C-111 PROJECT & CAPE SABLE SEASIDE SPARROW SUBPOPULATION D ANNUAL REPORT – 2016

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REPORT TO THE SOUTH FLORIDA WATER MANAGEMENT DISTRICT
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conserving birds and their habitats through science, restoration, and outreach

Contents

1.0 Executive Summary

The main purpose of this report is to provide current data on Cape Sable seaside sparrows (CSSS or the "sparrow") breeding in small sparrow subpopulation D during implementation of the C-111 Spreader Canal Western Phase I Project (C-111 SC Project), which began operations in summer 2012. The C-111 SC Project was designed to restore the quantity, timing and distribution of water delivered to Florida Bay via Taylor Slough and to improve hydroperiod and hydropattern in the area south of the C-111 Canal known as the Southern Glades and Model Lands. The U.S. Fish and Wildlife Service (USFWS or the "Service") issued a Biological Opinion dated August 25, 2009 addressing concerns over potential effects of the C-111 SC Project on CSSS populations and designated sparrow critical habitat, including subpopulation D which is located in the eastern portion of the Everglades just east of Taylor Slough and west of the C-111 Canal. As part of the USFWS Biological Opinion, the South Florida Water Management District (SFWMD or the "District") is required to measure the impact of the C-111 SC Project on sparrows and habitat in subpopulation D. As a result, we were contracted by the District to monitor and provide expert advice regarding potential effects to sparrows breeding in CSSS subpopulation D.

This report is divided into two main sections. **Section 2.0** is an introduction to this report, providing a brief overview of the C-111 SC Project and outlining potential effects on breeding sparrows in CSSS subpopulation D. **Section 3.0** reports the results of field research on sparrow distribution and demography conducted during the 2016 sparrow breeding season. An overview of each of these sections is provided below. The final two sections of this report provide literature cited (**Section 4.0**) and appendices (**Section 5.0**).

Section 2.0

In the USFWS Biological Opinion dated August 29, 2009, the Service concurred with the determination by the U.S. Army Corps of Engineers (USACE or the "Corps") that the C-111 SC Project "may affect, and is likely to affect" the endangered CSSS, and that the project "will affect" designated CSSS critical habitat. Computer simulation modeling indicated that local conditions within CSSS subpopulation D critical habitat may be adversely affected by the C-111 SC Project resulting in an increased hydroperiod in the area. In recent years CSSS numbers have been extremely low in subpopulation D (<10 sparrows typically), and there has been concern over recent declines in all of the small, spatially isolated sparrow subpopulations. The recent declines across all small sparrow subpopulations (A, C, D and F) have been attributed to anthropogenic changes in water flows in the Everglades ecosystem. The federally endangered CSSS is restricted to short-hydroperiod marl prairies in the southern Everglades, and this habitat has been adversely affected by hydrologic changes ranging from too much water in some areas (e.g., subpopulations A and D) to too little water in other areas (e.g., subpopulations C and F). Further, high water levels have been associated with reduced occupancy of sites and reduced reproductive performance. Due to the restricted range of the CSSS and the limited number (and condition) of remaining subpopulations, the potential loss of any sparrow subpopulation increases the probability of extinction for the entire species. Thus, any potential anthropogenic changes to hydrologic conditions in subpopulation D that may adversely affect sparrow breeding habitat must be monitored closely.

Baseline data related to the condition of critical habitat, hydrologic conditions and the sparrow population breeding in CSSS subpopulation D before completion and operation of the C-111 SC Project were established in 2011. All major components of the C-111 SC Project were completed by March 2012, and operations began in summer 2012. The present report focuses on field data collected during 2016 in CSSS subpopulation D only, as part of a continuing study to examine possible effects of the C-111 SC Project on sparrows breeding in this important CSSS subpopulation.

Section 3.0

Historically high water levels during the 2016 Cape Sable seaside sparrow breeding season made conducting fieldwork in subpopulation D, and elsewhere, very challenging. Record rainfall levels during the 2015-2016 dry season resulted in unusually high water depths throughout the sparrows' range during the 2016 breeding season. The high water levels in subpopulation D led to a substantial reduction in our research effort there in 2016. However, despite the high water levels we were able to make some positive observations in subpopulation D in 2016. First, we found 5-7 male sparrows on apparent territories in subpopulation D. These numbers are lower than the previous year, but we were only able to survey approximately 50% of our long-term study plot this year making the numbers more comparable than might be expected given the high water levels. Further, while we did not locate any sparrow nests in 2016 we did see evidence of successful breeding by at least one pair of sparrows. One breeding pair was seen apparently feeding juveniles, although we were unable to locate the juveniles. In a year with such high water depths across our study plot it is encouraging that sparrows apparently continued to breed successfully in subpopulation D. It is promising that successful breeding apparently occurred in subpopulation D for the fifth year in a row, indicating that this ephemeral sparrow subpopulation is still persisting during the operational testing and monitoring stage of the C-111 SC Project even during a period of substantially higher than average water levels.

The main problems facing CSSS subpopulation D continue to be the low population size and highly male-biased sex ratio. Four of five males found in subpopulation D apparently remained unmated in 2016, continuing the trend seen in previous years. Three of the males observed in subpopulation D this year were returning color-banded birds that were members of the breeding population in the previous year; however, only one of these males was paired in 2016.

We continue to recommend that intensive ground surveys and nest monitoring be conducted annually to rapidly identify any negative changes that may be caused by future operations of the C-111 SC Project. Banding of sparrows should also be continued because the demographic information being obtained in this small sparrow subpopulation is invaluable. We also suggest that future research be focused on trying to understand causes for the male-biased sex ratio (e.g., radio-tracking females to better understand dispersal patterns) and possible ways to reduce the bias (e.g., perhaps through translocation of females, but only if habitat conditions in subpopulation D improve to the point that this is not detrimental to the overall sparrow population).

We also recommend that consideration be given to conducting additional surveys (e.g., ground surveys using line transects, or acoustic surveys using remote field recorders) in habitat restoration areas to document the recruitment of individuals into these areas enabling managers to assess the success of restoration efforts. Finally, we continue to recommend that monitoring be initiated in CSSS subpopulation C since components of the C-111 SC Project are predicted to have potential effects on designated critical habitat in this area, and as of now no extensive demographic monitoring in this important small sparrow subpopulation is being conducted. We did conduct some limited surveys in CSSS subpopulation C during 2016 (reported elsewhere); however, we did not establish a demographic study plot there. Monitoring in subpopulation C may become even more critical as future restoration projects implemented under the new Central Everglades Planning Project might further alter hydrological conditions in this area. An added benefit of conducting monitoring in subpopulation C is that we could better examine questions related to dispersal patterns since this is the nearest sparrow subpopulation to subpopulation D.

Acknowledgements

We would like to thank Martha Nungesser, Christina Stylianos, Brian Garrett, and Manny Porras from the South Florida Water Management District for their support and valuable input into the project. We also thank Miles Meyer, Richard Fike, Sandra Sneckenberger and Mary Peterson from the U.S. Fish and Wildlife Service for all of their help and input related to the CSSS project. We would like to thank many at Everglades National Park, but especially Tylan Dean, Lori Oberhofer and Mario Alvarado for providing valuable input and support for our sparrow research over the years. Gary Slater, former Executive Director of Ecostudies Institute, continues to provide valuable advice towards our research. A special thanks to our 2016 field technicians Elizabeth Lago, Laura Young and Katy Lewis for all of their hard work. Finally, we would like to thank Dr. Rick Lathrop, John Bognar and Jim Trimble from the Grant F. Walton Center for Remote Sensing and Spatial Analysis at Rutgers University for their support and assistance with GIS analyses.

2.0 Introduction

2.1 Purpose

The Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) is an endangered subspecies of the seaside sparrow that is restricted to short-hydroperiod marl prairies of the southern Everglades ecosystem. First listed under the Endangered Species Preservation Act in 1967, the Cape Sable seaside sparrow (hereafter CSSS or just "sparrow") has become an important indicator species for the Everglades and its restoration since the fate of the marl prairies, and thus the sparrow, is closely tied with the seasonal timing and spatial extent of water flows through the Everglades. Recent and past anthropogenic changes to water flows have negatively affected the entire Everglades ecosystem changing the vegetation in sparrow habitat dramatically. Over the past several decades the CSSS has experienced severe population declines due in large part to widespread degradation of the Everglades ecosystem (Pimm *et al.* 2002; Cassey *et al.* 2007). However, the sparrow may benefit from unprecedented large-scale habitat restoration efforts currently underway. The Comprehensive Everglades Restoration Plan was authorized by the United States Congress as part of the 2000 Water Resources Development Act with a primary goal of restoring natural water flows to the Everglades (CERP 2010). Estimates for the total cost of CERP projects have reached $13.5 billion, with completion of all projects expected to take 50 years (Stern 2013). Since passage of CERP in 2000, the federal government has provided only $1 billion in funding through fiscal 2013 so substantial costs are yet to be incurred. Overall progress towards Everglades restoration is falling short of initial goals; however, the majority of the estimated 390,000 acres of land needed to accomplish CERP projects has already been acquired (Stern 2013). The main purpose of this report is to monitor potential effects on the CSSS by one of the first major CERP restoration projects to be completed and implemented: the C-111 Spreader Canal Western Phase I Project (C-111 SC Project).

