Silviculture and the red-cockaded woodpecker: Where do we go from here?

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SILVICULTURE AND THE RED-COCKADED WOODPECKER: WHERE DO WE GO FROM HERE? [1]

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Abstract. Recent standards and guidelines for the protection and management of red-cockaded woodpecker habitat within 3/4 mi of colony sites, and also thinning within colonies to reduce basal area and midstory will have a significant effect on National Forest lands. The relation of these thinnings to forest pest management will be examined as well as the area of forest involved. Current fire regulations in relation to prescribed burns and potential fuel buildup will be examined. Plans for research, including disturbances, hazard, and risk rating for southern pine beetle and landscape changes will be presented.

Introduction

Cultural practices in southern National Forests, and particularly in eastern Texas, have been affected by litigation stemming from declining populations of the red-cockaded woodpecker (RCW) (*Picoides borealis* Vieillot). The RCW was identified as a rare and endangered species in 1968 (USDI 1968), and officially listed as an endangered species since 1970 (USDI 1970). The bird received Federal endangered species protection with the passage of the Endangered Species Act in 1973. The USDA Forest Service (FS) in July 1975, amended its Wildlife Habitat Management Handbook to include a chapter on management of the RCW (USDA 1975, Ch. 420). Under authority of the Endangered Species Act, the Fish and Wildlife Service (FWS) approved a RCW recovery plan (USDI 1979). Following approval of the recovery plan in October 1979, the FS revised its Wildlife Habitat Management Handbook, Chapter 420 (USDA 1979). A 1980 rangewide RCW survey (except for the Croatan, Daniel Boone, Oconee, and Ouachi ta National Forests) estimated 2121+/-405 active colonies. This is about 70 percent of the active colonies found on all Federal lands during the 1980 rangewide survey (Lennartz et al., 1983). Using "Continuous Inventory of Stand Condition" information, the FS estimated 2,026 RCW colonies in 1980. These are summarized in Costa and Escano (1989).

Red-cockaded woodpecker populations have declined during the last 20 years, both southwide (Ligon et. al., 1986; Costa and Escano 1989) and in Texas (Conner and Rudolph 1989). As an example, the number of active colonies in the Angelina National Forest in Texas decreased from 38 in 1983 to 19 in 1988 (Conner and Rudolph 1989).

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A number of factors influenced this decline. Red-cockaded woodpeckers are unique in that nesting and roosting cavities are constructed and maintained exclusively in living pine trees, primarily "old-growth" longleaf (Pinus palustris Mill.), loblolly (P. taeda L.) and shortleaf (P. echinata Mill.) pines. Nest cavity trees must therefore have sufficient heartwood to support a nest cavity (Lennartz et al., 1983b; Conner and O'Halloran 1987). Loss of "old-growth" southern pine stands, either to short-rotation forestry or other uses, has resulted in significant loss and fragmentation of nesting habitat (USDI 1985). Hardwood midstory encroachment, resulting from a change in fire regime from periodic hot, growing-season fires to cooler, winter prescribed fires, is also strongly associated with cavity tree cluster abandonment (Locke et al., 1983; Conner and Rudolph 1989). In Texas, another major factor in cavity tree loss is the southern pine beetle (Dendroctonus frontalis Zimm.). Over a 13-year period, over 50 percent of cavity tree mortality in Texas National Forests was due to bark beetles, with significant losses occurring during both epidemic and endemic bark beetle population levels (Conner et al., 1991a). Red-cockaed woodpecker cavity trees are also highly susceptible to windsnap at the point of cavity excavation, accounting for about 30 percent of cavity tree loss in the previously referenced study.

Catastrophic losses to forests also impact the RCW. Most cavity trees lost on the Raven District of the Sam Houston National Forest in Texas occurred during a southern pine beetle epidemic (Billings and Varner 1986; Conner et al., 1991a). This bark beetle epidemic was coupled with Hurricane Alicia in 1983. Losses of 183 RCW cavity trees due to unknown causes were probably due to the southern pine beetle (Conner et al., 1991a). On the Kisatchie National Forest in Louisiana, RCW cavity trees and clusters were lost to a southern pine beetle epidemic followed by fire (Kulhavy et al., in press). Catastrophic losses occurred on the Francis Marion National Forest in South Carolina during Hurricane Hugo, on September 21, 1989.

