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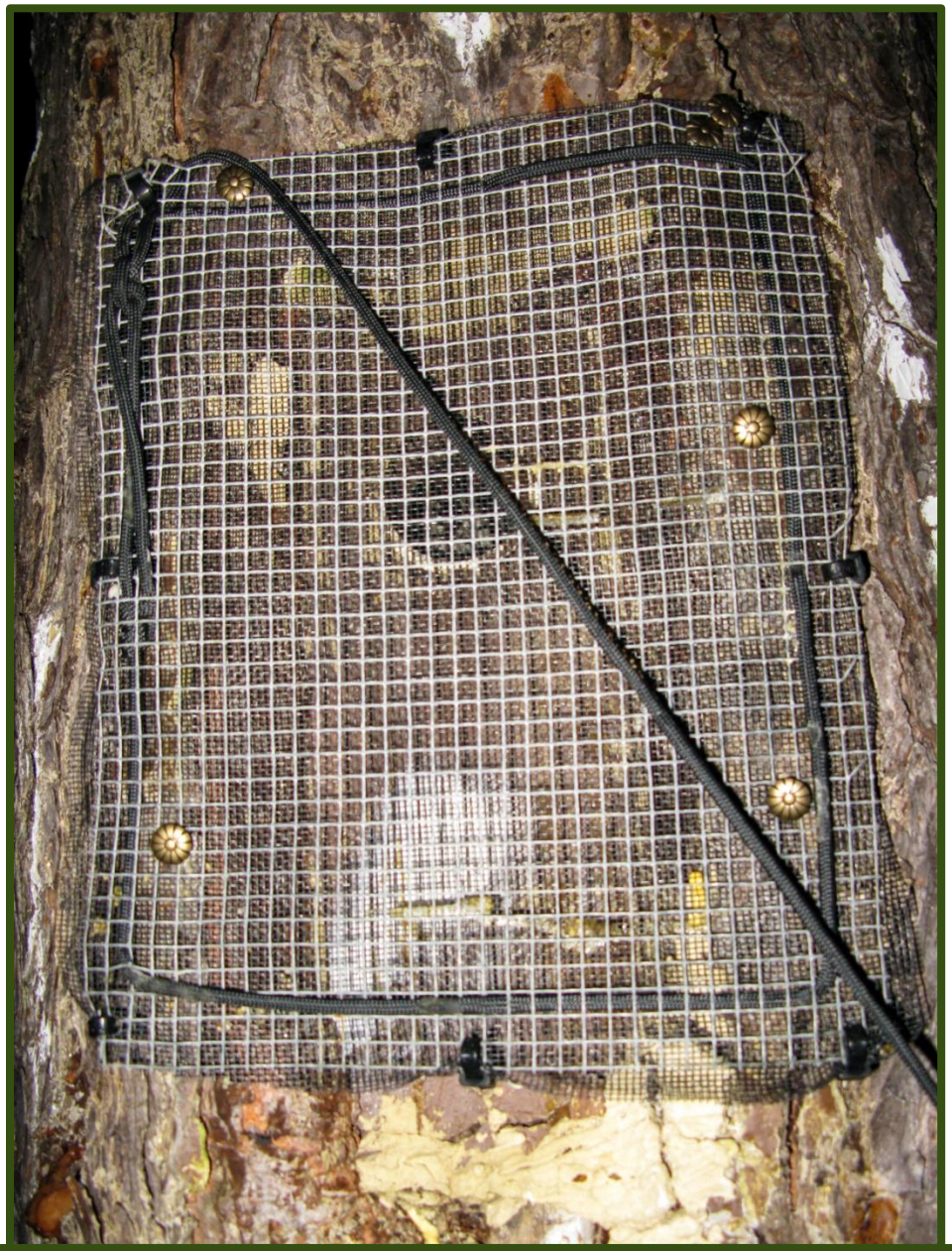

INVESTIGATION OF RED-COCKADED WOODPECKERS WITHIN THE GREAT DISMAL SWAMP NATIONAL WILDLIFE REFUGE: 2019 REPORT

THE CENTER FOR CONSERVATION BIOLOGY

WILLIAM AND MARY

VIRGINIA COMMONWEALTH UNIVERSITY

Investigation of Red-cockaded Woodpeckers within the Great Dismal Swamp National Wildlife Refuge: 2019 report

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Project Partners:

U.S. Fish and Wildlife Service
The Center for Conservation Biology
College of William and Mary

Front Cover: Woodpecker peers out of artificial cavity behind screen during translocation. Photo by Bryan Watts.

