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INVESTIGATION OF RED-COCKADED WOODPECKERS WITHIN THE GREAT DISMAL SWAMP NATIONAL WILDLIFE REFUGE: 2020 REPORT



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Investigation of red-cockaded woodpeckers within the Great Dismal Swamp National Wildlife Refuge: 2020 report

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

Front Cover: Male woodpecker prior to placement into a cavity at cluster C2-1. Photo by Bryan Watts.



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Table of Contents

Contents

EXECUTIVE SUMMARY	1
BACKGROUND	2
Context	2
GOALS AND OBJECTIVES	3
METHODS	3
Site Description	3
Breeding Monitoring	4
Population Monitoring	4
Translocation	4
Cavity Tree Monitoring	5
RESULTS	5
Breeding Monitoring	5
Monitoring Details	6
Cluster S2-3	6
Cluster S3-2	6
Cluster S3-3	6
Population Monitoring	7
Translocation	13
Cavity Tree Status	13
ACKNOWLEDGMENTS	17
LITERATURE CITED	18

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 2020 breeding season, three potential breeding groups were supported within the Great Dismal Swamp NWR (clusters S2-3, S3-2, S3-3) and nest trees appeared to be prepared by early May. Clusters supporting potential breeding groups were monitored weekly from mid-April through June and three of these groups produced nests. S2-3 produced a four-egg clutch, S3-2 produced three-egg clutch, and S3-3 produced at least a one-egg clutch. The eggs at S2-3 failed to hatch, but S3-2 fledged 2 young (1 male and 1 female) and S3-3 fledged one young (female) resulting in a net reproductive rate of 1.00 ± 0.58 (mean \pm SE) young/breeding group. The male young from S3-2 was observed at S3-3 and the female young from S3-3 was observed at C3-3 during the winter survey.

During the calendar year of 2020, 19 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, one bird from the 2017 translocation cohort, four birds from the 2018 translocation cohort, three birds from the 2019 translocation cohort, and nine birds from the 2020 translocation/local productivity cohort. Three translocation events were executed during the autumn of 2020 including two moves of two birds (two females and two males) from Piney Grove preserve on 7 – 8, and 8 – 9 September and two birds (one male and one female) from Francis Marion National Forest on 5 – 6 November. Eleven birds were detected during the 2020 winter survey (Table 2). This compares to seven in 2015, eight in 2016, twelve in 2017, eleven in 2018, and nine in 2019 (Table 2).

A total of 73 complete woodpecker cavities and 5 starts had been created within the study area at the Great Dismal Swamp NWR by the end of 2020 (Table 4). A total of 23 of these completed cavities have been lost, including one tree in January 2020 at S3-2 due to high winds, two trees (one at S3-2 and one at C2-3) in August 2020 during Tropical Storm Isaias, and another tree at S3-2 in December 2020 at S3-2. Seven cavities are being grown over by the tree bole. We observed mud dauber nests in 5 cavities, compared with 2 in 2019, and wintering paper wasps in 6 cavities after not being observed in any during 2019. As of the end of 2020, woodpeckers were using 3 natural cavities.

BACKGROUND

Context

The red-cockaded woodpecker (*Leuconotopicus 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 Wildlife Resources 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 NWR 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 2020 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 (Francis Marion National Forest, 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 2020 (Table 1). This compares to only one PBG in 2016, two PBGs in 2017, three PBGs in 2018, and three PBGs in 2019. Supporting clusters included S2-2/S2-3, S3-2 and S3-3. 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 (one fledgling produced at each cluster), but no attempts were made at YCC1. During 2020, the birds from S2-2 and S2-3 coalesced into a single widespread cluster and made an unsuccessful attempt while S3-2 (two fledglings produced) and S3-3 (one fledgling produced) both made successful nesting attempts.

