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**Assessing Impact of Hurricane Rita on Habitat Red-Cockaded Woodpecker
(*Picoides borealis*) Clusters in Angelina National Forest, Texas**

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Abstract

Red-cockaded Woodpecker (RCW) habitat on the northern portion of the Angelina National Forest is composed primarily of loblolly and shortleaf pine with a significant hardwood component, especially in the midstory. Intensive management of RCW habitat in Angelina National Forest in Texas is a priority for this endangered species. The research inventoried downed timber in endangered red-cockaded woodpecker clusters on the Angelina National Forest in Texas following Hurricane Rita and utilized a geographic information system to analyze and display data to assess RCW habitat. In the Bannister Wildlife Management Unit of the Angelina National Forest, pine trees either uprooted or snapped by Hurricane Rita in September 2005 were located and mapped to the nearest meter using either a Trimble ProXRS GPS Unit or a Juno™ ST handheld GPS unit. Data taken for each pine included diameter at 4.5 feet, height of pine, height to limbs, crown width, species, direction of disturbance, cause of disturbance and associated insect and disease signs and symptoms.

Keywords: red-cockaded woodpecker, endangered species

In the Bannister Wildlife Management Unit of the Angelina National Forest, pine trees either uprooted or snapped by Hurricane Rita on September 24, 2005 were located and mapped to the nearest meter using either a Trimble ProXRS GPS Unit or a Juno™ ST handheld GPS unit. Data taken for each pine included diameter (in) at 4.5 feet, height (ft.) of tree top, height (ft.) to limbs, crown width (ft.), species, direction of disturbance, cause of disturbance and associated insect and disease signs and symptoms. Data collected were entered into the Geographic Information Systems Laboratory database in ArcGIS 9.3 in the Arthur Temple College of Forestry and Agriculture and analyzed for direction of disturbance, and spatial analysis of the disturbances following Hurricane Rita. Statistical analysis of the tree data included descriptive data using SAS and analysis of the gap formation within the RCW clusters. A total of seven clusters were examined for disturbance and compared with seven replacement stands for analysis.

Lloyd's Index of Patchiness (IP) was applied to the data set. This model yields the dispersion patterns of disturbances over time. According to this index, the distribution of disturbances in nature may be random ($IP < 1$), regular ($IP = 1$) or aggregated ($IP > 1$). This provided insight into both the cause of patches and the potential for the inter-patch interaction. To analyze dispersion patterns, stand maps are divided into 100 X 100 feet or 10,000 square feet (929 m^2) grid cells. These cells have been overlaid on stand maps and all canopy gaps in each block counted and the total numbers of canopy gaps for each stand calculated. Lloyd's index of mean crowding was derived to provide an estimate of the number of individuals likely to co-occur in a quadrat centered on a randomly chosen individual.

For each category a database in ArcGIS 9.3 was attached so stand maps could be made. This coverage was manipulated by creating new regions based on the dataset. In general each coverage represents a separate layer. All RCW boundaries were designated by the USDA Forest Service.

Canopy gaps were compared between clusters, species of pine (loblolly and shortleaf), direction of fall, and dispersion. Frequency distribution and percent occurrence of disturbance events was evaluated with chi-square analysis. A *t*-test ($\alpha = 0.05$) was used to compare means of DBH, height and bearing of pines impacted by Hurricane Rita.

Measurement of aggregation of disturbances in the red-cockaded woodpecker indicated that RCW clusters and replacement stands were aggregated [Index of Patchiness (IP) > 1]. In seven RCW clusters and replacement stands of the Bannister Wildlife Management Unit of the Angelina National Forest, there were a total of 1,021 pines blown down or broken by Hurricane Rita on September 24, 2005. Within the seven clusters, there were 656 pines lost and within the replacement cluster, there were a total of 365 pines lost. Average diameter at 4.5 feet (DBH), Total Height (HT), and bearing of pines lost to Hurricane Rita are presented in Table 2 for all clusters and replacement stands.

Measurement of aggregation of disturbances in the red-cockaded woodpecker indicated that RCW clusters and replacement stands were aggregated [Index of Patchiness (IP) > 1]. There were significant differences between all clusters and replacement clusters combined for DBH ($P < 0.0001$), for HT ($P < 0.0001$), but not for bearing ($P = 0.5334$) (*t*-test). Area impacted in the clusters ranged from a high of 9.9 percent in the Bum Cluster to a low of 0.9 percent in the Norwood Cluster. Area

impacted in the replacement stands ranged from a high of 4.4 percent in the Bum Cluster to a low of 0.6 percent in the Norwood Cluster. Areas nearest to a recent clearcut had the highest impact (Bum, Peninsula, Pretty, Toothpick and Wilderness Clusters). The area impacted by Hurricane Rita in the cluster and replacement stands was greater than the combined damage in these clusters over a period of 15 years. Both loblolly and shortleaf pine were impacted and resulted in the loss of 1,021 pines in seven cluster and replacement stands. Loss was greater in the clusters even when adjusted for area. Pines were blown down in the direction of the hurricane winds (generally SSW) and larger pines were affected (ave DBH, 19.4 in; average HT, 85.4 ft). The percent of the cluster affected varied with both the intact nature of the canopy and distance from the track of the storm. Large disturbances can devastate RCW clusters and have been documented in the Gulf Coastal Plain.