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TREE FOILING: A TREATMENT TO IMPROVE NESTING SUCCESS BY RED-COCKADED WOODPECKERS (*Picoides borealis*)

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Abstract.—We tested a low-cost, temporary foiling technique to improve nesting success of Red-cockaded Woodpeckers (*Picoides borealis*). Total brood loss was studied for four breeding seasons, 2007-2010, on the Withlacoochee State Forest in central Florida. On the Citrus Tract a foiling technique was applied to half of the nest trees immediately after detection of the nest (n = 104). The other half received bark shaving only (n=100). Success was counted if at least one nestling fledged from the nest. Success of the nests improved with the addition of foil from 73% to 86%. The Croom population had all nest trees foiled (n = 70). First nest success was 90%, comparable to that of the protected nests in Citrus.

***Keywords*:** Red-cockaded Woodpecker, brood loss, snake excluder device

INTRODUCTION

Nesting success and partial brood loss in Red-cockaded Woodpeckers (*Picoides borealis*) has been the subject of many studies (McCormick 2004), (DeLotelle 2004) etc. In this study we diverge from arguments and causes of partial brood loss and look at total brood loss, which generally is attributed to predation, nest desertion, and loss of cavities to kleptoparasites (USFWS 2003). Personal observations suggest that having an unrelated female Red-cockaded "helper" or having inexperienced breeders may also be a cause of complete nest failure. Because determining the cause of complete nest loss was impractical, we measured success or failure of the initial nesting attempt regardless of the cause, correlated with a foil treatment of the nest tree.

Listed as federally endangered in 1970, the Red-cockaded Woodpecker's historic distribution approximates that of longleaf pine, ranging from eastern Texas, to southern Florida north to Missouri and New Jersey (Costa 1995). Current distribution is limited to scattered populations within this range where pinelands have been managed with prescribed fire. On these federal, state, and private lands about 15,000 Red-cockaded Woodpeckers remained in 2003 (USFWS 2003), including 2 tracts of the Withlacoochee State Forest; the Citrus and Croom tracts north of Tampa, in central Florida. Reproductive data has been collected on the Withlacoochee State Forest Croom Tract (82°

17" W, 28° 36' N) since 2000, and the Citrus Tract (82° 25" W, 28° 48' N) since 2002. These populations are located in similar sandhill habitat, managed similarly by the same agencies, and separated by 16 km (10 mi) of rural agricultural landscapes.

Augmented management strategies that have dramatically increased both populations include: translocation, artificial cavity insert and start placement, banding, artificial cluster placement, mechanical treatment of midstory hardwoods, and increased prescribed burning. This management began in 1998 on both tracts. In 1998, the Croom population contained about five occupied (active) clusters (clusters are separate groups of large pines with cavities where individual family groups of Red-cockaded Woodpeckers can roost and nest) with three of these clusters being occupied by single males and one of the potential breeding pairs demographically isolated from the rest. This earlier work on the Croom Tract was documented by Morris et al. (2004). By 2010, the Croom Tract contained 27 active clusters with 24 occupied by potential breeding groups.

The Citrus population contained about 44 active clusters with 43 occupied by potential breeding groups in 2002, the first year of accurate monitoring. By 2010, the population was composed of 74 active clusters with 64 occupied by potential breeding groups. Despite the increase in population size, two of the six nests in Croom failed during the 2002 nesting season. In an attempt to deter rat snakes, suspected of causing nest loss, we implemented a bark shaving technique in 2003 (Saenz et al. 1998a). By the beginning of 2004 all nest trees in Croom and some in Citrus were shaved according to this protocol.

Regardless of bark shaving techniques in place, three of 11 nests in Croom were lost between 14-26 and May 2004, representing 27% of the known nests. A further attempt to combat these nest losses was initiated using a tree foiling method described in this paper.

Methods

During the nesting season (typically between April 15-July 1) all active trees were monitored for nesting activity using Tree Top Peeper System at least every 7 days. Active trees are designated as active within a month preceding nesting season and defined by the presence of fresh resin and flaked bark around the area of the cavity resulting from Red-cockaded Woodpecker activity. When a nest was located in Croom, the tree was immediately foiled. In Citrus a random method was used to determine a 50% chance if the nest tree would be foiled or not. Second and third nesting attempts were always foiled but only initial nests are considered in the results.