As a result of lawsuits filed in 1985 against the USDA Forest Service in Texas by the Texas Committee on Natural Resources, the Sierra Club, and the Wilderness Society, on June 17, 1988, Judge Robert M. Parker, U.S. District Court for eastern Texas, issued a permanent injunction against the FS which, among other things, required the following silvicultural activities on National Forests in Texas (impacting about 200,000 ac):

1. Conversion of forest harvesting techniques from even-aged management to a program of selection or uneven-age management that preserves 'old-growth' pines from cutting within 200 m of any colony site.

2. Establishment of a basal area of 60 ft^2/ac, within 3/4 mi (1200 m) of any colony site.

3. Establishment of a program of midstory removal of hardwoods in and adjacent to colony sites.

4. Cessation of the use of existing logging roads or other non-paved roads within colony sites and restrict the use of such roadways to the essential minimum within 3/4 mi (1200 m) of any colony site. (June 17, 1988, opinion and order at 39)

The FS began implementation of these requirements but appealed the judge's decision. Basal area reduction and midstory hardwood removal were carried out on many RCW colonies during the appeals process. On March 4, 1991, the U.S. Court of Appeals for the Fifth Circuit issued a decision that will partially vacate the district court's injunction requiring specific features in the RCW habitat management plan for National Forests in Texas, while upholding the judge's findings that previous forest management in Texas National Forests resulted in a "take" of the RCW, thus violating the Endangered Species Act of 1973. The injunction order was remanded to the district court with the instruction that it review a new RCW management plan to be prepared by the FS. The District Court judge will either approve or disapprove the new plan, which is currently being formulated.

Our research in the National Forests of Texas has focused on site and stand characteristics of RCW colonies and interaction with southern pine beetle in stands composed principally of loblolly and shortleaf pines, stand characteristics, and physiological characteristics of RCW cavity trees have been examined, and silvicultural implications explored.

Hazard Rating for Southern Pine Beetle

Seven active RCW colonies in loblolly and shortleaf pine types in or near the Bannister Wildlife Management Area in the Angelina National Forest were chosen for hazard rating. RCW colonies and surrounding stands were rated using two methods: Texas (TX) Hazard (Mason et al. , 1981) and National Forest (NF) Risk (Lorio and Sommers 1981). Hazard systems are based on stand basal area, land form, tree height and diameter and other relevant stand attributes and rate the susceptibility of stands, based on these characteristics to southern pine beetle. Both systems used in this study produced similar results in Texas and Louisiana (Lorio et al., 1982). Areas within a radius of 1320 ft (402 m) were evaluated for each RCW colony.

Hazard And Risk Rating

Individual colonies (cavity tree clusters) were ranked low to moderate hazard using the TX Hazard system and moderate hazard using the NF Risk system. In 1986, within ¼ mi of the colonies 28 percent of the stands were low hazard, 25 percent moderate, 0.3 percent high, and 7.5 percent extreme with TX Hazard. Four percent were low hazard, 52 percent moderate, and 6 percent high with NF Risk (Mitchell et al., 1991). Average stand characteristics and hazard ratings (TX Hazard) were similar to those reported by Belanger et al. (1988) for RCW colonies in Georgia. Bark beetle infestations, particularly the southern pine beetle, were responsible for mortality of four active, one inactive, and 13 non-cavity trees from 1985-1987. More colony trees were lost in 1985 (an epidemic SPB-year in Texas) than in 1986 and 1987 (years of low population) combined (Mitchell et al., 1991).

Oleoresin Exudation Flow

Pecking of resin wells by the RCW causes copious resin flow. Resin on cavity tree boles acts as a barrier to rat snakes, a major predator of the RCW (Jackson 1974; Rudolph et al. , 1990a). Data on oleoresin exudation flow (OEF), also an important defensive characteristic against southern pine beetle (Hodges et al., 1979; Nebeker et al., 1988; Lorio et al., 1990), were collected periodically during the growing seasons of 1986 through 1989 in the Bannister Wildlife Management Area, and 1989 through 1990 in the Neches District of the Davy Crockett National Forest. OEF was measured by wounding the trees at approximately 4.5 ft (1.4 m) above the ground with a circular arch punch 1 inch (2.54 cm) in diameter driven to the interface of xylem and phloem (after Lorio and Sommers 1986 and Lorio et al., 1990).