The C-111 SC Project is the first CERP project that will directly benefit Everglades National Park (ENP). The project was designed to restore the quantity, timing and distribution of water delivered to Florida Bay via Taylor Slough and to improve hydroperiod and hydropattern in the area south of the C-111 Canal known as the Southern Glades and Model Lands. The C-111 SC Project was designed to use a complex system of water detention areas, existing canals, canal plugs, levees, weirs and pump stations to reduce seepage losses from Taylor Slough, Southern Glades and Model Lands (**Figure 2.1**). The U.S. Army Corps of Engineers (USACE or the "Corps") and the South Florida Water Management District (SFWMD or the "District") are the parties responsible for the design, construction and implementation of the C-111 SC Project. The U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion dated August 25, 2009 addressing concerns over potential effects of the C-111 SC Project on CSSS populations and designated sparrow critical habitat (USFWS 2009). In this opinion, USFWS concurred with the Corps' determination that the proposed project "may affect, and is likely to affect" the endangered CSSS, and that the project "will affect" designated CSSS critical habitat. These effects are restricted to three of the six extant CSSS subpopulations (B, C and D; **Figure 2.2**). One of these CSSS subpopulations (D) is located directly in the area predicted to be affected by the C-111 SC Project, with the current distribution of this subpopulation centered in the northwestern-central portion of designated critical sparrow habitat located east of Taylor Slough and west of the C-111 Canal. Baseline data related to the condition of critical habitat, hydrologic conditions and the sparrow population breeding in CSSS subpopulation D before completion and operation of the C-111 SC Project were established in 2011 (Virzi *et al.* 2011a).

Major construction began on the C-111 SC Project during SFWMD water year 2011 (WY2011; 01-May 2010 – 30-Apr 2011). By the end of WY2011 most earthwork and major construction of all project components were completed. During WY2012, the C-111 SC Project was entirely completed (Mar 2012). During WY2013, operations commenced (summer 2012). Presently, the project is in the regular operational and monitoring stage. Hydrologic monitoring results are reported annually, and the first *Annual Permit Report for C-111 Spreader Canal Phase I (Western) Project* was completed in 2014 (SFWMD 2014). Operations continued into 2016, with no major alterations in the hydrological regime reported in CSSS subpopulation D during WY2015 (SFWMD 2015).

Operations of the C-111 SC Project are in accordance with the Interim Operational Plan (IOP) for protection of the CSSS. As part of IOP requirements, pumping from project pump stations must cease when gages in certain water monitoring stations located within CSSS designated critical habitat exceed predetermined limits (10 cm) during the critical portion of the CSSS nesting season (15 Mar – 30 Jun) as identified by USFWS. There are 13 water monitoring stations covered in the hydrometeorologic monitoring plan (**Figure 2.3**). Two of the stations collect rainfall data (S-177 and S-18C), and the other stations measure flows and/or stages in the project area. The main water station being monitored in CSSS designated critical habitat is SWEVER4 which is located near the current sparrow subpopulation; three additional stations were installed by SFWMD in areas in closer proximity to known CSSS breeding locations (CSSSD1, CSSSD2 and CSSSD3).

Since the initial baseline report issued in 2011 (Virzi *et al.* 2011a), annual monitoring of breeding sparrows in CSSS subpopulation D has been conducted (Virzi and Davis 2012a, Virzi and Davis 2013a, Virzi and Davis 2014, Virzi *et al.* 2015). The present report focuses on field data collected during the 2016 sparrow breeding season in CSSS subpopulation D as part of our continuing study to examine the potential effects of the C-111 SC Project on sparrows breeding in this important CSSS subpopulation (see **Section 3.0**). During 2016, we conducted additional ground surveys in CSSS subpopulation C, located in Everglades National Park. Surveys in subpopulation C were conducted because field conditions in subpopulation D limited our research efforts there in 2016 due to historically high water levels (discussed in greater detail in **Section 3.0**). With the support and permission from SFWMD, we opportunistically used some of our available staff time to conduct surveys in subpopulation C since this area was also predicted to be affected by the operations of the C-111 SC Project (USFWS 2009). Further, additional hydrological changes in subpopulation C are predicted due to implementation of the Central Everglades Planning Project (CEPP 2014), and thus we took advantage of the opportunity to conduct some limited surveys in this area. These data are not presented in this report; the results of these surveys will be included in our annual report to USFWS (Virzi *et al.* In Prep).

2.2 Figures

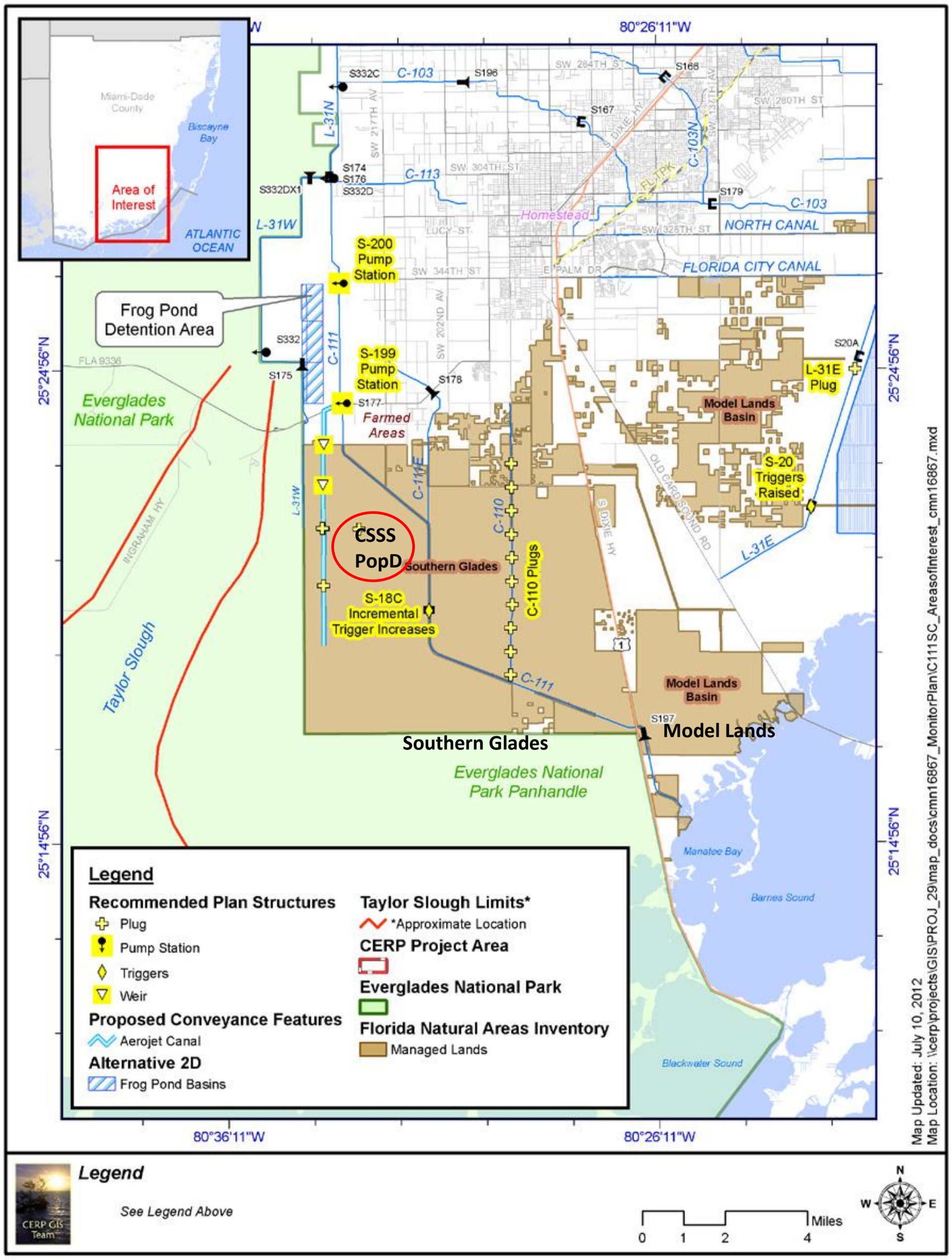

Figure 2.1: Map of C-111 SCW Project Features. Map taken from SFWMD *Annual Permit Report for C-111 Spreader Canal Phase I (Western) Project* (SFWMD 2014). Approximate location of Cape Sable seaside sparrow (CSSS) subpopulation D indicted by red circle (added to map).