Gender of Red-cockaded Woodpecker sub-adults can be determined only when the birds attain plumage, with males determined by a red spot on the top of the head. Sex checks are generally performed after the birds have fledged, but are still not independent from their parents (16-20 days after banding which occurs 7-9 days after hatching). For the purposes of this paper, fledge checks occurred as soon as possible following fledging so post fledging mortality would not be counted as nest failure. A successful nest was de-

fined as one or more fledglings being found during sex check. If all eggs or nestlings were prematurely lost from the nest, or if no chicks were detected during sex checks, then the nest was considered a failure. In the event of a total brood loss due to a flooded cavity, that nest was removed from the data and is not considered in this paper (this occurred 4 times in 2009).

Materials

Low-cost aluminum foil 30.5 cm wide (Publix brand foil was mostly used), high quality duct tape 4.8 cm wide (multiple brands used), longleaf pine cones, and bark scraper.

Treatment

Active trees were examined at least every 7 days using the Tree Top Peeper System until a nest was detected. In Croom all nests were immediately treated. In Citrus about 50% of nest trees were treated based on a predetermined random technique or the flip of a coin.

The loose bark from the ground level buttress to approximately head high (2 m.) was scraped off using a longleaf pine cone, or bark scraper. Aluminum foil was wrapped starting at the bottom and encircling the tree like a barber pole with about 2 cm of overlap between loops. Loose portions of foil were compressed together to make the foil fit tightly to the tree. At the ends, both top and bottom were completely secured to the tree with duct tape. This was accomplished with a single pass encircling the tree with the tape half contacting the tree and half contacting the foil. Additionally any tears or loose spots were taped using small pieces of duct tape. For a visual demonstration see "RCW nest tree foiled" on YouTube. The final result was smooth foil and duct tape covered at least 135 continuous cm of the tree. In the case of a turpentine tree or tree with a severe wound that made wrapping the tree impossible, the foil was placed higher in the tree.

Control

In Citrus, about half of the trees were foiled. The trees that were not foiled received bark scraping (Saenz et al. 1998).

Results

The results are considered separately by year, tract, and combined.

Citrus

During the four years data were collected in Citrus (2007-2010) there were 204 initial nests detected. Of these 104 were foiled and 100 were scraped. Of the foiled trees, 89 were considered a success, a rate of 86%. Of the 100 trees that were not foiled, 73 were considered a

Table 1. Citrus Red-cockaded Woodpecker nesting success 2007-2010 foiled nest trees compared to shaved only nest trees (control).

Year	2007	2008	2009	2010	Total
Nests	48	50	52	52	204
Foiled	20	31	21	32	104
Successful	17	28	13	31	89
Percent Successful	85%	90%	62%	97%	86%
Not foiled	28	19	31	22	100
Successful	21	17	15	20	73
Percent Successful	75%	89%	48%	91%	73%
Statistics	χ^2	χ^2	χ^2	χ^2	χ^2
	0.231	0	0.457	0.113	4.193
	P	P	P	P	P
	0.631	1	0.499	0.737	0.041

Chi-square analysis 2 × 2 contingency table, Yates corrected

success, a rate of 73%. This suggests that total brood loss diminished by 13% using the foil treatment compared with bark scraping alone. This conclusion is significant according to 2 × 2 Chi square contingency table, Yates corrected ($\chi^2 = 4.193$, P = 0.041).

Croom

All trees were treated. During the years 2007-2011 seventy initial nests were detected. Of these, 63 were successful. This is an apparent success rate of 90%.

Citrus and Croom Combined

The combination of the data only increases the treatment data, providing a treatment sample size of 174. Untreated sample size remains 100. Overall 152 treated nest trees produced fledglings. Combined success rate is 87%.

Discussion

Corn snakes (*Pantherophis guttatus*) and yellow rat snakes (*P. alleghaniensis*) inhabit the Withlacoochee State Forest. Corn snakes

Table 2. Croom Red-cockaded Woodpecker nesting success 2007-2010 foiled only nests.

Year	2007	2008	2009	2010	Total
Nests (all foiled)	14	20	18	18	70
Successful	13	19	15	16	63
Percent Successful	93%	95%	83%	89%	90%

Table 3. Croom and Citrus Red-cockaded Woodpecker combined nesting success in treated nests trees 2007-2011 compared to Citrus shaved only nests (control).