A small aluminum funnel was placed immediately under the wound which directed exuded oleoresin into a graduated tube. The OEF measurements were recorded 8 and 24 hours post-wounding. All holes were punched between the hours 0700 to 1000 to minimize effects of diurnal variation (Nebeker et al., 1988). One hole was punched per tree. The bark plug removed by the arch punch was then placed back into the tree. OEF was evaluated on three types of trees: active, inactive, and potential (control). Trees were considered active if they were currently being used for roosting or nesting. Inactive trees had been used for nesting or roosting at some point, but were currently unused by RCW. Potential trees were morphologically similar to cavity trees, but showed no evidence of ever having been used by RCW.

Resin production and resin flow in southern pines is interactive with weather, soil moisture, season, and topographic position (Blanche et al., 1985; Lorio 1986; Lorio and Sommers 1986; Lorio 1988; Lorio et al., 1990). Results from oleoresin exudation flow studies in Texas RCW colonies indicate OEF can also vary with site and species (in this case, shortleaf and loblolly). In the Angelina National Forest, most cavity trees were loblolly pine, but the shortleaf pine exhibited higher OEF. Exactly the opposite occurred in the Davy Crockett National Forest colonies, with shortleaf more common but loblolly showing greater OEF (Ross et al., 1991).

Differences in OEF between cavity tree types varied with site, species, and year of sampling (Mitchell 1987; Ross et al., 1991). Overall OEF trends tend to indicate that newly activated RCW cavity trees have higher OEF, but that the effect when it occurs is transient. (For a more detailed analysis of OEF data, see Ross et al., 1991.)

Plant Moisture Stress

Plant moisture stress was evaluated on selected active, inactive, and potential cavity trees from 1986 to 1989 in the Angelina National Forest, and 1989 to 1990 in the Neches District of the Davy Crockett National Forest. Moisture stress was measured using the pressure chamber technique described by Scholander (1965). Twigs for sampling were collected from the upper crowns of the trees using a 12-gauge shotgun, with moisture status recorded within 60 seconds of removal from tree. Sampling was done between the hours 1300 and 1500.

Pressure chamber readings showed no differences in moisture status that could be detected during peak stress hours. Sampling moisture stress was not as intensive as we would have liked however, due to logistic difficulties and concern about sampling impact on the trees and the birds.

Conclusion

Management for Red-cockaded woodpeckers is ultimately going to have to focus on maintaining the kind of forest ecosystems where they along with other endemic wildlife can thrive. One long-range need is restoration of longleaf pine within its native range. Longleaf, because of its longevity, fire resistance, and resistance to bark beetles and diseases, is frequently recommended as the pine species of choice for RCW (Lennartz et al., 1983a, 1983b; Conner et al., 1991a). Cool winter prescribed burns need to be replaced, where feasible, with hot, growing season fires for control of hardwood mids tory, control of hardwood regeneration, and facilitation of pine regeneration (Conner and Rudolph 1989, Costa and Escano 1989).

Management strategies for RCW colonies in shortleaf and loblolly stands should emphasize reducing the risk of bark beetle attack by optimizing general stand health (Conner et al., 1991b; Kulhavy et al., in press; Mitchell et al., 1991). Age, species, and genetic diversity are frequently cited as factors in reducing bark beetle risk (Hicks et al., 1979). Currently, decision notices have been prepared for interim standards and guidelines for the protection and management of RCW within 3/4 mi (1200 m) of colony sites (USDA Forest Service 1991a, 1991b).

Catastrophic disturbances cannot be prevented. However, managers must be prepared to use the most effective methods to prevent cavity tree loss during both epidemic and endemic populations of bark beetles. Direct control methods available in RCW colonies include cut and remove, cut and leave, and cut and chemical spray. Cut, pile, and burn is not permitted in RCW colonies (USDA 1987).

