Test of a Population Estimation Technique for Red-cockaded Woodpeckers

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Abstract: A population estimation technique for red-cockaded woodpeckers (*Picoides borealis*), originally developed in the South Carolina Coastal Plain, was tested in the Georgia Piedmont. The technique provided an accurate estimate within 8% of the true population size. The survey procedures have been tested in the major habitat types occupied by red-cockaded woodpeckers and should provide valid population estimates throughout the species' range.

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The red-cockaded woodpecker is among the more controversial endangered species in the South. Unlike endangered species, whose populations are restricted and number only a few individuals, red-cockaded populations still persist from eastern Texas to southern Virginia, and the range-wide population numbers in the thousands (Jackson 1978, Lennartz et al. 1983, U.S. Fish and Wildl. Serv. 1985). Individual populations range from a few to several hundred breeding pairs (Lennartz et al. 1983). Consequently, in some areas the bird is viewed as quite rare and in others as relatively common. Because no large forest tracts have been surveyed over time using systematic and unbiased population estimation procedures, impressions and opinions about probable trends are speculative and controversial. Valid population estimates could serve to clarify the species' status and to assess the effectiveness of current management strategies.

Harlow et al. (1983) developed an accurate and relatively inexpensive method for estimating the number of active red-cockaded woodpecker colonies (active colony = clan = breeding pair) using maps, with the locations of cavity trees plotted, and a circular scale for aggregating individual trees into colony groupings. The method was developed and tested in the Coastal Plain of South Carolina, and was subsequently employed in a range-wide survey of red-cockadeds on federal

lands (Lennartz et al. 1983). Although used in the range-wide survey because it was the only tested technique available, the method had not been tested or validated against populations of known size outside the Atlantic Coastal Plain. The purpose of this study was to test the methods of Harlow et al. (1983) on a red-cockaded population occupying habitats distinctly different from those where the method was developed, yet typical of habitats in other portions of the species' range. Results would provide an additional, independent test of accuracy, and would help establish the range of conditions across which the method could be expected to provide reasonable estimates.

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Methods

The area chosen to test the estimation technique was the Piedmont National Wildlife Refuge (NWR) and the adjacent Hitchiti Experimental Forest in Jones and Jasper counties, Georgia. The Piedmont study area was distinct from the South Carolina Coastal Plain where the technique was developed. In the South Carolina Coastal Plain the estimation technique was developed on a portion of the Francis Marion National Forest and then tested on another portion of the Francis Marion and at the Belle W. Baruch Forest Science Institute of Clemson University. Red-cockaded habitats at both study sites were stands of longleaf pine (*Pinus palustris*), loblolly pine (*P. taeda*), and mixed longleaf and loblolly pines on sites typified by flat terrain and sandy soils. Pine habitats were control-burned frequently, at 1-3-year intervals, so stands were open and parklike with virtually no midstory and an understory of forbs, grasses, and low shrubs. In contrast, pine stands on the rolling, clay hills of the Georgia Piedmont were loblolly pine or mixed loblolly and shortleaf pine (*P. echinata*). Fire was more difficult to control in the dissected Piedmont terrain, and it was difficult to maintain a controlled burning schedule of 3–5 years. Consequently, pine stands had moderate to dense midstories of mixed hardwoods. Hardwood midstories in Piedmont pine stands made searching for and locating red-cockaded cavity trees difficult, and populations in loblolly pine habitats were generally not as large nor as dense as those in longleaf pine forests (Lennartz et al. 1983).

The red-cockaded population estimation technique developed by Harlow et al. (1983) involves: 1) locating all red-cockaded cavity trees in the area of interest (e.g., entire forest or sample plot), 2) categorizing each tree as active or inactive according to guides suggested by Jackson (1977) or Hooper et al. (1980), 3) accurately plotting trees on a map such as a U.S. Geological Survey topographic sheet, 4) aggregating individual trees into colony groupings using a circular scale of 460-m diameter,and 5) counting as an active colony each circle containing 2 or more cavity trees, 1 of which must be active. On the Piedmont NWR, cavity trees had originally been located and plotted by professional foresters during periodic timber

cruises. Each administrative compartment on the refuge is cruised every 8 years, and cruises are conducted along systematic transects spaced approximately 200 m apart. On the Hitchiti Experimental Forest, cavity trees originally had been located by National Forest personnel during periodic compartment prescription cruises or by research foresters selecting stands for installing research plots. On both areas, the plotted location and status of all trees were checked and verified by a biological technician. In addition, the biological technician systematically searched a circular area of 230-m radius around each cluster of cavity trees to search for any cavity trees that might have been missed by the timber cruises or excavated subsequent to the last cruise.