The Center for Conservation Biology is an organization dedicated to discovering innovative solutions to environmental problems that are both scientifically sound and practical within today's social context. Our philosophy has been to use a general systems approach to locate critical information needs and to plot a deliberate course of action to reach what we believe are essential information endpoints.

Table of Contents

Contents

EXECUTIVE SUMMARY

The Virginia population of red-cockaded woodpeckers is the northernmost throughout the species range and has been in eminent danger of extinction for more than 30 years. The single remaining population within the Piney Grove Preserve has responded to intensive management and is now approaching capacity but continues to be at risk to stochastic events such as hurricanes, tornadoes and disease. To offset this risk, a three-phase conservation plan was developed that includes the establishment of additional breeding locations. The Great Dismal Swamp National Wildlife Refuge was identified as a high priority site for the establishment of a second population due to its capacity for habitat management and the similarity of habitat to non-typical red-cockaded woodpecker sites in nearby coastal North Carolina. In an effort to establish a population within the swamp, habitat management was initiated several years ago and translocation of birds into established recruitment clusters began in 2015.

During the 2019 breeding season, three potential breeding groups were supported within the Great Dismal Swamp NWR (clusters S3-2, S3-3, YCC1) and nest trees appeared to be prepared by early May. Clusters supporting potential breeding groups were monitored weekly from mid-April through June and two of these groups produced nests. S3-3 produced three-egg clutch, S2-3 produced at least a two-egg clutch and YCC1 failed to produce eggs. Both clusters with nests fledged one young apiece resulting in a reproductive rate of 0.67 ±0.33 (mean±SE) young/breeding group. Both birds were females and neither were recorded in the site during the 2019 winter survey.

During the calendar year of 2019, 18 individual red-cockaded woodpeckers were identified within the Great Dismal Swamp NWR (Table 2). This includes one bird from the 2015 translocation cohort, one bird from the 2016 translocation cohort, three birds from the 2017 translocation/local productivity cohort, five birds from the 2018 translocation cohort, and eight birds from the 2019 translocation/local productivity cohort. Two translocation events were executed during the fall of 2019 including a move of four birds (two females and two males) from Carolina Sandhills NWR on 11 October and two birds (two males) from Piney Grove Preserve on 17 October (Table 3). Nine birds were detected during the 2019 winter survey. This compares to seven in 2015, eight in 2016, twelve in 2017, and eleven in 2018.

A total of 70 woodpecker cavities had been created within the study area on the Great Dismal Swamp NWR by the end of 2019 (Table 4). Three cavity trees were lost in October of 2016 during Hurricane Matthew and six cavity trees were lost in March of 2017 during high-wind events. During 2018, three artificial and one natural cavity trees were lost during a high-wind event in February of 2018. Additionally, three cavities were lost due to being filled with mud-dauber nesting material and one tree died (all in cluster S2-1). During 2019, one cavity tree was lost during an early spring high-wind event and four other cavity trees were lost during late summer storms. As of the end of 2019, woodpeckers were using four natural cavities.

BACKGROUND

Context

The red-cockaded woodpecker (*Picoides borealis*) is endemic to the southeastern pine ecosystem breeding from Texas and Oklahoma east to Florida and north to Virginia (Jackson 1994). Highly specialized, the species requires old growth, fire-maintained pine savannas. Throughout the twentieth century, advances in transportation, wood processing, and silvicultural practices shifted the emphasis from long-rotation lumber production to maximum-yield fiber production and resulted in catastrophic declines in habitat availability for this species. Breeding distribution contracted from the edges of the range and became localized within the core of the historic range where remnant old growth remained. The red-cockaded woodpecker was listed as endangered in 1970 and received protection with the passage of The Endangered Species Act in 1973 (16 U.S.C. 1531 et seq).

The historic status and distribution of the red-cockaded woodpecker in Virginia is poorly known because no systematic survey of the species was completed prior to dramatic habitat losses. Early accounts of red-cockaded woodpeckers were made from all physiographic provinces of Virginia. Jurisdictions with records include the counties of Giles (Bailey 1913), Albemarle (Rives 1890), Brunswick (Murray 1952), Dinwiddie (Murray 1952), Chesterfield (Murray 1952), Southampton (Steirly 1949), Sussex (Steirly 1950), Prince George (Steirly 1957), Greensville (Steirly 1957), Isle of Wight (Steirly 1957), and the current independent cities of Norfolk (Bailey 1913), Suffolk (Steirly 1957), Virginia Beach (Sykes 1960), and Chesapeake (van Eerden and Bradshaw, unpublished observation). The first systematic survey of the species was initiated in 1977 and resulted in the documentation of 43 clusters within 5 counties (Miller 1978). By 1980, only nine of these clusters were still forested (Bradshaw 1990). During the 20-year period between 1980 and 2000, the decline of the Virginia population is well documented (Watts and Bradshaw 2005). By 1990, only 5 of the original 23 clusters detected in 1977 were still active. During the breeding season of 2002, Virginia supported only two breeding pairs and two clusters with solitary males.