Site specificity is an important consideration in any cultural activity, regardless of goals. Forest managers and wildlife biologists need to have room to use their expertise in deciding when and how to apply thinnings, hardwood midstory control, prescribed fire, and extraordinary measures, such as augmentation and artificial nest cavity construction. For example, tailoring a harvest/regeneration cut or basal area reduction thinning to accomplish their purpose while minimizing wind damage to cavity trees requires site specific management. Harvest/regeneration cutting near RCW cluster areas should emphasize approaches that do not require total forest removal, such as seedtree, shelterwood (Conner et al., 1991b), and selection. An irregular shelterwood system may be appropriate in many situations (Smith 1986).

The interaction of the RCW in the southern pine forest ecosystem is complex and requires the integration of long-term forest management goals with the recovery of the species. The impact of current management (i.e., midstory removal, stand thinning, periodic burns) on the forest ecosystem needs to be further assessed in terms of economic impact and forest succession. The forest created for the RCW will endure for many years, and the benchmark for the species needs to be recorded.

Literature Cited

Belanger, R.P.; Hedden, R.L.; Lennartz, M.R. 1988. Potential impact of the 'southern pine beetle on red-cockaded woodpecker colonies in the Georgia Piedmont. Southern J. Applied Forestry 12:194-199.

Billings, R.F.; Varner, F.E. 1986. Why control southern pine beetle infestations in wilderness areas? The Four Notch and Huntsville State Park experience. pp. 129-134, In: Kulhavy, D.L.; Conner, R.N. (eds.); Wilderness And Natural Areas in The Eastern United States: A management Challenge. School of Forestry, Stephen F. Austin State Univ., Nacogdoches, TX. 416 p.

Blanche, C.A.; Nebeker, T.E.; Hodges, J.D.; Karr, B.L.; Schmitt, J.J. 1985. Effect of thinning damage on bark beetle susceptibility indicators in loblolly pine. pp. 471-479, In: Shoulders, E. (ed.); Proceedings Third Biennial Southern Silviculture Research Conference; Gen. Tech. Rep. SO-50-54. New Orelans, LA; USDA Forest Service, Southern Forest Experiment Station. 589 p.

Conner, R.N. ; O'Halloran, K.A. 1987. Cavity-tree selection by red-cockaded woodpeckers as related to growth dynamics of southern pines. Wilson Bull. 99:398-412.

Conner, R.N. ; Rudolph, D.C. 1989. Red-cockaded woodpecker colony status and trends on the Angelina, Davy Crockett, and Sabine National Forests. USDA Forest Service Res. Pap. SO-250. 15 p.

Conner, R.N.; Rudolph, D.C.; Kulhavy, D.L.; Snow, A.E. 1991a. Causes of mortality of red-cockaded woodpecker cavity trees. J. Wildlife Management 55:531-537.

Conner, R.N.; Snow, A.E.; O'Halloran, K.A. 1991b. Red-cockaded woodpecker use of seed-tree/shelter-wood cuts in eastern Texas. Wildlife Society Bulletin 19:67-73.

Costa, R.; Escano, R.E.F. 1989. Red-cockaded woodpecker status and management in the Southern region in 1986. USDA Forest Service Southern Region Tech. Pub. R8-TP 12. 71 p.

Hicks, R.R. Jr.; Coster, J.E.; Watterston, K.G. 1979. Reducing southern pine beetle risks through proper management planning. Forest Farmer 38(7):6-7.

Hodges, J.D.; Elam, W.W.; Watson, W.F.; Nebeker, T.E. 1979. Oleoresin characteristics and susceptibility of four southern pines to southern pine beetle (Coleoptera: Scolytidae) attacks. Canadian Entomol. 111:889-896.

Jackson, J.A. 1974. Gray rat snakes versus red-cockaded woodpeckers: predator-prey adaptations. Auk 91:342-347.

Kulhavy, D.L.; Coster, R.; Conner, R.N.; Hogan, K.; Mitchell, J.H. (in press) Forest protection in wilderness management: The southern pine beetle and the red-cockaded woodpecker. In: Krumpe, E.E.; Weingarten, P. (eds.); Proceedings Fourth World Wilderness Congress.

Lennartz, M.R.; Geisler, P.H.; Harlow, R.F.; Long, R.C.; Chitwood, K.M.; Jackson, J.A. 1983a. Status of the red-cockaded woodpecker on Federal lands in the South. pp. 7-12, In: Wood, D.A. (ed.); Red-cockaded Woodpecker Symposium II. Proceedings, Florida Game and Fresh Water Fish Comm. Tallahassee, FL. 112 p.