Every year, since 1983, we have monitored woodpecker clan composition and reproductive success at all groups of active cavity trees on the study area. Groups of active trees were visited frequently (about twice a week) throughout the nesting season (mid-April to mid-July), while inactive trees were monitored less frequently, once or twice a year, for presence of roosting woodpeckers. This monitoring provided a known population size in the study area with which to test our census technique estimates.

To test the population estimation technique we prepared accurate maps depicting location and status of all known cavity trees on the study site and asked 17 wildlife students to apply Harlow's aggregation and enumeration procedures to arrive at population estimates. None of the students had previous acquaintance with the technique or the study site. Maps and estimates of all students were checked by an experienced biological technician to ensure that correct procedures had been followed. Estimates were compared with the known population size to determine accuracy.

Results and Discussion

Based on intensive and extensive observations of clan composition and nesting success, the known number of red-cockaded woodpecker clans on the Piedmont NWR and adjacent Hitchiti Experimental Forest is 37. Estimates ($N = 17$) of population size derived with the methods of Harlow et al. (1983) ranged from 37 to 45 active colonies and averaged 40 (SD = 1.59). When individual maps were checked by a trained technician, we found that 6 individuals had made at least 3 types of errors in aggregating trees or enumerating colonies. Two individuals simply miscounted the number of aggregations containing active trees. Three failed to detect groups of trees containing 1 or more active trees, and 3 observers included the same active trees in more than 1 circular aggregation when circles overlapped. When these procedural errors were corrected, individual estimates ranged from 40 to 41 active colonies and averaged 40 (SD = 0.24). This mean only slightly (8%) overestimates the true population size and indicates that the estimating procedures are as accurate in loblolly-shortleaf habitats of the Piedmont as in the loblolly and longleaf habitats of the Coastal Plain (94–95%, Harlow et al. 1983). Having now been tested in both major habitat types occupied by red-cockadeds and found to be

accurate, the population estimation procedures should be useful throughout the species' range.

Since the original survey procedures were developed by Harlow et al. (1983) and tested there have been a number of queries from managers and other researchers seeking clarification of the survey procedures. Experience with our proposed survey procedures has also identified some ambiguities with Harlow's original methods which can affect accuracy of estimates.

Original guidelines (Harlow et al. 1983) for using cavity tree maps and a circular scale for estimating numbers of red-cockaded woodpecker colonies included: (1.) all cavity trees in the area of interest (e.g., sample plot or entire property) must be accurately mapped and categorized as active or inactive; (2.) a circular scale (template) of 460-m diameter should be used to aggregate individual trees into colony groups; (3.) only groups $\geq$2 trees, one of which is active, should be circled; (4.) circles should encompass or touch the maximum number of trees possible; (5.) single, isolated trees should be ignored even if designated as active; and (6.) circles can touch but not overlap.

We suggest the following modifications for investigators interested in using Harlow's population procedures. It is important that cavity trees be accurately categorized as active or inactive. This can be difficult for an inexperienced observer, and we recommend guidelines proposed by Jackson (1977) and Hooper et al. (1980) for this purpose. Recent red-cockaded activity can be determined by fresh chipping on resin wells and by fresh sap flow. We have found fresh chipping of resin wells and the plate surrounding the cavity the most reliable, and least ambiguous, indicator of activity. Resin can continue to flow from resin wells and other chipped areas of cavity trees long after a cavity has been abandoned by red-cockadeds; thus, resin flow alone is not a reliable indicator. In contrast, the brick-red color of freshly chipped underbark (Jackson 1977) is unmistakable and a clear sign of recent woodpecker activity. The color of freshly chipped bark can be easily referenced by the observer using a pocket knife to chisel a small excavation in the bark of the cavity tree or any nearby pine tree.

When aggregating individual trees into groups with the circular scale (No. 4 above), the investigator may have to choose between encircling a number of active trees or encircling a larger number of trees most of which are inactive. Because the purpose of the procedures is to estimate the number of active colonies, the investigator should strive to encircle the maximum number of active trees. Finally, the original guidelines note that circles may touch but should not be allowed to overlap (No. 6). In rare instances this may be impractical. With some very large groups of closely spaced trees, it may be impossible to encircle all trees if some circles do not overlap. The critical point is to make sure that all active trees are encompassed by a circle, and any given tree or group of trees is counted only once in 1 circle.

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