The red-cockaded woodpecker was recommended for endangered status within the state of Virginia in 1978 (Byrd 1979) and 1989 (Beck 1991) and was listed as a Tier I Species of Greatest Conservation Need in the 2005 Virginia Wildlife Action Plan (VDGIF 2005). The stated rationale for recommendations was the extremely low and declining population in Virginia, continued loss and degradation of required old growth forests, and the fact that all remaining breeding sites existed on private lands making appropriate management unfeasible. Following these recommendations, the Virginia Department of Game and Inland Fisheries and partners have mounted extensive monitoring and management efforts for the past 30 years. Acquisition of the Piney Grove Preserve in 1998 by The Nature Conservancy was a critical turning point in the species' recovery (Watts and Bradshaw 2005). Intensive habitat and population management on this last remaining site in Virginia has resulted in a population increase from 2 breeding groups in 2002 to 13 breeding groups in 2014 (Watts et al. 2017).

The possibility of losing this single Virginia population due to stochastic events such as hurricanes, tornadoes, pests, and diseases over time is high. To offset this risk a three-phase conservation plan was developed that includes the establishment of additional breeding locations (Watts and Harding 2007). Red-cockaded woodpeckers have been found in non-typical habitats within coastal North Carolina over the past

decade that includes pond pine pocosin woodlands. This habitat type is abundant within the Great Dismal Swamp National Wildlife Refuge and the site has been identified as a high priority for establishment of a second population. Habitat restoration was initiated within the site several years ago and translocation of birds into established recruitment clusters began in 2015.

GOALS AND OBJECTIVES

The primary objective of this ongoing project is to establish a breeding population of Red-cockaded Woodpeckers within the Great Dismal Swamp NWR. A secondary objective is to collect information relevant to the continued management of birds and their habitat in Virginia. Specific objectives include:

1) To determine the number and identification of all birds resident within the Great Dismal Swamp NWR during the 2019 calendar year.
2) To monitor breeding activity in order to document productivity and allow for the unique banding of all individuals within the population.
3) To determine fledging success for all breeding attempts.
4) To translocate birds from donor sites to the Great Dismal Swamp NWR.
5) To monitor cavity tree and artificial cavity condition.

METHODS

Site Description

The Great Dismal Swamp is the northernmost of the great humid swamp forests within the southeastern United States and one of the largest remaining on the Coastal Plain. Considered to be centered on Lake Drummond in the Virginia cities of Suffolk and Chesapeake, the swamp extends into the North Carolina counties of Currituck, Camden, Perquimans, Gates, and Pasquotank. The swamp is positioned on a low, poorly drained, flat marine terrace that ranges from 4.5 to 7 m above sea level. Except for the western edge, which is defined by the Suffolk Scarp, the boundaries of the swamp are poorly defined. The Great Dismal Swamp NWR (45,000+ ha) and the adjacent North Carolina Dismal Swamp State Park (6,000+ ha) are protected portions of the historic swamp that support a complex ecosystem. The vegetational composition of the swamp has changed dramatically over the past 100 years and comparisons to historical descriptions suggest a strong succession toward mesic forest types and away from swamp-like conditions. Virtually no virgin timber remains on the site.

The section of the swamp that has been designated for the establishment of red-cockaded woodpeckers is referred to as “The Blocks.” Thirteen recruitment clusters have been developed within this study area to facilitate population establishment (Figure 1). Each cluster includes four pine trees with artificial cavities and an access trail connected to the road system.

Breeding Monitoring

Documenting breeding attempts and their outcomes is an essential element of the monitoring program. We identified all potential breeding groups (PBG: sites with at least one male and one female) during the spring census and followed these sites through the breeding season. We initiated checks of clusters supporting PBGs in mid-April and conducted weekly checks through June to limit the risk of missing any breeding attempts. All cavities within PBG clusters were examined using a peeper scope (a miniature video camera mounted on a telescopic with an extendable pole that allows an observer to view the contents of a cavity). Cavities within surrounding clusters were examined periodically for any possible roosting or breeding activity.