Table 1. Summary of 2020 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 S2-3	Yes	Yes	4	0	0	0
Cluster S3-2	Yes	Yes	3	2	2	2
Cluster S3-3	Yes	Yes	≥1	≥1	1	1
Total	3	3	≥8	≥3	3	3

Monitoring Details

Cluster S2-3

This is the fourth year that this cluster has known to have 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 and is the same bird that was part of a PBG in 2016–2018. The female (AL/DP:RY/DB/WH)) was from the 2015 cohort that was translocated from Carolina Sandhills, NWR. The female had been observed roosting in T-48 at S2-3 during the 2019 spring head count but no male was recorded. The female was observed roosting in T-64 at S2-2 during the 2019 winter survey. During the 2020 spring survey the male and female were both observed foraging and interacting at S2-2 and S2-3, with the female roosting in T-64 at S2-2 and a new tree was discovered at S2-3 that the male was using to roost.

The female was observed exiting the natural cavity in S2-3 on 29 April, but no eggs were observed. The female was observed incubating four eggs on 4 May. The nest was checked weekly and four eggs were observed at least 22 days after clutch completion on 25 May. These were the same eggs as they became more and more speckled with sap every time. The eggs also appeared discolored on one end, suggesting they were not viable. Zero eggs were observed on 10 June and 19 June. All other cavities in S2-2 and S2-3 were inspected for possible second clutches.

The nest tree did not appear to be newly constructed and raises the possibility that a breeding attempt was made in 2019 but was missed as the male was never observed in the cluster near the artificial cavities. However, no unbanded young were observed at the site following the 2019 breeding season during pre-translocation surveys. The fact that the male has taken part in two breeding attempts with different females and neither attempt resulted in hatched eggs also raises the possibility that the male may not be capable of producing viable young.

Cluster S3-2

This is the second year that this cluster has been occupied during the breeding season and the breeding pair was the same as in 2019. 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. We first observed the female emerge out of the nesting cavity on 4 May but an inspection of the cavity contents revealed she had not yet laid. We observed three eggs on 12 May and 3 young nestlings on 19 May. The two nestlings were banded on 25 May at six days old (physical age, both keyed out to six days) and the nestlings weighed 22 and 25 grams respectively. One bird was sexed as a female and the other as a male prior to fledging and both birds were observed foraging outside the cluster with the parents on 18 June. During the winter survey, the male (DG/OR/DG:YE/AL) was observed at S3-3, but the female was not located.

Cluster S3-3

This is the third year that this cluster has been occupied during the breeding season. The female (AL/RE:LB/HP/DG) has occupied this sites since 2018 after being translocated during the fall of 2017 from Carolina Sandhills NWR. The male that bred with this female during 2019 (AL/DP:DB/LB/YR) was replaced

by a younger male (AL/DP:DB/YE/BR) from the 2019 cohort that was translocated from Carolina Sandhills NWR.

During the breeding season, adult birds were heard in the vicinity of the cluster during three out of five visits from 29 April – 15 May, but no nests were located in known cavities. On 19 May, we discovered a new cavity approximately 100 m south of the nearest known cavity, but rain, extensive shrub-scrub, and height of the cavity prevented inspection of the nest. We returned on 20 May with Refuge manager and fire crew staff to forge a new trail and climb the tree to view the cavity contents; there was one nestling at approximately day 4. We banded this nestling at six days old (physical age; keyed to six days) on 22 May. We sexed the young bird as a female and it was observed foraging outside the cluster with the parents on 10 June. The young bird was observed at cluster C3-3 during the winter survey.

Population Monitoring

During the calendar year of 2020, 19 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, one birds from 2017 translocation cohort, four birds from the 2018 translocation cohort, three birds from the 2019 translocation cohort, and nine birds from the 2020 translocation/local productivity cohort. Zero birds were lost between the 2019 winter survey and the 2020 spring survey.