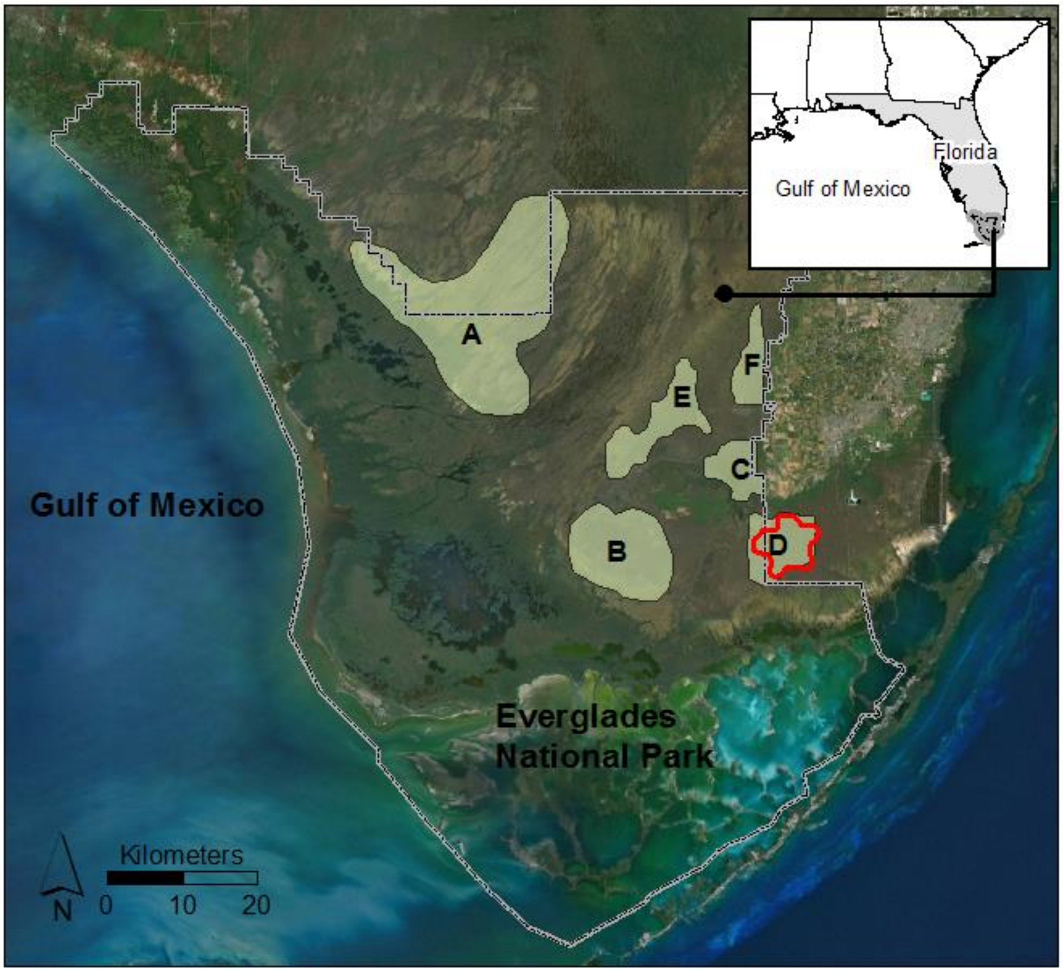

Figure 2.2: Cape Sable seaside sparrow (CSSS) distribution in the Florida Everglades. Green-shaded areas represent historic extent of CSSS habitat (2000 data) by sparrow subpopulation (A through F). Red line indicates current (2007) CSSS critical habitat boundary in sparrow subpopulation D. Dashed line indicates boundary of Everglades National Park.

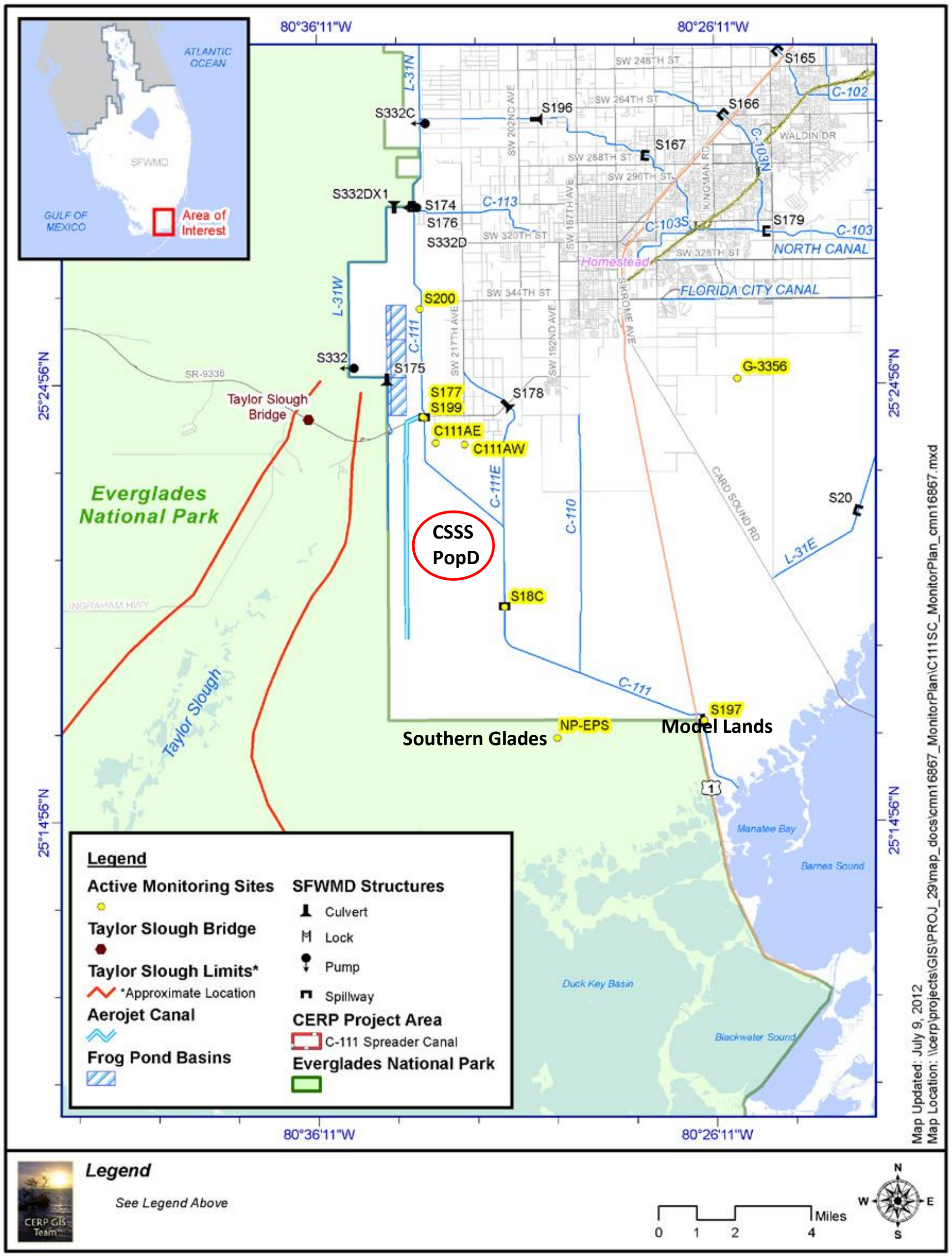

Figure 2.3: Map of C-111 SCW Project Monitoring Stations. Map taken from SFWMD *Annual Permit Report for C-111 Spreader Canal Phase I (Western) Project* (SFWMD 2014). Approximate location of Cape Sable seaside sparrow (CSSS) subpopulation D indicted by red circle (added to map). Monitoring stations located in CSSS designated critical habitat (SWEVER4, CSSSD1, CSSSD2, and CSSSD3) not included on map; stations are located within red circle added to map.