Population Monitoring

We conducted two systematic surveys of all birds within the Great Dismal Swamp NWR to identify individuals and to determine distribution. We conducted surveys in the early spring prior to the expected breeding window and in early winter after the expected dispersal period. We visited all recruitment clusters before dusk to identify birds as they returned to roost trees for the night. We read combinations of color bands with spotting scopes and determined roost trees. We systematically worked through all sites over a period of days until all individuals were identified.

Translocation

A large, integrated team of biologists roosted birds in August and September within donor sites (Carolina Sandhills NWR, Piney Grove Preserve) to determine retention of hatching-year birds and to identify target birds. Target birds and backup birds were identified for possible translocation. Target and backup birds were roosted again during the week running up to the scheduled translocation in preparation for captures. Trapping teams were deployed to capture birds prior to roosting during the night of the translocation. Birds were captured after entering cavities using pole nets. Once captured, birds were lowered to the ground and handled to confirm identification and gender. Birds were placed in transport boxes and driven to the Great Dismal Swamp NWR for placement.

Birds were placed in artificial cavities, screened in for the night, and released at dawn the following morning. We climbed recipient trees using Swedish climbing ladders, placed birds in artificial cavities, and tacked screens over the entrance. A release team returned to the recruitment cluster before dawn the following morning. Screens were removed just after dawn and birds were allowed to fly out into their new habitat.

Cavity Tree Monitoring

All known cavity trees were visited to evaluate tree condition and cavity characteristics. Tree-condition categories used included live or dead, standing, broken (snapped off), fallen (down by roots), evidence of

beetle or other insect damage, and evidence of lightning strike. Cavity characteristics recorded included origin (artificial insert or natural), height, entrance orientation, occurrence of resin wells, size and completeness of entrance plate, and the activity status. Activity status was determined by the presence or absence of chipping, fresh or recent sap flow, and dry sap. We used a peeper scope to examine cavities for the presence of competitors.

RESULTS

Breeding Monitoring

Great Dismal Swamp NWR supported three PBGs of red-cockaded woodpeckers in 2019 (Table 1). This compares to only one PBG in 2016, two PBGs in 2017, and three PBGs in 2018. Supporting clusters included S2-3, S3-2, S3-3 and YCC1. During the 2016 breeding season only S2-3 supported a PBG (no nesting attempt was documented), during 2017 both S2-3 and S3-3 supported PBGs (both sites made nesting attempts with S3-3 producing 2 fledglings), and during 2018 S2-3, S3-3, and C3-3 supported PBGs (no nesting attempt was documented). During 2019, successful breeding attempts were made at S3-2 and S3-3, but no attempts were made at YCC1.

Table 1. Summary of 2019 breeding activity for red-cockaded woodpeckers within Great Dismal Swamp NWR.

Breeding Group	Potential Breeding Group?	Breeding Attempt?	Eggs Laid	Eggs Hatched	Banding Age	Fledged
Cluster S3-2	Yes	Yes	≥2	2	1	1
Cluster S3-3	Yes	Yes	3	3	1	1
Cluster YCC1	Yes	No	-----	-----	-----	-----
Total	3	0	≥5	5	2	2

Monitoring Details

Cluster S3-2

This is the first year that this cluster has been occupied during the breeding season. The male (AL/PU: DG/RY/OR) was from the 2015 cohort that was translocated from Carolina Sandhills NWR. This bird was half of the PBG located within S2-3 during the 2016 breeding season and moved to S3-3 during the 2017 and 2018 breeding seasons. The female (LB/PU/LB:LB/AL) was from the 2018 cohort, translocated from Palmetto Palmtree Preserve. The male began occupying the natural cavity at the cluster by the time of the

2018-2019 winter survey, while the female did not begin occupying the cluster until the 2019 spring survey. We observed the female emerge out of the natural cavity on 6 May after we approached the cavity tree, but there were a number of small branches below the cavity obstructing camera access with the peeper. We trimmed several of these branches on 14 May and observed two nestlings. One nestling was banded on 19 May at five days old (physical age, keyed out to five days) and weighed 23.5 grams. The bird was sexed as a female and observed foraging outside the cluster with the parents on 11 June.

Cluster S3-3

This is the third year that this cluster has been occupied during the breeding season. The male (AL/PU: DG/RY/OR) that occupied the cluster in 2017 and 2018 was replaced by a male (AL/DP:DB/LB/YR was from the 2017 cohort that was translocated from Carolina Sandhills NWR. The female (AL/RE:LB/HP/DG) was translocated during the fall of 2017 from Carolina Sandhills NWR and was also present during the 2018 breeding season.