Ten birds were detected during the spring 2020 census including one from the 2015 cohort, one form the 2016 cohort, one from the 2017 cohort, four from the 2018 cohort and three from the 2019 cohort (Table 2). This included five males and five females. Three of the males and three of the females were associated with PBGs. One single females was roosting alone in YCC1, and the other female was a non-breeder at S3-2. The non-breeding males were roosting at S3-2 and S2-3. The population supported three PBGs into the breeding season compared to three in 2019, three in 2018, two during the breeding season of 2017, and only one during the 2016 breeding season.

Eleven birds were detected during the 2020 winter survey (Table 2). This compares to seven in 2015, eight in 2016, twelve in 2017, eleven in 2018, and nine in 2019 (Table 2). Included were one bird from the 2015 translocation cohort, one bird from the 2017 translocation cohort, one bird from the 2018 translocation cohort, and three birds from the 2019 translocation cohort, and five birds from the 2020 translocation/local productivity cohort. There were five 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 2019 translocation cohort that was roosting at S2-2, a male from the 2020 translocation cohort at C3-3, and a second male produced at S3-2 that was roosting at S3-3. The male associated with the PBG at S2-3 was not detected. The clusters at S2-2 and C3-3 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	Spring 2020	Winter 2020
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	S3-2, T25	S3-2, T25	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							
2651-03370	AL/YE: WH/RY/PU	2016	M											
2651-03404	AL/YE: LG/YR/HP	2016	F											
2651-03330	AL/YE: LB/YE/DB	2016	F											
2651-03319	AL/YE: HP/HP/LG	2016	M											

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019	Spring 2020	Winter 2020
2651-03411	AL/YE: DB/YE/RV	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, T45	S2-3, T45	
2421-02968	GY/DB/LG: PK/AL	2017	F											
2651-03675	AL/RE: WH/RV/DG	2017	M											
2651-03772	AL/RE: YR/YR/YE	2017	M											
2651-03764	LG/LB/YE: AL/RE	2017	M											
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					

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019	Spring 2020	Winter 2020
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	S3-3, T102	S3-3, T102
2651-03784	AL/RE: HP/DB/OR	2017	F					YCC1, T01	YCC1, T01	YCC1, T01	YCC1, T01			
2651-03714	AL/RE: YE/DB/RV	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	S3-2, NT	S3-2, T24/25
2651-03877	AL/DP: DB/LB/YR	2018	M								S3-3, T102	S3-3, T102	S3-3, T108	
2701-94028	AL/DP: HP/YE/YE	2018	M											
2421-02994	LB/YE/LB: AL/DB	2018	M											
2421-02991	YE/WH/YE: AL/LB	2018	F									YCC1, T01	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	S2-2, T64	
2651-03842	AL/DP: LB/LG/YR	2018	F							YCC1, T02				

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019	Spring 2020	Winter 2020
2701-94187	AL/DP: YE/LB/YE	2019	F											
2701-94172	AL/DP: DB/YE/BR	2019	M									S3-3, T105	S3-3, T105	S3-3, T108
2701-94161	AL/DP: DG/BR/DG	2019	M										S2-2, T43	S2-2, T43
2701-94171	AL/DP: DB/HP/WT	2019	F									S3-2, T24	S3-2, T24/25	S2-2, T64
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											
901-29897	AL/DG: OR/WH/OR	2020	F											YCC1, T103
2421-01610	OR/YE/OR: AL/RE	2020	M											C3-3, T009
901-29887	RE/WH/RE: AL/YE	2020	F											C2-3, T123
901-29895	AL/RE: WH/YE/WH	2020	M											
2421-24335	WH(RFID) : AL/DB	2020	F											

USGS	Color Combo	Cohort	Sex	Winter 2015	Spring 2016	Winter 2016	Spring 2017	Winter 2017	Spring 2018	Winter 2018	Spring 2019	Winter 2019	Spring 2020	Winter 2020
2421-24392	OR/BK/BK: AL/DB	2020	M											
2421-01617	OR/DG/OR: AL/DB	2020	F											
2421-01618	DG/OR/DG: YE/AL	2020	M											S3-3, T105
2421-01616	AL/OR: LB/DB/LB	2020	F											C3-3, T009

Translocation

Three translocation events were executed during the autumn of 2020 including two moves of two birds (two females and two males) from Piney Grove preserve on 7 – 8, and 8 – 9 September and two birds (one male and one female) from Francis Marion National Forest on 5 – 6 November October (Table 3). 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 three clusters including C3-1, C2-1, and S2-1.

