red-cockaded woodpecker *(Picoides borealis)* trees as an aesthetically pleasing, more cost-effective, and safer alternative to other snake excluder devices. We used a drawknife to carefully shave the bark around the circumference of 4 treatment trees in a l-m-wide band to eliminate any furrows or rough surfaces, without cutting into the cambium. Four control trees were not altered. We tested our method from April 1997 to August 1997 and found that shaved trees were nearly 100% effective in preventing rat snakes from climbing (n=40 climbing attempts), whereas control trees were successfully climbed (n=20 climbing attempts) on each attempt. One shaved barrier was crossed by one snake 14 weeks after the barrier was initially created. The bark had roughened from tree growth. After we reshaved the barrier, the snake was unable to cross the barrier again. Despite loss of effectiveness over time, the shaved barriers can provide red-cockaded woodpeckers a head-start in developing their own defenses against rat snake predation in a manner that is more natural in appearance than other snake-excluder devices.

Key words *Picoides borealis,* rat snake, red-cockaded woodpecker, snake-excluder device, tree climbing

Rat snakes *(Elaphe obsoleta)* are well known as climbers that prey on eggs, nestlings, and adults of many bird species (Fitch 1963, Blem 1979, Fendley 1980, Haggerty 1981, Gress and Weins 1983, Aldrich and Endicott 1984). Jackson (1976) suggested that arboreal@ in rat snakes may have evolved as a mechanism to escape fires in the frequently burned southern pine (*Pinus* spp.) forests, which may have facilitated exploitation of arboreal food sources. Rat snakes commonly climb limbless pine boles (Neal et al. 1993, Richardson and Stockie 1995). Withgott et al. (1995) and Conant and Collins (1991) suggested that rat snakes ascend by grip ping bark crevices with their ventral scales. Gans (1974) reported that rat snakes climb a vertical trunk by a combination of concertina and undulation. Forces applied near the snake's ventral surfaces push its angled side against irregularities in the bark.

Nestlings of the endangered red-cockaded woodpecker (*Picoides borealis)* have been reported as prey items of rat snakes (Jackson 1978*a*, Neal et al. 1993, Richardson and Stockie 1995), despite antipredator behaviors such as bark scaling, where woodpeckers peck off loose bark to the point where the bark is quite smooth, and woodpeckers' excavating resin wells (Jackson 1974, Rudolph et al. 1990). Neal et al. (1993) reported that rat snakes attempted to climb red-cockaded woodpecker cavity trees significantly more often than control trees and all of the climbing occurred exclusively during the breeding season, suggesting that rat snakes actively seek woodpecker nests. Withgott et al. (1995) developed a snake-excluder device made of

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60-cm-wide aluminum flashing, which, was tested and found to be effective.in preventing rat snakes from reaching woodpecker cavities in experimental trials.

We describe methods used by rat snakes to climb limbless pine tree trunks. We also test a modification of the Withgott et al. (1995) snake-excluder technique.

Methods

All of the snakes (*n*=21) used in the study were wild-caught Texas rat snakes (*E. o. lindheimeri*, total length 102-156 cm) from Angelina, Jasper, Nacogdoches, and San Augustine counties in eastern Texas (Dixon 1987). Most (*n*=17) of the snakes used in our study were trapped in the Angelina National Forest as part of a mark-and-recapture study These snakes were kept in captivity for one week and then released. Other captured snakes that were not part of another study often were kept for several weeks. All snakes were given water but no food. During climbing trials, we studied the method by which rat snakes moved up the bark of the pine trees in an upland, well-burned loblolly pine (*Pinus taeda*) stand on the Stephen F. Austin Experimental Forest in Nacogdoches County, Texas.