Year	2007	2008	2009	2010	Total
Croom Nests (all foiled)	14	20	18	18	70
Citrus Foiled Nests	20	31	21	32	104
Total Foiled Nests	34	51	39	50	174
Successful	30	47	28	47	152
Percent Successful	88%	92%	72%	94%	87%
Not foiled (Citrus)	28	19	31	22	100
Successful	21	17	15	20	73
Percent Successful	75%	89%	48%	91%	73%
Statistics	χ^2	χ^2	χ^2	χ^2	χ^2
	1.048	0	3.067	0	7.962
	P	P	P	P	P
	0.306	1	0.080	1	0.005

Chi-square analysis 2 × 2 contingency table, Yates corrected

have been observed in sandhill habitat, Red-cockaded Woodpecker trees, and even in Red-cockaded Woodpecker cavities. However, this study does not assume that foiling is acting as a snake excluder device (SNED). While 4.5 feet of smooth foil seems as if it would behave as a SNED, we collected no direct evidence that this is the mechanism for decreasing total brood loss. The foil could act in some other unknown way to decrease nest failure that we have not observed or detected.

In my experience, total brood loss leaves behind very little evidence to help determine a cause, but I believe it is caused by intruder Red-cockaded Woodpeckers, other animal species including Red-bellied Woodpeckers, southern flying squirrels, and rat snakes, as well as starvation of the nestlings. Of the total nest losses, I believe about half are caused by rat snakes, which are the ones that the foiling mostly prevents. Snakes may still reach a cavity by reaching from an adjacent tree or perhaps some other means. It is possible that foiling could deter other nest predators such as flying squirrels that may not like to ascend trees with foil. The total brood losses that are unaffected by foil are probably due to starvation or predation by other woodpeckers. There have been total brood losses during this study that have almost certainly been caused by starvation because they are associated with inexperienced (young) breeders. If we were to analyze additional data about breeder fitness, we could probably make a case for total brood loss resulting from inexperienced breeders being a high proportion of the cases of total brood loss that cannot be prevented by foiling the

tree. If this loss were somehow teased out of the results we may find an even higher correlation between foiling and successful nesting.

In all 4 years there was a higher success rate in foiled trees, however, rates were different each year. The most pronounced year was 2009, a year with abnormally high amounts of May rainfall which seemed to negatively affect overall nesting success. This is a difficult phenomenon to explain but perhaps with so much rainfall, snakes were more likely to climb trees in search of food, or perhaps wet trees are less difficult to ascend. In 2008 there was very little difference between foiled and shaved treatments. Again this is difficult to explain without a better understanding of rat snake behavior.

Large differences in reproductive rates have been measured between the first nest and subsequent nesting activities. Of 16 initial nest failures recorded in Croom between the years 2000-2010, 3 successfully renested and these nests produced 5 offspring (FFS unpublished data). Reproduction rates of second nests are 0.31 fledglings per pair that lost the initial nest, compared to 1.7 fledglings per nest on a successful first nest. In Citrus, between 2002 and 2101 0.48 fledglings were produced per group that lost the initial nest compared to 1.54 birds produced in a successful first nest (FWC unpublished data). This suggests that a successful initial nest in Citrus produces 1.06 more fledglings than subsequent nesting activity. Second nests are probably less successful because the timing does not correspond to seasonal abundance of prey and advantageous weather conditions. It may be less difficult to raise young during the Florida spring drought in May compared to summer monsoon pattern that begins in June. The second nest may also be less productive statistically because birds that fail the first time may be predisposed to failure due to inexperience, poor nest tree selection, or a persistent predator. This issue may not be resolved and the second nest could fail for the same reason the first nest failed. Using the data from the Citrus Tract for all nests from 2002-2010, a theoretical population containing 100 groups that attempted nesting would behave the following way: If all trees were foiled, 86 of the nests would be successful producing 86*1.54 = 132 fledglings. The 14 groups that lost the initial nest would eventually produce 14*0.48 = 7 fledglings. This theoretical population produces 139 fledglings. The same theoretical population with shaved trees would produce 73 successful initial nests, or 73*1.54 = 112 fledglings. The initially failed nests would yield 27*0.48 = 13 fledglings for a total of 125 birds.

The calculated increase in production due to foiling would be 14 fledglings, an 11% increase in fledging rate. Considering that many of the second or third nests counted in our calculations were foiled (all subsequent nesting events in Citrus since 2007 were foiled) the actual

difference may be even greater if foil protects second or third nests similarly to the first (something not tested in this study).

Foiling the nest tree takes about 5 min, and uses about $5.00 worth of materials. The total cost for treatment is therefore about $6.00. In this scenario, 100 initial nests costing $600 to foil would be $600/14, a cost of $43.00 per additional nestling. There is additional cost for treating 2nd and 3rd nests not calculated in this scenario. Considering other management costs, this is an inexpensive method to produce more birds.

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