Table 3. Individual red-cockaded woodpeckers translocated to Great Dismal Swamp NWR during the fall of 2020. Donor sites included Piney Grove Preserve (PGP) and Francis Marion National Forest (FMNF).

USGS	Left Leg	Right Leg	Release Date	Donor Site	Donor Cluster	Release Cluster
901-29895	AL/RE	WH/YE/WH	9/8/2020	PGP	C-19	C3-1
901-29887	RE/WH/RE	AL/YE	9/8/2020	PGP	C-7	C3-1
2421-01610	OR/YE/OR	AL/RE	9/9/2020	PGP	C-13	C2-1
901-29897	AL/DG	OR/WH/OR	9/9/2020	PGP	C-10	C2-1
2421-24392	OR/BK/BK	AL/DB	11/6/2020	FMNF	188B	S2-1
2421-24335	WH(RFID)	AL/DB	11/6/2020	FMNF	166C	S2-1

Cavity Tree Status

A total of 73 complete woodpecker cavities and 5 starts had been created within the study area on the Great Dismal Swamp NWR by the end of 2020 (Appendix 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, two that were installed in 2019, and two that were installed in 2020. Six natural cavities have been excavated to completion by woodpeckers and five other natural cavities have been started. A total of 23 of these completed cavities have been lost, primarily due to wind throw. 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. During 2019, one cavity tree was lost during an early spring high-wind event, four other cavity trees were lost during late summer storms, and one cavity tree died. During 2020, one tree was lost in January at S3-2 due to high winds, two trees (one at S3-2 and one at C2-3) were lost in August during Tropical Storm Isaias, and another tree at S3-2 was lost due to high winds in December at S3-2. To mitigate some of these

losses, one new cavity box was replaced at S3-3 and another was installed at S3-3. Two new natural cavities were also created; one at S2-2 and one at S3-3. A fresh start at S3-3, an advanced start at S3-3, and two advanced starts at YCC1 continue to be monitored. An additional advanced start at S3-3 was recorded during a helicopter flight by J Carter but has not yet been located on the ground. As of the end of 2020, woodpeckers were using three natural cavities.

Table 4. Condition and observations of red-cockaded woodpecker cavities within the Great Dismal Swamp NWR during December 2020.

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	Clean
C2-2	T-22	Pond Pine	Live	Insert	2015	Dry	Clean
C2-2	T-23	Pond Pine	Live	Insert	2015	Leaked	Growing Over
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	Lost 08/2020	Insert	2016	----	----
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	Mold, Growing Over
C3-1	T-32	Loblolly Pine	Live	Insert	2015	Dry	Mud-Daubers
C3-1	T-33	Loblolly Pine	Live	Insert	2015	Dry	Cobwebs
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-111	Pond Pine	Live	Insert	2016	Dry	Clean
C3-2	T-112	Pond Pine	Live	Insert	2016	Dry	Mold
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-115	Pond Pine	Live	Insert	2017	Dry	Clean
C3-2	T-116	Pond Pine	Live	Insert	2017	Dry	Mud-Daubers
C3-3	T-006	Pond Pine	Lost 3/2017	Insert	2016	----	----
C3-3	T-007	Pond Pine	Live	Insert	2016	Dry	Mud-daubers
C3-3	T-008	Pond Pine	Lost 3/2017	Insert	2016	----	----
C3-3	T-009	Pond Pine	Live	Insert	2017	Dry	Clean