The male was roosting in T-102 during the spring survey and the female in Tree 101. Both trees were in very good shape with extensive, active resin wells coming into the breeding season and Tree 102 later had some chips in the cavity. T-103 showed very little signs of work and the cavity popped out of Tree 100 prior to the spring survey; this cavity was replaced, but the tree snapped prior to the breeding season. We observed three eggs in T-102 on 6 May and three young on 14 May. We banded one young that was seven days old (physical age; keyed to seven days) on 21 May. We sexed the young bird as a female and it was observed foraging outside the cluster with the parents on 11 June.

Cluster YCC1

This is the first year that birds have occupied this cluster during the breeding season. The male (RE/YE/RE:LG/AL) that occupied this site during the breeding season is from the 2018 cohort that was translocated from Palmetto Peartree Preserve. He occupied a cavity at S2-3 during the winter survey and was first observed at YCC1 during the 2019 spring survey in T-01. A female (AL/RE:HP/DB/OR) that had occupied the site since the winter 2017-2018 survey was observed using T-02 during the spring survey, but was replaced prior to the breeding season by a female (YE/WH/YE:AL/LB) that had not been observed since being translocated from Piney Grove Preserve during the fall 2018 season. All four cavity trees at this cluster display signs of recent work with fresh resin work, though T-01 and T-02 have the greatest amount of work on them. There are also two starts on a tree near T-01. We monitored this pair at least every week and would often hear and see the pair in the vicinity of the cluster, but no fresh woodchips or any other sign of breeding was documented.

Population Monitoring

During the calendar year of 2019, 18 individual red-cockaded woodpeckers were identified within the Great Dismal Swamp NWR (Table 2). This includes one bird from the 2015 translocation cohort, one bird from the 2016 translocation cohort, three birds from the 2017 translocation/local productivity cohort, five birds from the 2018 translocation cohort, and eight birds from the 2019 translocation/local productivity cohort. Four birds were lost between the 2018 winter survey and the 2019 spring survey. This included a female (AL/PU:YR/LG/RY) from S2-3 that was translocated in 2015, the pair from C3-3 (AL/RE:DB/YR/YR and YE/DB/WH:PK/AL) that were both translocated in 2017, and a female (AL/DP:LB/LG/YR) translocated from Piney Grove Preserve in 2018 that had been roosting in YCC1.

Eight birds were detected during the spring 2019 census including two from the 2015 cohort, three from the 2017 cohort, and four from the 2018 cohort (Table 2). This included three males and five females. All of the males and five of the females were associated with PBGs. Single females were roosting in S2-3 and YCC1. The population supported three PBGs into the breeding season compared to thee in 2018, two during the breeding season of 2017, and only one during the 2016 breeding season.

Nine birds were detected during the 2019 winter survey (Table 2). This compares to seven in 2015, eight in 2016, twelve in 2017, and eleven in 2018 (Table 2). Included were one bird from the 2015 translocation cohort, one bird from the 2016 cohort, one bird from the 2017 translocation cohort, three birds from the 2018 translocation cohort, and two birds from the 2019 translocation cohort. There were four males included in the winter count, including two males associated with the PBGs at S3-2 and S3-3 in 2018, a male from the 2017 cohort that was roosting S2-3, and a second male from the 2019 translocation that was roosting at S3-3. The male associated with the PBG at YCC1 was not detected. The clusters at S2-3 and S3-3 both have resident females.

Table 2. Occurrence of individual red-cockaded woodpeckers within the Great Dismal Swamp NWR during winter and spring surveys. Presence is indicated by cluster and roost tree codes (cluster, roost tree).

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019
2651-13366	WH/RE/WH:AL/RE	2015	M									
2651-03124	AL/PU:OR/LG/LB	2015	M	S2-3, T50								
2651-03069	AL/MV:OR/HP/YE	2015	M	S3-2, T27								
2651-03051	AL/PU:OR/DB/LG	2015	F	S2-3, T47	S2-3, T50							
2651-13336	OR/YE/OR:LG/AL	2015	F	YCC1, T04	YCC1, T02	YCC1, T02						
2651-03019	AL/PU:WH/YE/YE	2015	F	C3-1, T31	C3-1, T31	C3-1, T31	S3-3, T102	S3-3, T102				
2651-03119	AL/PU:DG/RY/OR	2015	M	S2-3, T48	S2-3, T48	S3-3, T101	S3-3, T101	S3-3, T101	S3-3, T101	S3-3, T101	S3-2, T25	S3-2, T25
2651-03221	AL/PU:YR/LG/RY	2015	F	S2-3, T49	S2-1, T51	S2-2, T63	S2-3, T48	S2-3, T48	S2-3, T48	S2-3, T48		
2651-03370	AL/YE:WH/RY/PU	2016	M									
2651-03404	AL/YE:LG/YR/HP	2016	F									