3.0 Cape Sable Seaside Sparrow Distribution and Demography in Subpopulation D

3.1 Background

Early field research on Cape Sable seaside sparrows breeding in subpopulation D began in 1981 when Everglades National Park (ENP) conducted the first rangewide surveys for sparrows in all suitable habitat found in all sparrow subpopulations identified (A through F; see **Figure 2.2** above). These surveys, conducted annually since 1992, have provided valuable information about trends in the status and distribution of sparrows in subpopulation D and elsewhere over the past three decades. More intensive field research in small sparrow subpopulations was started by Rutgers University in 2006 providing the first information on the breeding success and dispersal of sparrows in subpopulation D. This research, funded by ENP and the U.S. Fish and Wildlife Service (USFWS), was conducted annually until 2010 providing a wealth of demographic data about the sparrows recently attempting to breed in subpopulation D (USFWS 2009, Lockwood *et al.* 2010). During 2011-2015 additional sparrow research in CSSS subpopulation D was funded by the South Florida Water Management District (SFWMD or the "District") to gather baseline data about sparrows breeding in this subpopulation and to study potential effects caused by hydrologic changes that are anticipated to occur in this CSSS subpopulation as a result of the C-111 SC Project, which could have detrimental effects on sparrow habitat in this area (Virzi *et al.* 2011a, Virzi and Davis 2012a, Virzi and Davis 2013a, Virzi and Davis 2014, Virzi *et al.* 2015). During 2016, Ecostudies Institute was contracted by the District to conduct additional field research during the sparrow breeding season in an ongoing effort to study the effects of the C-111 SC Project during the regular operational and monitoring period. Our main objective of the current study was to gather distributional and demographic data on sparrows breeding in CSSS subpopulation D.

3.2 Methods

3.2.1 Ground Surveys

During 2016, we conducted ground surveys in subpopulation D throughout the CSSS breeding season. Ground surveys began on 28 Mar and continued until 24 Jun. Our 2016 field season was disrupted due to severely wet field conditions as a result of historic rainfall in South Florida during the months preceding the 2016 CSSS breeding season. Thus, our survey effort was reduced substantially in 2016 due to difficult and hazardous field conditions resulting from the historic water levels reported in South Florida during the winter of 2015-2016 (see **Section 3.3.4**). In past years, sparrow surveys in subpopulation D were conducted two days per week by 2-4 researchers throughout the peak duration of the CSSS breeding season (Mar – Jun; Virzi *et al.* 2015). In 2016, we were only able to conduct intensive ground surveys on three days (28 Mar, 7 Apr, and 24 Jun). Field conditions were difficult enough to require access by helicopter rather than by walking for the last site visit.

Our study plot in CSSS subpopulation D ordinarily includes the core area occupied by sparrows located east of Aerojet Road and south of the East-West Road, between the following ENP helicopter survey sites: rprse-22 to 24 and rprse-31 to 33 (**Figure 3.1**). However, in 2016 we could not conduct ground surveys in the eastern portion of our long-term demographic study plot. Thus, our survey effort was restricted to the area between the following ENP helicopter survey sites: rprse-22 to 23 and rprse-31 to 32. Our ground surveys have been focused on this core area since this is where sparrows nested in subpopulation D over the previous decade (2006-2015) and where intensive monitoring was conducted to obtain baseline data on sparrows and vegetation in 2011 (Virzi *et al.* 2011a, Virzi and Davis 2012a, Virzi and Davis 2013a, Virzi and Davis 2014, Virzi *et al.* 2015). We expected sparrows to establish territories in 2016 in the same area where males held territories in 2015 due to strong philopatry and the influence of conspecific attraction on territory establishment of any returning or new male sparrows in the subpopulation this year (Virzi *et al.* 2012).

During ground surveys researchers recorded the location of any sparrows observed and documented behavior. Locations were recorded with a handheld GPS device (Garmin GPSmap 76CSx) for later analysis in a geographic information system including territory mapping. During surveys, singing male sparrows typically are observed first since they are more conspicuous. Females are more difficult to locate. As such, any time a male sparrow was encountered additional time was spent in that area in an attempt to document the presence of a female on the territory (typically 1-2 hrs, often over several occasions). If a female was observed on a particular territory additional time was spent in an attempt to document breeding. Often, an entire morning may be spent trying to locate a single nest if breeding behavior is observed. During 2016, our survey effort to detect females and locate nests was substantially reduced compared to previous years.

In addition to our intensive ground surveys and nest monitoring in CSSS subpopulation D, we also obtained and reviewed real-time data from the ENP rangewide helicopter surveys conducted in the subpopulation during 2016. If any sparrows were detected in areas in subpopulation D that were outside our study plot we planned to conduct intensive ground surveys in those areas, if feasible, in order to determine if sparrows were breeding since the ENP rangewide helicopter surveys only detect presence/absence of sparrows and do not confirm breeding. During 2016, however, field conditions made it impossible to follow-up ENP detections with intensive ground surveys. Still, we present data on CSSS detections made during ENP helicopter surveys in subpopulation D later in our results.

During 2015-2016 we modified our survey technique somewhat to ensure complete coverage of our study plot in subpopulation D (Virzi *et al.* 2015, Virzi *et al.* 2016). In previous years, we conducted ground surveys by exploring the area described above without systematically tracking the extent of our coverage of our study plot. While we feel that we adequately surveyed the entire subpopulation in the past due to the intensity and duration of our surveys, we decided to modify our survey method to systematically survey a fixed area using line transects (**Figure 3.1**). This was implemented for two reasons: 1) to ensure that we surveyed the entire area contained within our main study plot with consistent effort throughout the entire sparrow breeding season, and 2) we were interested in examining the feasibility of using distance sampling along line transects to obtain a precise density estimate for sparrows breeding on our study plot. We intended to continue to conduct replicated line transect surveys in 2016; however, field conditions again disrupted our ability to conduct our surveys. Thus, distance data were very limited this year and could not be analyzed.

3.2.2 Nest Monitoring

In most years we conduct intensive nest searches for all pairs of sparrows detected on our study plot in CSSS subpopulation D. Nest searching is difficult and requires multiple site visits to monitor the behavior of CSSS pairs enabling researchers to locate nests. Due to the difficult field conditions in 2016 we were unable to conduct nest searching with effort comparable to past years. Nest searching was still conducted during our ground surveys, albeit with much reduced effort. No nests were located during 2016; however, we report on all breeding behavior observed and any anecdotal nesting activity encountered.

3.2.3 Mark-Recapture Data

In order to study demographic patterns in subpopulation D we continued to resight previously color-banded individuals to gain information for a long-term mark-recapture study of the CSSS. We did not color-band any new sparrows in subpopulation D in 2016. Sparrows are typically captured on breeding territories using mist-nets, following well-established protocols, and leg bands are applied to enable later identification of individuals. The band combination includes a metal USFWS band and three plastic color bands on each sparrow's legs; the combination of which identifies an individual. Our ground surveys included resighting previously color-banded individuals which could be done with binoculars or a spotting scope rather than recapturing individuals thus limiting handling.

3.3 Results and Discussion

3.3.1 Current Status and Distribution

Subpopulation D had experienced a continual decline since its 1981 estimate of 400 sparrows. Since 2000, habitat in this area appeared to have suffered from high water levels, and consequently, sawgrass continues to dominate the area with only small drier patches of muhly grass acting as island refuges for breeding sparrows. These patches of suitable habitat may have increased moderately in recent years, due in part to prolonged drought conditions that prevailed in recent years in South Florida (Virzi *et al.* 2011a). It is possible that the sparrow population has responded favorably in recent years as a result of these recent habitat changes and due to relatively dry conditions during recent breeding seasons (Virzi and Davis 2012a, Virzi and Davis 2013a, Virzi and Davis 2014, Virzi *et al.* 2015).

During 2016, subpopulation D continued to hold very few sparrows. While our survey effort was reduced substantially in 2016, we feel that the results of our limited surveys viewed in conjunction with the results of the ENP rangewide helicopter surveys support our claim that subpopulation D continues to hold very few sparrows. Our ground surveys and territory mapping activities detected five male sparrows and one female sparrow in 2016 (**Figure 3.2** and **Appendix 1**). We were able to conduct a single replicate of our line transect surveys, and only three of four transects located on our study plot could be surveyed (Tr-D2, Tr-D3, and Tr-D4; **Figure 3.2**). Further, we could not survey the eastern half of any of the transects during 2016 due to persistently high water levels in that portion of our study plot. Despite our reduced survey effort, we still detected seven male sparrows on our transect surveys on one day (7 Apr). Thus, we estimate that there were 5-7 territorial males present on our study plot in subpopulation D in 2016. This is down substantially from the 11-12 males found there in 2015 (Virzi *et al.* 2015); however, since we did not survey the eastern portion of our study plot in 2016 this should not be taken as an indication of a decline in numbers. In fact, there were four male sparrows in the eastern portion of our study plot in 2015, so the total number of males in the area surveyed in 2016 is actually somewhat comparable between years.