Lennartz, M.R.; Knight, H.A.; McClure, J.P.; Rudis, V.A. 1983b. Status of red-cockaded woodpeckers nesting habitat in the South. pp. 13-19, In: Wood, D.A. (ed.); Red-cockaded Woodpecker Symposium II. Proceedings, Florida Game and Fresh Water Fish Comm. Tallahassee, FL. 112 p.

Ligon, J.D. ; Stacey, P.B. ; Conner, R.N. ; Bock, C.E. ; Adkisson, C.S. 1986. Report of the American Ornithologist Union Committee for the conservation of the red-cockaded woodpecker. Auk 103:848-855.

Locke, B.A.; Conner, R.N.; Kroll, J.C. 1983. Factors influencing colony site selection by red-cockaded woodpeckers. pp. 46-50, In: Wood, D.A. (ed.); Red-cockaded Woodpecker Symposium II. Proceedings, Florida Game and Fresh Water Fish Comm., Tallahassee, FL. 112 p.

Lorio, P.L., Jr. 1986. Growth-differentiation balance: A basis for understanding southern pine beetle--tree interactions. Forest Ecology and Management 14:259-273.

Lorio, P.L., Jr. 1988. Growth and differentiation balance relationships in pines affect their resistance to bark beetles (Coleoptera: Scolytidae). pp. 73-92, In: Mattson, W.J.; Levieux, J.; Bernard-Dagan, C. (eds.); Mechanisms of Woody Plant Defenses Against Insects. Springer-Verlag, New York, NY.

Lorio, P.L., Jr.; Sommers, R.A. 1981. Use of available resource data to rate stands for southern pine beetle risk. pp. 75-78, In: Hedden, R.L.; Barras, S.J.; Coster, J.E. (tech. coords.); Hazard-rating Systems in Forest Insect Pest Management. USDA Tech. Rep. WO-27. 169 p.

Lorio, P.L., Jr.; Sommers, R.A. 1986. Evidence of competition for photosynthates between growth processes and oleoresin synthesis in *Pinus taeda* L. Tree Physiology 2:301-306.

Lorio, P.L., Jr.; Mason, G.N.; Autry, G.L. 1982. Stand risk rating for the southern pine beetle: Integrating pest management with resource management. J. Forestry 80:202-214.

Lorio, P.L., Jr.; Sommers, R.A.; Blanche, C.A.; Hodges, J.D.; Nebeker, T.E. 1990. Modeling pine resistance to bark beetles based on growth and differentiation balance principles. pp. 402-409, In: Dixon, R.K.; Meldaho, R.S. ; Ruark, G.A.; Warren, W.G. (eds.); Process Modeling of Forest Growth Responses to Environmental Stress. Timber Press, Portland, OR.

Mason, G.N.; Hicks, R.R., Jr.; Bryant, C.M., V; Mathews, M.L.; Kulhavy, D.L.; Howard, J.E. 1981. Rating southern pine beetle by aerial photography. pp. 109-114, In: Hedden, R.L.; Barras, S.J.; Coster, J.E. (tech. coords.); Hazard-rating Systems in Forest Insect Pest Management; Symposium Proceedings, USDA Forest Service Gen. Tech. Rep. WO-27. 169 p.

Mitchell, J.H. 1987. Hazard and risk rating of red-cockaded woodpecker colony areas and relative susceptibility of cavity trees to the southern pine beetle. M.S. Thesis, Dept. Forestry, Stephen F. Austin State Univ., Nacogdoches, TX. 113 p.

Mitchell, J.M.; Kulhavy, D.L.; Conner, R.N.; Bryant, C.M., V. 1991. susceptibility of red-cockaded woodpecker colony areas to southern pine beetle infestations in East Texas. Southern J. Applied Forestry 15: 158-162.

Nebeker, T.E.; Hodges, J.D.; Honea, C.R.; Blanche, C.A. 1988. Preformed defensive system in loblolly pine: Variability and impact on management practices. pp. 147-162, In: Payne, T.L.; Saarenmaa, J. (eds.); Integrated Control of Scolytid Bark Beetles. Virginia Polytechnic and State Univ., Blacksburg, VA.