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019
2651-03330	AL/YE:LB/YE/DB	2016	F									
2651-03319	AL/YE:HP/HP/LG	2016	M									
2651-03411	AL/YE:DB/YE/RY	2016	M									
2651-03333	AL/YE:HP/YR/DG	2016	M									
2651-03309	AL/YE:OR/LB/OR	2016	M			YCC1, T01						
2655-03414	AL/YE:RY/YE/LG	2016	F			C3-3, T06						
2651-03344	AL/YE:YE/YR/YE	2016	F			C2-3, T121	S2-3, T50					
2651-03358	AL/YE:PU/YE/YR	2016	M			YCC1, T02	S2-3, T49	S2-3, T49	S2-3, T49	S2-3, T49		S2-3, NT
2421-02968	GY/DB/LG:PK/AL	2017	F									
2651-03675	AL/RE:WH/RY/DG	2017	M									
2651-03772	AL/RE:YR/YR/YE	2017	M									
2651-03764	LG/LB/YE:AL/RE	2017	M									

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019
2421-02965	YE/WH/BK:PK/AL	2017	M					C3-1, T31				
901-29850	YE/DB/PK:PK/AL	2017	F					S3-3, T103	S3-3, T103			
2651-03660	AL/RE:DB/WH/PK	2017	F					S2-3, T50	S2-3, T46			
901-29849	YE/DB/WH:PK/AL	2017	F					C3-3, T11	C3-3, T11	C3-3, T10		
2651-03670	AL/RE:LB/HP/DG	2017	F					S3-3, T102	S3-3, T102	S3-3, T102	S3-3, T101	S3-3, NT
2651-03784	AL/RE:HP/DB/OR	2017	F					YCC1,T01	YCC1,T01	YCC1,T01	YCC1, T01	
2651-03714	AL/RE:YE/DB/RY	2017	F					YCC1,T02	YCC1,T02	S2-2,T64	S2-2, T64	
2651-03655	AL/RE:DB/YR/YR	2017	M					C3-3, T09	C3-3, T09	C3-3, T11		
2641-58950	LB/PU/LB:LB/AL	2018	F								S3-2, T30	S3-2, NT
2651-03877	AL/DP:DB/LB/YR	2018	M								S3-3, T102	S3-3, T102
2701-94028	AL/DP:HP/YE/YE	2018	M									
2421-02994	LB/YE/LB:AL/DB	2018	M									

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019
2421-02991	YE/WH/YE:AL/LB	2018	F									YCC1, T01
2701-79461	RE/YE/RE:LG/AL	2018	M							S2-3,T50	YCC1, T02	
2701-94017	AL/DP:RY/DB/WH	2018	F							S3-2,T29	S2-3, T48	S2-2, T64
2651-03842	AL/DP:LB/LG/YR	2018	F							YCC1,T02		
2701-94187	AL/DP:YE/LB/YE	2019	F									
2701-94172	AL/DP:DB/YE/BR	2019	M									S3-3, T105
2701-94161	AL/DP:DG/BR/DG	2019	M									
2701-94171	AL/DP:DB/HP/WT	2019	F									S3-2, T24
901-29866	LB/YE/LB:YE/AL	2019	M									
901-29875	YE/OR/YE:DB/AL	2019	M									
901-29869	OR/DG/OR:AL/OR	2019	F									
901-29874	DB/YE/DB:OR/AL	2019	F									

Translocation

Two translocation events were executed during the fall of 2019 including a move of four birds (two females and two males) from Carolina Sandhills NWR on 11 October and two birds (two males) from Piney Grove Preserve on 17 October (Table 3). Both of these events were scheduled following two rounds of intensive identification of target birds and location of roost trees. Birds were captured successfully following roost entry, placed in transport boxes, driven to Great Dismal Swamp NWR, placed in artificial inserts, and screened in cavities for the remainder of the night. Birds were released the following morning by pulling screens and allowing the birds to fly out. All birds were translocated and released without incident. Birds were released into four clusters including S2-2, S2-3, C3-1 and S3-1.

Table 3. Individual red-cockaded woodpeckers translocated to Great Dismal Swamp NWR during the fall of 2019. Donor sites included Carolina Sandhills NWR (CSNWR), Piney Grove Preserve (PGP) and Palmetto-Peartree Preserve (P3).