The ENP rangewide helicopter surveys detected sparrows at three survey sites (*n* = 41) in subpopulation D in 2016 (**Figure 3.3**). All three sites where sparrows were detected were in close proximity to our demographic study plot in subpopulation D. This provides evidence that sparrows continue to only occupy habitat in subpopulation D in the core area where sparrows have nested in recent years. In total, five sparrows were detected during the ENP surveys; one at sites rprse-23 and rprse-41, and three at site rprse-32. The latter site is located directly within our demographic study plot, and thus the sparrows detected there are likely the same individuals that we detected during our ground surveys. While it is possible that the other two sparrows detected during the ENP surveys are different individuals than those detected during our surveys, we cannot rule out that these may be the same individuals. **Figure 3.4** shows the home range sizes of male sparrows (based on 2015 data; Virzi *et al.* 2016) compared to the location of sparrows detected on the ENP surveys. The large home range size of single male sparrows suggests that males might be encountered at multiple survey sites. Thus, it is possible that the ENP surveys were detecting male sparrows that we already counted during ground surveys on our study plot.

Only one female sparrow was observed in subpopulation D during the 2016 breeding season. Thus, following the trend in small subpopulation D, four of the five male sparrows observed on our study plot (80%) apparently remained unmated. A second female was suspected in 2016; however, this individual was never confirmed during our surveys. This resulted in a highly male-biased sex ratio of 0.71-0.83 in 2016. Highly male-biased sex ratios are often observed in small sparrow subpopulations in general (Virzi *et al.* 2011b, Virzi and Davis 2012b, Virzi and Davis 2013b, Slater *et al.* 2014); however, the persistence of such a highly-skewed sex ratio in subpopulation D is of major concern.

The sole confirmed pair of sparrows in subpopulation D appeared to have been a successful breeding pair based on behavioral evidence (see **Section 3.3.2**). Thus, while it remains too soon after commencement of operations of the C-111 SC Project to evaluate the success of the project, our data continues to indicate that sparrows are still able to use habitat in subpopulation D and breed successfully after initial implementation and operation of the project. We remain encouraged by our data, and SFWMD is also encouraged by the observed hydrologic patterns in Taylor Slough so far, indicating that the project has operated smoothly and as expected (SFWMD 2016a).

3.3.2 Nest Monitoring Results

We did not locate any sparrow nests in subpopulation D in 2016. However, we did observe evidence that at least one pair nested in 2016. One color-banded male sparrow (RDDP_ORAL; DS-16-01; **Figure 3.2**) was observed with a female on 24 Jun, and this pair appeared to be feeding juveniles on this date; however, no juveniles were observed. We feel that the observed behavior provides some evidence that sparrows once again nested successfully in subpopulation D in 2016, despite the historically high water levels. This anecdotal evidence of breeding supports the conclusion that successful breeding can still occur in subpopulation D with the C-111 SC Project in its operational testing and monitoring stage.

3.3.3 Mark-Recapture Data

Four of the five male sparrows detected in CSSS subpopulation D in 2016 were previously color-banded individuals. We were able to obtain accurate resights of the color-bands for only three of these individuals (LGRW_ORAL; RDDP_ORAL; PUYL_ORAL; **Table 3.1**). All three males were single males found on our study plot in subpopulation D in 2015; RDDP_ORAL was the only confirmed paired male on our study plot in 2016. RDDP_ORAL was originally banded as a second-year male in subpopulation D in 2012 making this individual the first sparrow to return to the subpopulation for a fifth consecutive year. The other two color-banded males were originally banded in subpopulation D as adults in 2014 making them returning birds for the third consecutive year. The only color-banded female present on our study plot in 2015 was not observed in 2016.

In total, during 2016 we resighted three of the 11 color-banded adult sparrows that were present in the breeding population in 2015. Thus, we observed a return rate of 0.27 for adult sparrows, which is well below the rate expected (~0.60) based on previous CSSS research

(Boulton *et al.* 2009, Gilroy *et al.* 2012). However, we caution that the low return rate is somewhat a function of our reduced survey effort in 2016. The fact that three male sparrows returned to our study plot for more than two consecutive years is encouraging since we typically do not see this many individuals returning to this breeding population in multiple years. Surveys in 2017 will be necessary to examine real trends in return rates in this CSSS subpopulation.

3.3.4 Hydrologic Data

The dry conditions that had prevailed in South Florida over the past two years came to an abrupt end during the early part of the 2016 dry season. An historic amount of rainfall fell on the region during the winter of 2015-2016 resulting in extremely high water levels at the onset of the CSSS breeding season. The dry season typically begins in Oct and ends in May; however, extremely wet conditions prevailed throughout the early part of the 2015-2016 dry season. The wet conditions began in Nov 2015, which saw South Florida receiving the highest Nov rainfall total since 1998 (SFWMD 2016b). Miami-Dade County saw some of the wettest conditions, receiving rainfall totals 174% above average for the month. The wet conditions continued into Dec 2015, with eastern Miami-Dade County recording the wettest Dec since record keeping began in 1932; rainfall totals were 500% above average. Conditions only became worse in Jan 2016 with South Florida receiving the highest rainfall total for the month since 1932. In fact, the month was also the wettest dry season month recorded since 1970. The above average rainfall continued into Feb 2016 before finally returning to more normal levels in Mar 2016.

The historic rainfall that occurred during the 4-month period leading up to the 2016 CSSS breeding season set the tone for a difficult to impossible field season in subpopulation D. The high water levels over such a prolonged period during the dry season created conditions that prevented safe access to our study site in subpopulation D. Suspended sediment in the flooded prairies did not settle at any point during the 2016 CSSS field season making walking on the site difficult to impossible and even dangerous in some areas. A brief analysis of 2015-2016 hydrologic data shows the extent of the wet conditions in CSSS subpopulation D this year. Rainfall data from the SFWMD DBHYDRO database at the nearest meteorological monitoring station to CSSS subpopulation D (S-18C) was reviewed for previous two years to illustrate the differences in rainfall between years (**Figure 3.5**; SFWMD 2016c). These data clearly show that overall the period before the 2016 CSSS breeding season was substantially wetter than the period leading up to the 2015 breeding season. The mean monthly rainfall total for the winter 2015-2016 (0.20 inches) was substantially higher than for winter 2014-2015 (0.05 inches), with total rainfall for the period almost four times the previous year (**Table 3.2**). Breeding season rainfall totals were actually quite similar between years, but water depths were well above average in 2016 due to the historic rainfall during the winter period.

Water depths at the onset of the 2016 CSSS breeding season were well above average, with depths more than a foot higher than the previous year (**Figure 3.6**; SFWMD 2016c). Water depths remained well above average for the entire breeding season in 2016, with depths looking more like a typical rainy season. The minimum monthly average water depth at the CSSSD1 monitoring station during the 2016 CSSS breeding season was almost as high as the maximum monthly average water depth in the previous year (**Table 3.3**). Even during the modest dry down that occurred in May 2016 water depths remained well above average for the breeding season.

Previously, we have suggested that the dry conditions that prevailed in South Florida over recent years may have contributed towards the recent observed increase in sparrow density in subpopulation D (Virzi *et al.* 2015). It is interesting that we did not observe a drastic decrease in sparrow numbers in subpopulation D despite the historically high water levels in 2016. This could be an indication that habitat in our study plot remains favorable for breeding, but it could also be due to strong site fidelity or the influence of conspecific attraction, both of which are known to occur in the CSSS (Virzi *et al.* 2012). The 2017 CSSS breeding season will be an interesting year to see if sparrows abandon the area due to the extremely wet conditions that prevailed during 2016, or if this ephemeral subpopulation persists over the near-term despite the high water levels.

3.3.5 Conclusions

Once again, our research in CSSS subpopulation D in 2016 continued to show some encouraging trends for this small, ephemeral sparrow subpopulation. Despite our greatly reduced research effort in subpopulation D, we found a comparable number of sparrows in the subpopulation and reported evidence of successful breeding. This would mark the fifth consecutive year that sparrows nested successfully in subpopulation D. We also continued to resight previously color-banded male sparrows in the subpopulation, which is an indication that survival rates may be similar to other sparrow subpopulations and that sparrows are at least returning to the subpopulation to establish territories providing some indication of habitat suitability in the area. However, on a negative note there continues to be a highly imbalanced sex ratio in subpopulation D as we observed only one female sparrow on our study plot in 2016.