Cluster	Tree ID	Tree Species	Condition	Type	Established	Cavity Seal	Observations
C3-3	T-10	Pond Pine	Lost 8/2019	Insert	2016	----	----
C3-3	T-11	Pond Pine	Live	Insert	2017	Dry	Clean
C3-3	T-12	Pond Pine	Live	Insert	2020	Dry	Clean
S2-1	T-51	Pond Pine	Lost 8/2019	Insert	2015	----	----
S2-1	T-52	Pond Pine	Live	Insert	2015	Dry	Clean
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	Mud-Daubers
S2-2	T-63	Pond Pine	Lost 3/2017	Insert	2015	----	----
S2-2	T-68	Pond Pine	Live	Natural	2020	Dry	Clean
S2-2	T-64	Pond Pine	Live	Insert	2017	Dry	Clean
S2-2	T-65	Pond Pine	Live	Insert	2015	Dry	Wasps
S2-2	T-66	Pond Pine	Live	Insert	2017	Dry	Mud-Daubers
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	Mold
S2-3	T-49	Pond Pine	Live	Insert	2015	Dry	Clean
S2-3	T-50	Pond Pine	Live	Insert	2015	Dry	Mold
S2-3	T-45	Pond Pine	Live	Natural	2019	Dry	Clean
S2-4	T-130	Pond Pine	Live	Insert	2016	Dry	Wasps, Growing Over
S2-4	T-131	Pond Pine	Live	Insert	2016	Dry	Wasps, Growing Over
S2-4	T-132	Pond Pine	Live	Insert	2016	Dry	Wasps, Growing Over
S2-4	T-133	Pond Pine	Live	Insert	2016	Dry	Wasps, Growing Over
S3-1	T-56	Loblolly Pine	Live	Insert	2015	Dry	Wasps, Growing Over
S3-1	T-57	Loblolly Pine	Live	Insert	2015	Dry	Cobwebs, Growing Over
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

Cluster	Tree ID	Tree Species	Condition	Type	Established	Cavity Seal	Observations
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	Lost 08/2020	Insert	2015	----	----
S3-2	T-30	Pond Pine	Lost 1/2020	Insert	2015	----	----
S3-2	T-26	Pond Pine	Lost 2/2018	Insert	2017	----	----
S3-2	T-224	Pond Pine	Lost 12/2020	Natural	2019	----	----
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	T-105	Pond Pine	Live	Insert	2020	Dry	Clean
S3-3	T-108	Pond Pine	Live	Natural	2020	Dry	Clean
S3-3	T-107	Pond Pine	Live	Natural (AS)	2020	----	----
S3-3	NT	Pond Pine	Live	Natural (FS)	2020	----	----
S3-3	NT	Pond Pine	Live	Natural (AS)	2020	----	----
YCC1	T-01	Pond Pine	Live	Insert	2015	Dry	Moss/Debris
YCC1	T-02	Pond Pine	Live	Insert	2015	Dry	Clean
YCC1	T-03	Pond Pine	Live	Insert	2015	Dry	Moss/Debris
YCC1	T-04	Pond Pine	Live	Insert	2015	Dry	Clean
YCC1	NTa	Pond Pine	Live	Natural (AS)	2019	----	----
YCC1	NTb	Pond Pine	Live	Natural (AS)	2019	----	----

The majority of cavities in active clusters continue to be in good condition during 2020 (Table 4), but artificial cavities are degrading in most clusters that are inactive. Seven of the cavities are being grown over by the tree bole. We observed mold in 4 cavities, indicating moisture is an issue. Mud daubers constructed nests in 5 cavities (compared with 2 in 2019) and paper wasps were observed in 6 cavities after not being observed in any during 2019. It is unknown if the increase in paper wasps was due to colder weather when checking or local populations rebounded after the comprehensive paper wasp removal during the 2018-2019 winter.

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