USGS	Left Leg	Right Leg	Release Date	Donor Site	Donor Cluster	Release Cluster
2701-94187	AL/DP	YE/LB/YE	10/11/2019	CSNWR	05-05	S3-1
2701-94172	AL/DP	DB/YE/BR	10/11/2019	CSNWR	17-04	S3-1
2701-94161	AL/DP	DG/BR/DG	10/11/2019	CSNWR	20-08	C3-1
2701-94171	AL/DP	DB/HP/WT	10/11/2019	CSNWR	17-04	C3-1
901-29866	LB/YE/LB	YE/AL	10/17/2019	PGP	11	S2-3
901-29875	YE/OR/YE	DB/AL	10/17/2019	PGP	13	S2-2

Cavity Tree Status

A total of 70 woodpecker cavities had been created within the study area on the Great Dismal Swamp NWR by the end of 2019 (Table 4). This includes 32 artificial cavities that were installed in 2015, 21 that were installed in 2016, nine that were installed in 2017, one that was installed in 2018, and two that were installed in 2019. Five natural cavities have been excavated by woodpeckers. Three cavity trees were lost in October of 2016 during Hurricane Matthew and six cavity trees were lost in March of 2017 during high-wind events. During 2018, three artificial and one natural cavity trees were lost during a high-wind event in February of 2018. Additionally, three cavities were lost due to being filled with mud-dauber nesting material and one tree died (all in cluster S2-1). During 2019, one cavity tree was lost during an early spring high-wind event and four other cavity trees were lost during late summer storms. To mitigate these losses, three cavity boxes were replaced at S2-1, one new artificial cavity was installed at S3-2, and one new artificial cavity was installed at S3-3. Three new natural cavities were also created; one at S2-3, one at S3-2, and one at S3-3. Two advanced starts at YCC1 continue to be monitored. As of the endo of 2019, woodpeckers were using four natural cavities.

Table 4. Condition and observations of red-cockaded woodpecker cavities within the Great Dismal Swamp NWR during December 2019.

Cluster	Tree ID	Tree Species	Condition	Type	Established	Cavity Seal	Observations
C2-2	T-20	Pond Pine	Live	Insert	2015	Dry	Clean
C2-2	T-21	Pond Pine	Live	Insert	2015	Dry	Mud-Daubers
C2-2	T-22	Pond Pine	Live	Insert	2015	Dry	Mud-Daubers
C2-2	T-23	Pond Pine	Live	Insert	2015	Leaked	Bird's Nest
C2-3	T-120	Pond Pine	Live	Insert	2016	Dry	Clean
C2-3	T-121	Pond Pine	Lost 3/2017	Insert	2016	-----	-----
C2-3	T-122	Pond Pine	Live	Insert	2016	Dry	Clean
C2-3	T-123	Pond Pine	Live	Insert	2016	Dry	Clean
C2-3	T-124	Pond Pine	Live	Insert	2017	Dry	Clean
C3-1	T-31	Loblolly Pine	Live	Insert	2015	Dry	Cobwebs
C3-1	T-32	Loblolly Pine	Live	Insert	2015	Dry	Cobwebs
C3-1	T-33	Loblolly Pine	Live	Insert	2015	Leaked	Mold
C3-1	T-34	Loblolly Pine	Live	Insert	2015	Dry	Cobwebs
C3-2	T-110	Pond Pine	Lost 3/2017	Insert	2016	-----	-----
C3-2	T-112	Pond Pine	Live	Insert	2016	Dry	Clean
C3-2	T-113	Pond Pine	Lost 2/2018	Insert	2016	-----	-----
C3-2	T-114	Pond Pine	Dd 12/2018	Insert	2016	-----	-----
C3-2	T-111	Pond Pine	Live	Insert	2016	Dry	Clean
C3-2	T-115	Pond Pine	Live	Insert	2017	Dry	Clean
C3-2	T-116	Pond Pine	Live	Insert	2017	Dry	Clean
C3-3	T-006	Pond Pine	Lost 3/2017	Insert	2016	-----	-----
C3-3	T-007	Pond Pine	Live	Insert	2016	Dry	Clean
C3-3	T-008	Pond Pine	Lost 3/2017	Insert	2016	-----	-----
C3-3	T-009	Pond Pine	Live	Insert	2017	Dry	Clean
C3-3	T-10	Pond Pine	Lost 8/2019	Insert	2016	-----	-----
C3-3	T-11	Pond Pine	Live	Insert	2017	Dry	Bird's Nest
S2-1	T-51	Pond Pine	Lost 8/2019	Insert	2015	-----	-----
S2-1	T-52	Pond Pine	Live	Insert	2015	Dry	Clean