Although there are some encouraging signs that CSSS subpopulation D is persisting, we continue to offer some words of caution regarding this small sparrow subpopulation. It should be stressed that this subpopulation remains well below the size predicted to be necessary for a healthy CSSS subpopulation (20 pairs) and thus is still subject to extreme risk of local extinction. Thus, intensive monitoring of CSSS subpopulation D is recommended in order to detect any rapid changes in demographic parameters or population declines. We also suggest that more research be conducted on possible causes for the highly-skewed sex ratio observed in the subpopulation (e.g., by radio-tracking females to better understand dispersal patterns), and explore possible solutions (e.g., translocation of females into subpopulation D).

3.4 Tables and Figures

Table 3.1: Color-banded adult Cape Sable seaside sparrows resighted in subpopulation D in 2016. All sparrows resighted in 2016 were originally color-banded as adults in subpopulation D; one male was originally banded in 2012; two males were originally banded in 2014; one male with unknown (UNK) color combo also resighted. No sparrows were newly banded in 2016. Colors: AL = aluminum, DP=dark pink, LG = light green, OR = orange, PU = purple, RD = red, RW = red-white, YL = yellow. Ages: SY = second year, AHY = after hatch year, ATY = after third year, 5Y = known age five.

USFWS Band #	Resight Date	Color (Left)	Color (Right)	Sex	Age	Notes
2291-49632	03/28/16	LGRW	ORAL	M	ATY	Banded as AHY in 2014; single 2015; single 2016
2291-49530	06/24/16	RDDP	ORAL	M	5Y	Banded as SY in 2012; single 2015; paired 2016
2291-49631	06/24/16	PUYL	ORAL	M	ATY	Banded as AHY in 2014; single 2015; single 2016
UNK	04/07/16	UNK	UNK	M	AHY	Single male in new area; 4th banded male in 2016

Table 3.2: Mean (+SD), minimum, maximum and total daily monthly rainfall (inches) at South Florida Water Management District rainfall monitoring station S-18C in Cape Sable seaside sparrow subpopulation D in 2015 and 2016. Data provided by the SFWMD DBHYDRO Database (SFWMD 2016c). Breeding season = 1 Mar – 31 Jul; winter period = 1 Nov – 28 Feb.

Metric	Mean	SD	Min	Max	Total
Breeding 2015	0.13	0.53	0.00	5.78	19.48
Breeding 2016	0.12	0.38	0.00	2.81	18.55
Winter 2015	0.05	0.26	0.00	2.26	6.29
Winter 2016	0.20	0.67	0.00	5.18	23.74

Table 3.3: Mean (+SD), minimum and maximum daily water depths (feet) at South Florida Water Management District water monitoring station CSSSD1 in Cape Sable seaside sparrow subpopulation D in 2015 and 2016. Data provided by the SFWMD DBHYDRO Database (SFWMD 2016c). Breeding season = 1 Mar – 31 Jul; winter period = 1 Nov – 28 Feb.

Period	**Mean**	**SD**	**Min**	**Max**
Breeding 2015	1.91	0.40	0.88	2.75
Breeding 2016	2.73	0.11	2.44	3.00
Winter 2015	2.41	0.27	1.84	2.81
Winter 2016	2.78	0.18	2.36	3.24

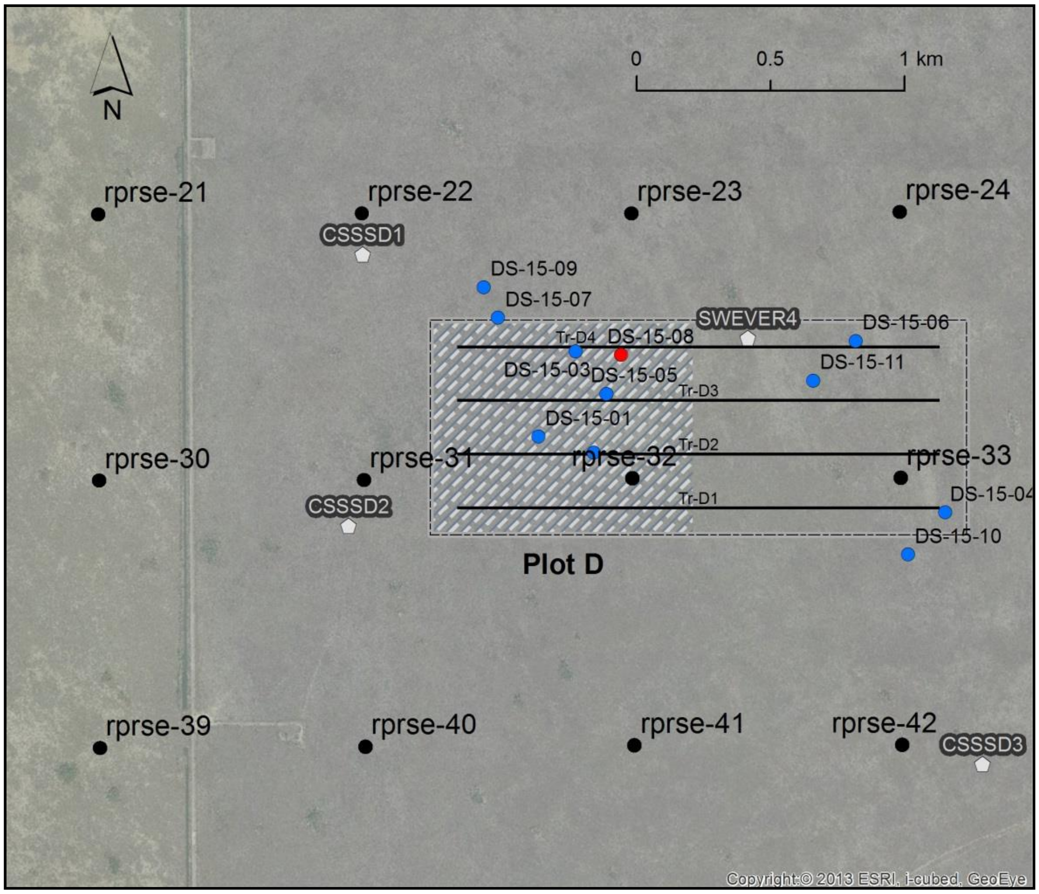

Figure 3.1: Map of 2016 study area in Cape Sable seaside sparrow (CSSS) subpopulation D. CSSS ground surveys were conducted in most areas east of Aerojet Road and west of the C-111 Canal where sparrows were located during the 2015 field season (blue circles = single males; red circle = paired male). Survey effort in 2016, however, was focused in the western portion (hatched area) of the study plot (dashed-outlined area) between ENP helicopter survey sites (black circles) rprse-22 to 23 and rprse-31 to 32. Areas further east on the study plot could not be surveyed in 2016 due to high water levels.