We selected mature loblollies as treatment trees (*n*=4, 42- to 48-cm DBH) and controls (*n*=4, 42- to 4&m DBH) in our climbing trials. A 2-m section of the bole was delineated on all 8 trees from 1 m to 3 m above the ground using tree-marking paint. On 15 April 1997, we used a drawknife to carefully shave the bark around the circumference of the treatment trees to eliminate any furrows and rough surfaces, without cutting into the cambium, from 2 m to 3 m above the ground (Figure 1). During preliminary trials, we used a 60-cm-wide shaved barrier modeled after the Withgott et al. (1995) technique. Rat snakes were not able to grip the shaved bark, but some snakes were still able to cross the barrier by stretching across the 60-cm-wide band. We therefore increased the width of the shaved barrier to 1 m. Neal et al. (1999) also determined that 60 cm was not a wide enough barrier and recommend an excluder of at least 91.4 cm in width.

From April 1997 to August 1997, 10 rat snakes tried to climb treatment trees (*n*=40 total climbing attempts) and five snakes tried to climb control trees (*n*=20 total climbing attempts). Because most of the snakes used in this study were borrowed from another study, they were available for only a short time; therefore, each snake did not climb each tree. This increased the number of snakes needed to complete the climbing trials. Each snake attempted to climb a maximum of 1 treatment tree and 1 control tree per day, with a minimum of 2 days of rest before climbing again. Treatment trees were always tested first because we believed that rat snakes might give their best effort during their first climbing attempt. In all climbing trials, snakes were placed on the tree bark 1 m above the ground and were coaxed by gentle prodding into climbing up the tree. We chose to start the snakes at 1 m up the trunk of the tree, instead of a lower height, so that they would be less inclined to climb downward in an attempt to escape to the ground. If the snake's tail passed the 3-m mark on the tree, it was considered a successful climb. If the snake's tail did not pass the 3-m mark, it was considered an unsuccessful climb. Some snakes refused to climb; therefore, we recorded only those attempts where the snakes aggressively tried to climb beyond the barrier.

Figure 1. Bark being shaved from a pine tree with a drawknife to deter climbing by rat snakes.

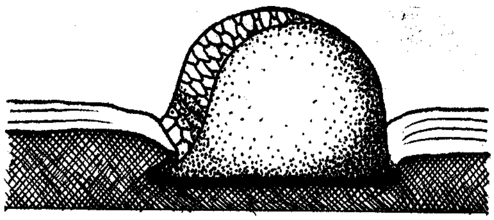

Figure 2. Cross-section of a rat snake climbing a pine tree.

Snakes in the process of shedding their skin, identified by the opaque appearance of their eyes, were excluded from the climbing trials, as were snakes that had recently eaten. Snakes that had recently eaten were identified by a lump in the body produced by a prey item. Food items in the gut probably reduced a snake's ability to climb.

Results

Rat snakes did use their ventral scales to climb pine trees. However, they did not use the leading edges of the scales (portion of the scale that overlaps the next posterior scale) for traction as might be expected. Instead, the snakes folded their ventral scales dorsolaterally on either side of their body, often on both sides at the same time (Figure 2), and wedged the folded scales into crevices to grip the tree (Figure 3). The snakes often found suitable crevices with the sides of their necks, then ran their entire body length though this purchase point.

All attempts (n=20) to cross the 3-m mark on control trees were successful. In contrast, only one snake was able to cross the shaved barrier beyond the 3-m mark. This individual did so approximately 14 weeks after the initial shaving. After this tree was reshaved, the snake was unable to cross the barrier. This same snake also was unable to cross the shaved barrier on 2 other treatment trees.

Discussion

Conant and Collins (1991) described the cross-section of rat snakes as having the shape of a loaf of bread, where the flat belly meets the side of the body at an angle. Rat snakes differ from most other snakes, which have a more rounded cross-section. Conant and Collins (1991) also reported that the angles in the belly scales of rat snakes allow them to grip irregularities on the boles of trees for climbing. We observed that rat snakes could climb fairly smooth trees as long as irregularities were present in the bark; however, they seemed to climb more easily and quickly on pine trees with deep vertical furrows in the bark.