Cluster	Tree ID	Tree Species	Condition	Type	Established	Cavity Seal	Observations
S2-1	T-53	Pond Pine	Live	Insert	2015	Dry	Clean
S2-1	T-55	Pond Pine	Live	Insert	2015	Dry	Clean
S2-2	T-61	Pond Pine	Lost 10/2016	Insert	2015	-----	-----
S2-2	T-62	Pond Pine	Live	Insert	2015	Dry	Clean
S2-2	T-63	Pond Pine	Lost 3/2017	Insert	2015	-----	-----
S2-2	T-64	Pond Pine	Live	Insert	2017	Dry	Clean
S2-2	T-65	Pond Pine	Live	Insert	2015	Dry	Clean
S2-2	T-66	Pond Pine	Live	Insert	2017	Dry	Clean
S2-2	T-67	Pond Pine	Lost 2/2018	Natural	2017	-----	-----
S2-3	T-46	Pond Pine	Live	Insert	2017	Dry	Clean
S2-3	T-47	Pond Pine	Lost 10/2016	Insert	2015	-----	-----
S2-3	T-48	Pond Pine	Live	Insert	2015	Dry	Clean
S2-3	T-49	Pond Pine	Live	Insert	2015	Dry	Clean
S2-3	T-50	Pond Pine	Live	Insert	2015	Dry	Clean
S2-3	NT	Pond Pine	Live	Insert	2019	Dry	Clean
S2-4	T-130	Pond Pine	Live	Insert	2016	Dry	Clean
S2-4	T-131	Pond Pine	Live	Insert	2016	Dry	Clean
S2-4	T-132	Pond Pine	Live	Insert	2016	Dry	Clean
S2-4	T-133	Pond Pine	Live	Insert	2016	Dry	Clean
S3-1	T-56	Loblolly Pine	Live	Insert	2015	Dry	Clean
S3-1	T-57	Loblolly Pine	Live	Insert	2015	Dry	Clean
S3-1	T-59	Pond Pine	Live	Insert	2015	Dry	Clean
S3-1	T-58	Loblolly Pine	Live	Insert	2015	Dry	Clean
S3-2	T-24	Pond Pine	Live	Insert	2019	Dry	Clean
S3-2	T-25	Pond Pine	Live	Natural	2018	Dry	Clean
S3-2	T-27	Pond Pine	Lost 8/2019	Insert	2015	-----	-----
S3-2	T-28	Pond Pine	Lost 10/2016	Insert	2015	-----	-----
S3-2	T-29	Pond Pine	Live	Insert	2015	Dry	Clean
S3-2	T-30	Pond Pine	Live	Insert	2015	Dry	Clean
S3-2	T-31	Pond Pine	Lost 2/2018	Insert	2017	-----	-----

Cluster	Tree ID	Tree Species	Condition	Type	Established	Cavity Seal	Observations
S3-2	NT	Pond Pine	Live	Natural	2019	Dry	Clean
S3-3	T-100	Pond Pine	Lost 2/2018	Insert	2016	-----	-----
S3-3	T-101	Pond Pine	Lost 8/2019	Insert	2016	-----	-----
S3-3	T-102	Pond Pine	Live	Insert	2016	Dry	Clean
S3-3	T-103	Pond Pine	Lost 8/2019	Insert	2016	-----	-----
S3-3	T-104	Pond Pine	Lost 4/2019	Insert	2018	-----	-----
S3-3	T-105	Pond Pine	Live	Insert	2019	Dry	Clean
S3-3	NT	Pond Pine	Live	Natural	2019	Dry	Clean
YCC1	T-01	Pond Pine	Live	Insert	2015	Dry	Clean
YCC1	T-02	Pond Pine	Live	Insert	2015	Dry	Clean
YCC1	T-03	Pond Pine	Live	Insert	2015	Dry	Clean
YCC1	T-04	Pond Pine	Live	Insert	2015	Dry	Clean

The majority of cavities continue to be in good condition during 2019 (Table 4). Only two cavities had any indication of recent water. There was relatively little new mud-dauber nest construction in cavities this year (only recorded in two cavities), though some remains from mud-dauber cavities cleaned out in 2018 remained. No paper wasps were observed when cavities were checked in October despite having them in at least seven cavities in 2018. It is unknown if the drop in paper wasps was due to a lack of cold enough temperatures that force paper wasps into hibernacula or the comprehensive paper wasp removal during the past winter. Several inactive cavities were filled with cobwebs and two bird nests were also recorded in cavities. All cavities with cobwebs, mud-dauber material, and passerine nests were cleaned prior to the fall translocation.

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