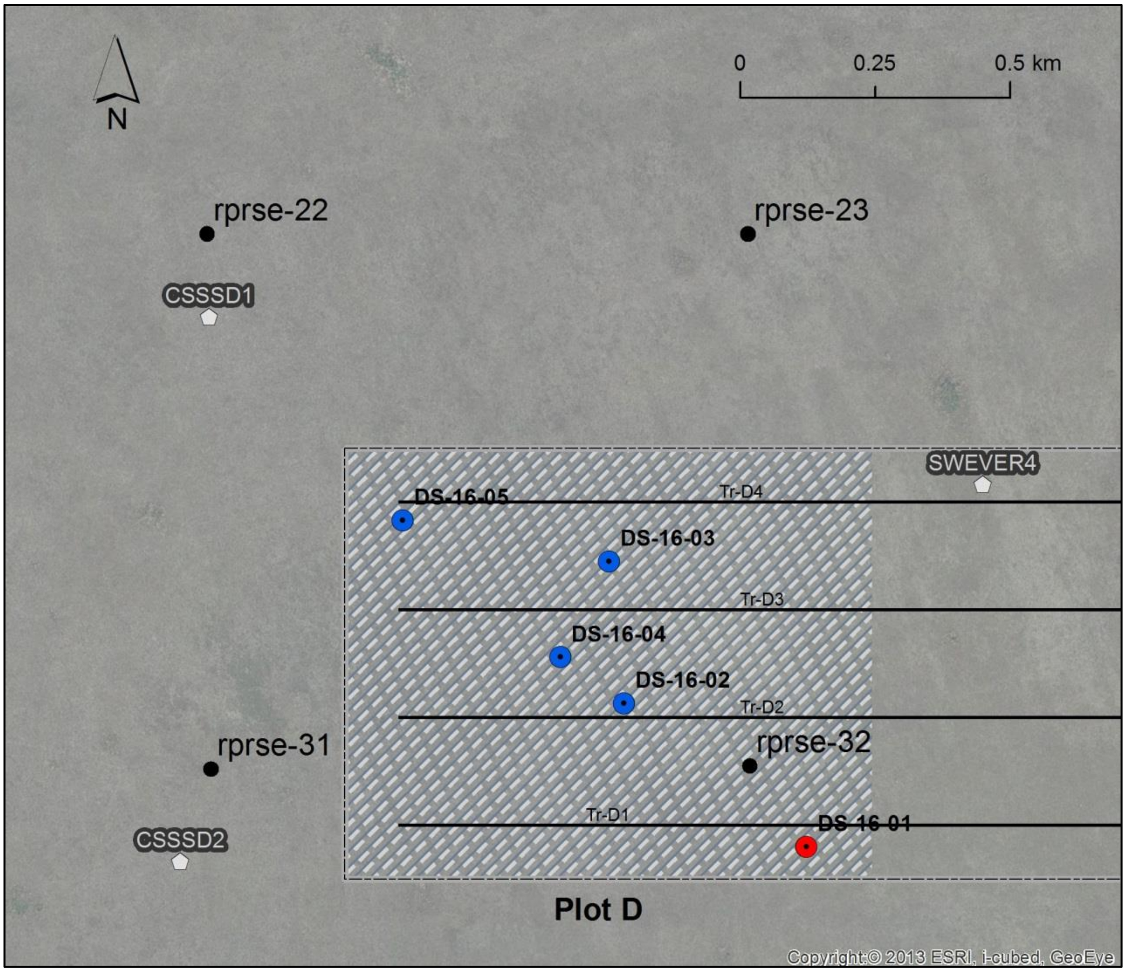

Figure 3.2: Location of Cape Sable seaside sparrow (CSSS) territories in subpopulation D during the 2016 breeding season. Black circles correspond to ENP helicopter survey sites. Five male sparrows were observed singing on apparent territories during 2016; only one of these males was paired and apparently nested (DS-16-01). Blue circles represent central locations of single male sparrow territories; red circle represents central location of the only paired male sparrow territory (female detected – possibly feeding fledglings). Hatched area represents area where survey effort was focused in 2016.

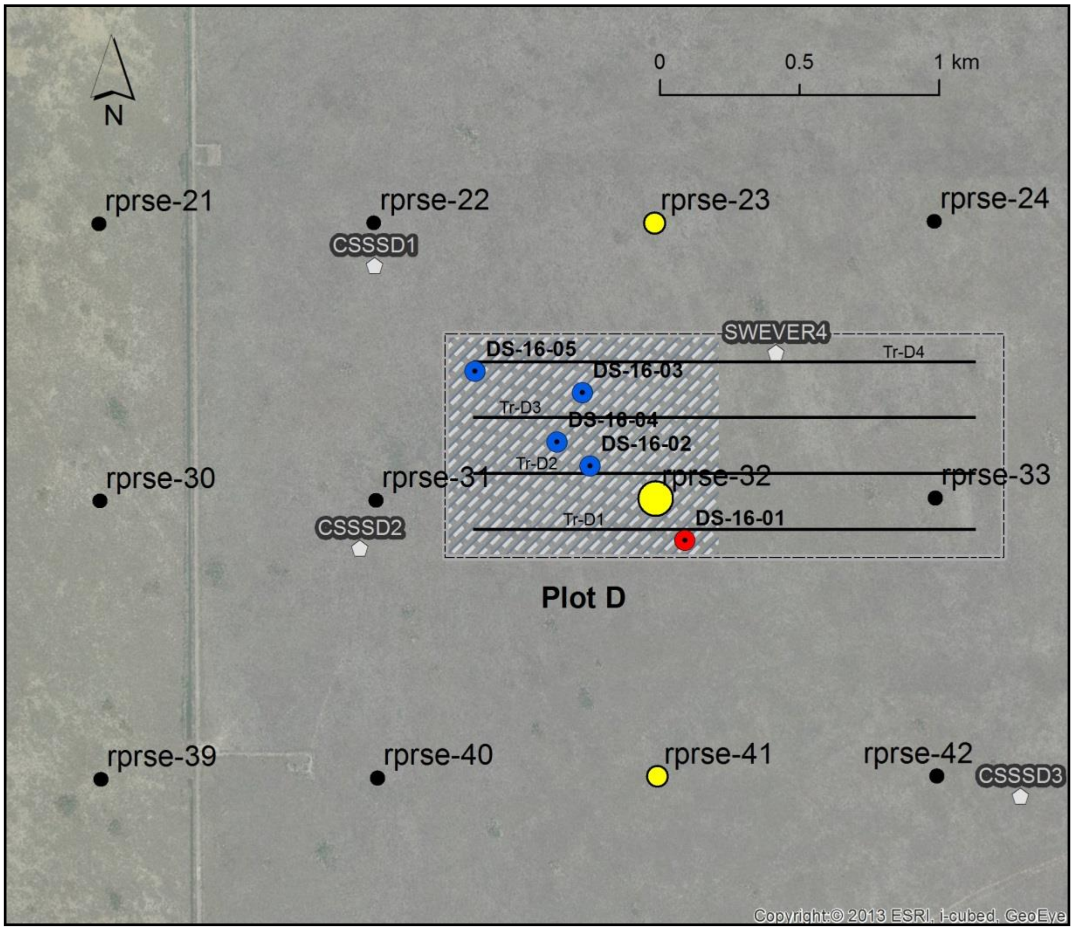

Figure 3.3: Location of all Cape Sable seaside sparrow (CSSS) detections made during ENP helicopter surveys in subpopulation D in 2016. Black circles correspond to ENP helicopter survey sites; yellow circles indicate sites where CSSS were detected during surveys (larger circles indicate higher counts). No CSSS were detected at any other ENP survey sites visited in subpopulation D in 2016. CSSS territory data collected during demographic monitoring included on map for comparison. Blue circles represent central locations of single male sparrow territories; red circle represents central location of the only paired male sparrow territory in 2016.

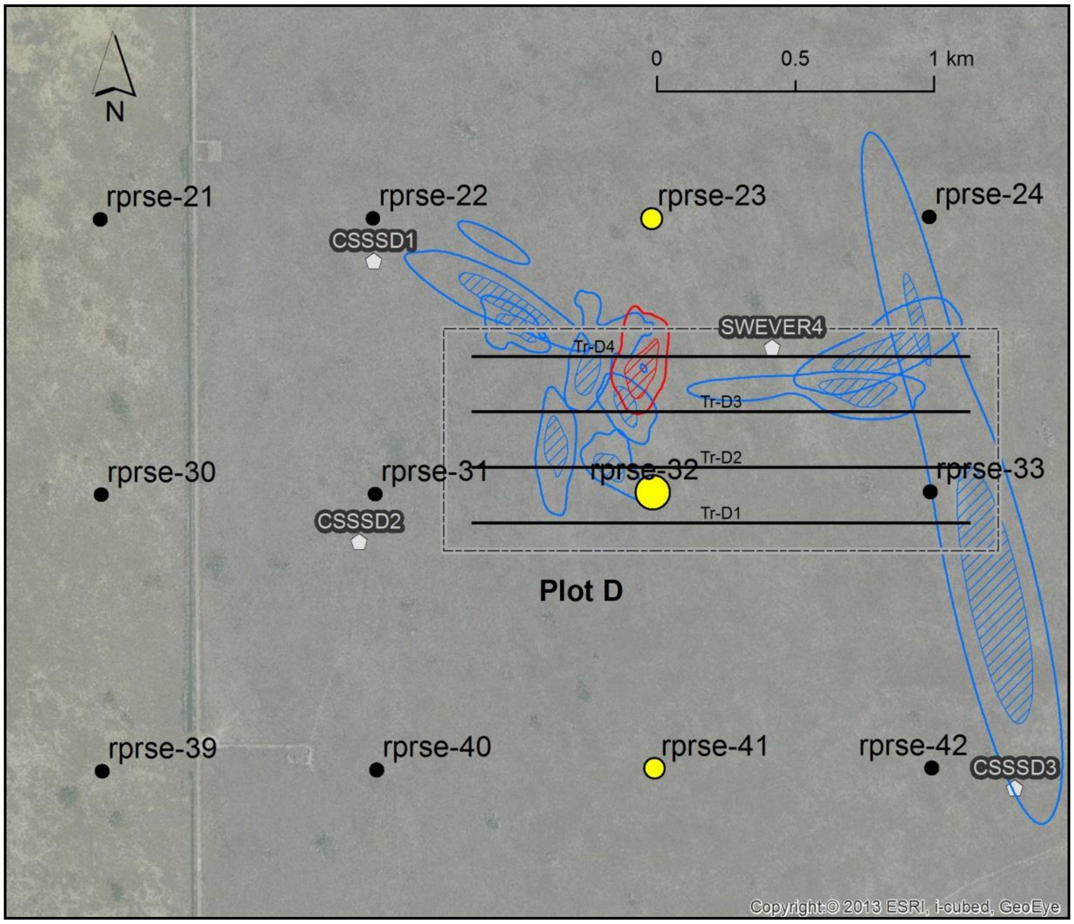

Figure 3.4: Location of Cape Sable seaside sparrow (CSSS) detections made during ENP helicopter surveys in subpopulation D in 2016 overlaid with home range estimates for all territorial male sparrows detected in subpopulation D in 2015. Home ranges from 2015 were used for comparison because there were not enough territory data collected to map home ranges in 2016. Blue polygons indicate home ranges for single male sparrows; the red polygon indicates the home range for the only paired male sparrow in 2015. Black circles correspond to ENP helicopter survey sites; yellow circles indicate sites where CSSS were detected during surveys (larger circles indicate higher counts).