Removing irregularities in bark by shaving appears to be a good method to deter rat snakes from climbing red-cockaded woodpecker cavity trees. Our method, however, was not 100% successful in the climbing trials. The one snake that crossed the barrier was among the smaller snakes (107 cm total length) used in our trials, and it appeared to be an extremely proficient climber. We suspect that the failure was from the natural roughening of the bark caused by tree growth, as the rat snake crossed the barrier approximately 14 weeks after the tree was initially shaved. We noticed that the bark on the barrier that failed had become considerably rougher by the time the rat snake crossed it. After 2 days, we reshaved the barrier and tested the same snake that had made the successful crossing. The snake made a very good effort in trying to cross the barrier, spending approximately 5 minutes actively searching on the shaved portion of the

Figure 3. Rat snakes climb by using the dorsolateral folds in their skin to grip the furrows in the bark of pine trees.

bole, but was unable to gain a purchase and did not cross the barrier. We are confident that this retrial, along with all of the initial trials, demonstrates the effectiveness of the bark-shaving technique in preventing rat snakes from climbing pine trees.

Despite the inevitable loss of barrier effectiveness over time, we believe the shaved-bark technique is a good alternative to aluminum flashing (Withgott et al. 1995) when aesthetics are a concern. If the tree becomes active (is used as a roost tree), the shaved bark gives the woodpecker time to initiate its own defenses against rat snakes, such as bark scaling and resin-well excavation. Red-cockaded woodpeckers frequently flake the bark from their cavity trees to the extent that the trees appear exceptionally smooth and red (Jackson 1978*b*). If the cavity tree is not used by a red-cockaded woodpecker, the pine tree should in time replace the shaved bark and regain its normal appearance.

Fire resistance of shaved trees may be decreased because of the removal of the insulating bark; cavity trees should be protected from prescribed burns by raking away or back-burning adjacent fuels (United States Department of Agriculture 1995). Trees with shaved bark at breast height (n=6) in our study area were subjected to a prescribed burn approximately 3 months after they were shaved and suffered no apparent damage. Although bark shaving might seem to be an activity that could increase the tree's susceptibility to southern pine beetles (*Dendroctonus frontalis*), Berisford (1980) found that most of the southern pine beetle parasitoids increased in number as bark became thinner, which might deter pine beetles from choosing trees with bark thinned by shaving. Overall, we believe that shaving the bark from pines may not affect negatively the health of the tree. In addition, our method is cost-effective because it requires only a reusable draw knife and because only a few minutes are required to shave a barrier. If desired, the barrier can be reshaved or its width can be increased at any time with minimal effort.

In very productive sites, rapid tree growth can cause the aluminum-flashing barrier to rupture over time and lose its effectiveness (Saenz et al., personal observation). The flashing will then need to be removed or repaired, requiring additional expense. Torn aluminum flashing can be potentially hazardous to field personnel and wildlife. Aesthetically, aluminum flashing is less natural in appearance, whereas the shaved barrier appears similar to bark scaling by red-cockaded woodpeckers.

New artificial cavity trees (Copeyon 1990, Allen 1991) usually lack scaled bark or a resin barrier when woodpeckers begin roosting in them, making them more vulnerable to rat snake predation than natural cavity trees. Translocation and reintroduction of red-cockaded woodpeckers usually requires that the birds be placed into a new artificial cavity (Rudolph et al. 1992), forcing them to use a roost tree without any protection from rat snakes. While snake excluder devices may not be necessary in all situations, they can provide a head start for woodpeckers in developing a defense against snake predation when used on new artificial cavity trees, prior to translocations and reintroductions, and on nest trees with low resin production.

We suggest that shaved barriers be placed near breast height to allow for easy installation, which can be performed by one person in a short time. We also suggest that a very sharp drawknife be used because a dull knife may pull bark from the trees, exposing the cambium. Practice trees should be shaved before this technique is attempted on cavity trees because the bark needs to be shaved as smooth as possible without damaging the cavity tree.

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