Paine, T.D. ; Stephen, F.M.; Cates, R.G. 1985. Induced defenses against Dendroctonus frontalis and associated fungi: Variation in loblolly pine resistance. pp. 169-176, In: Branham, S.J.; Thatcher, R.C. (eds.); Integrated Pest Management Research Symposium: Proceedings. USDA Forest Service Gen. Tech. Rep. SO-56. 383 p.

Payne, T.L. 1980. Life history and habits. pp. 7-28, In: Thatcher, R.C.; Searcy, J.L. ; Coster, J.E.; Hertel, G.D. (eds.); The Southern Pine Beetle. USDA Forest Service, Expanded Southern Pine Beetle Research Applied Program, Education Tech. Bull. 1631. 266 p.

Ross, W.G. ; Kulhavy, D.L.; Conner, R.N.; Sun, J. 1991. Physiology of red-cockaded woopecker cavity trees: Implications for management. pp. 558-566, In: Coleman, S.S.; Neary, D.G. (comps.); Proceedings of the Sixth Biennial Southern Silvicultural Research Conference; 1990 October 30-November 1; Memphis, TN. Gen. Tech. Rep. SE-70. Asheville, NC: USDA Forest Service, Southeastern Forest Experiment Station. 868 p.

Rudolph, D.C.; Kyle, H.; Conner, R.N. 1990a. Red-cockaded woodpeckers vs. rat snakes: The effectiveness of the resin barrier. Wilson Bull. 102: 14-22.

Rudolph, D.C.; Conner, R.N.; Turner, J. 1990b. Competition for red-cockaded woodpecker roost and nest cavities: Effects of resin age and entrance diameter. Wilson Bull. 102:23-36.

Scholander, P.F.; Hammel, H.T.; Bradstreet, E.D.; Hemingsen, E.A. 1965. Sap pressure in vascular plants. Science 148:339-346.

Smith, D.M. 1986. The Practice of Silviculture. John Wiley and Sons, NY. 527 p.

USDA Forest Service. 1975. Wildlife habitat management handbook. Ch. 420, In: Red-cockaded Woodpecker. Southern Region, Forest Service Handbook 2609.23R, Atlanta, GA. (unpublished administrative document)

USDA Forest Service. 1979. Wildlife habitat management handbook. Chapter 4.20, In: Red-cockaded Woodpecker. Southern Region, Forest Service Handbook 2609.23R, Atlanta, GA. (unpublished administrative document)

USDA Forest Service. 1985. Wildlife habitat management handbook. Chapter 420, In: Red-cockaded Woodpecker. Southern Region, Forest Service Handbook 2609.23R, Atlanta, GA. (unpublished administrative document)

USDA Forest Service. 1987. Final Environmental Impact Statement for The Suppression of The Southern Pine Beetle. Vol. l-3. Southern Region Manage. Bull, R8-MB 2.

USDA Forest Service. 1991a. Decision Notice Finding of No Significant Impact And Supplement to The Environmental Assessment Interim Standards And Guidelines for Protection And Management of RCW Habitat within 3/4 mile of Colony Sites (as it pertains to the Apalachicola and Kisatchie National Forests). Southern Region (R-8), Atlanta, GA. (unpublished administrative document)

USDA Forest Service. 1991b. Supplement to the Environmental Assessment Interim Standards And Guidelines for Protection And Management of RCW Habitat within 3/4 Mile of Colony Sites. Southern Region (R-8), Atlanta, GA. (unpublished administrative document)

USDI Fish and Wildlife Service. 1968. Rare And Endangered Fish And Wildlife of The United States. Sport Fisheries and Wildlife Resource Pub. 34, Washington, D.C.

USDI Fish and Wildlife Service. 1970. Listing of Red-cockaded Woodpecker As Endangered. Federal Register 35:16047, October 13, 1970.

USDI Fish and Wildlife Service. 1979. Red-cockaded Woodpecker Recovery Plan. Region 4, Atlanta, GA. 38 p.

USDI Fish and Wildlife Service. 1985. Red-cockaded Woodpecker Recovery Plan. Atlanta, GA. 88 p.