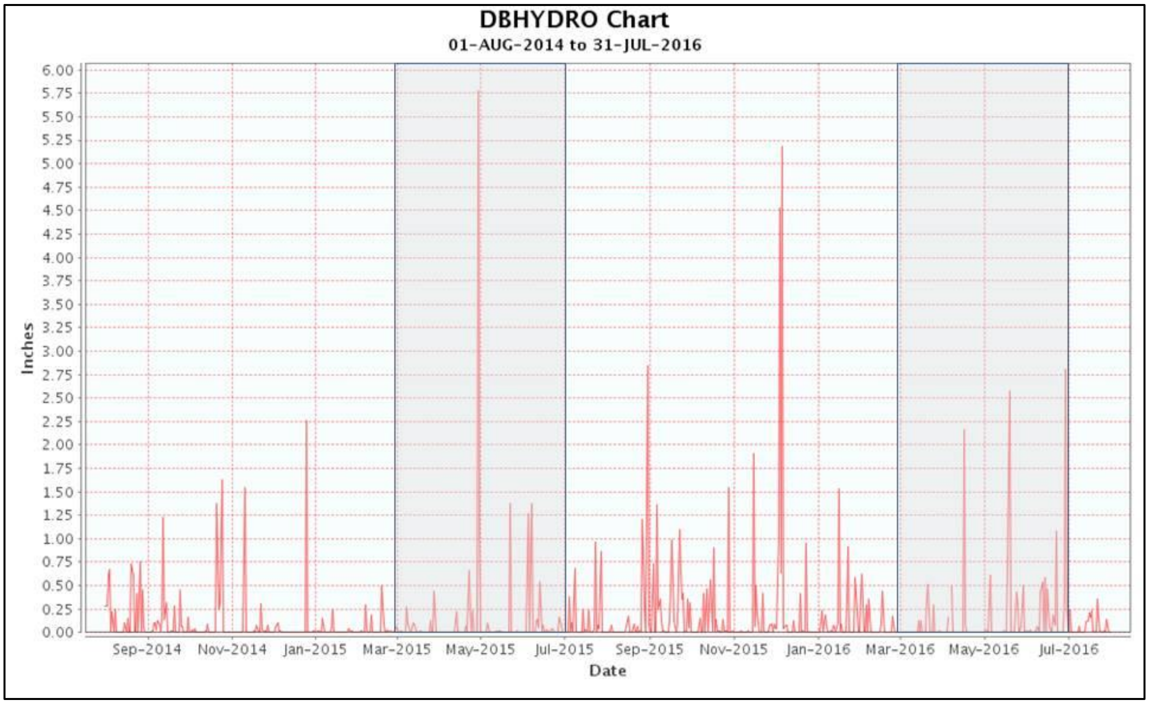

Figure 3.5: Daily total rainfall plot for the S-18C monitoring station located in Cape Sable seaside sparrow (CSSS) subpopulation D for the 2-year period from 31 Jul 2014 – 31 Jul 2016. Grey-shaded areas highlight the 2015 and 2016 CSSS breeding seasons (1 Mar – 31 Jul). Unshaded areas show rainfall patterns for the periods leading up to the corresponding CSSS breeding seasons. Plots taken from the South Florida Water Management DBHYDRO Database (SFWMD 2016c; shaded areas added).

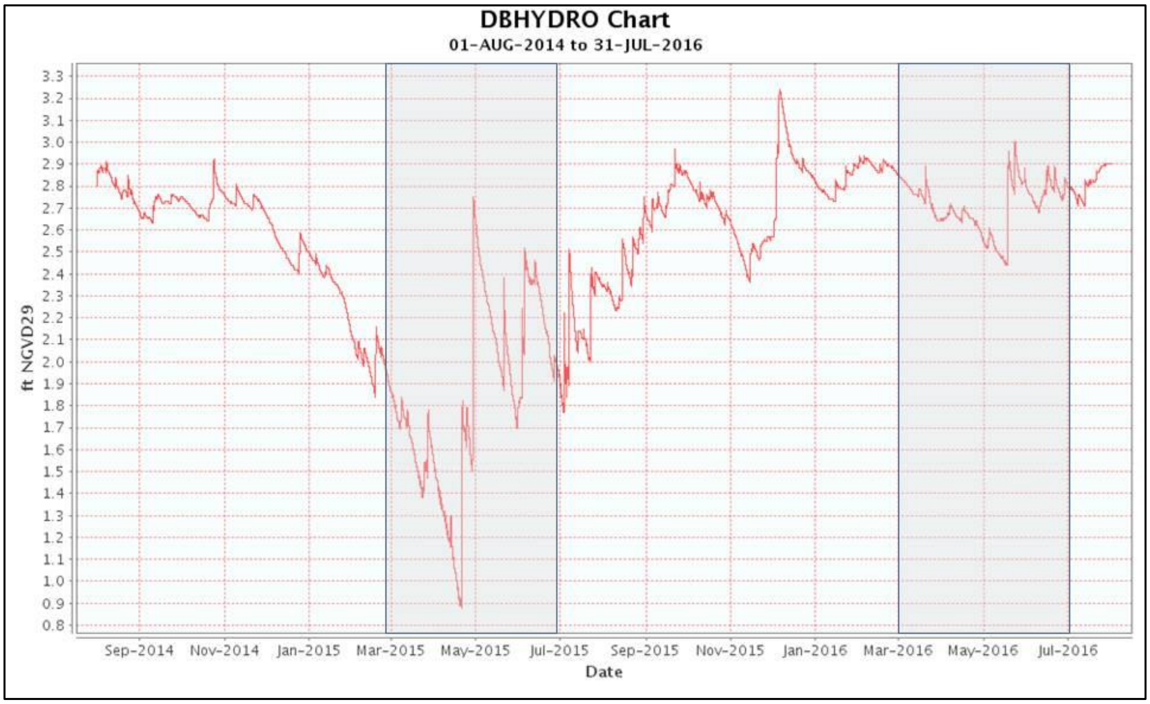

Figure 3.6: Daily mean surface water depth plots for the CSSSD1 monitoring station located in Cape Sable seaside sparrow (CSSS) subpopulation D during the 2-year period from 31 Jul 2014 – 31 Jul 2016. Grey-shaded areas highlight the 2015 and 2016 CSSS breeding seasons (1 Mar – 31 Jul). Unshaded areas show water depths for the periods leading up to the corresponding CSSS breeding seasons. Data for other monitoring stations in sparrow subpopulation D (CSSSD2, CSSSD3 and SWEVER4) not presented here, but showed similar trends. Plots taken from the South Florida Water Management DBHYDRO Database (SFWMD 2016c; shaded areas added).

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5.0 Appendices

5.1 Appendix 1

Appendix 1: Location of all Cape Sable seaside sparrow detections in subpopulation D in 2016 and their coordinates. The coordinates are in WGS 1984. Color combination for leg bands indicated when observed (UNB = unbanded; BANDED = bands seen, but color combo not confirmed). Colors: AL = aluminum, DP=dark pink, LG = light green, OR = orange, PU = purple, RD = red, RW = red-white, YL = yellow.

GPS_ID	Month	Day	Year	Color_Combo	Latitude	Longitude
14	3	28	2016	LGRW_ORAL	25.342897	-80.551913
14	3	28	2016	LGRW_ORAL	25.342897	-80.551913
37	4	7	2016	BANDED male	25.343144	-80.555883
38	4	7	2016	BANDED male	25.343163	-80.555665
213	6	24	2016	RDDP_ORAL	25.337662	-80.548339
213	6	24	2016	RDDP_ORAL	25.337662	-80.548339
212	6	24	2016	PUYL_ORAL	25.340077	-80.551699
212	6	24	2016	PUYL_ORAL	25.340077	-80.551699
210	6	24	2016	LGRW_ORAL	25.342016	-80.552018
211	6	24	2016	UNB male	25.340855	-80.552873