**Cape Sable Seaside Sparrow**
**(*Ammodramus maritimus mirabilis*)**

**5-Year Review:**
**Summary and Evaluation**

Photo credit: David La Puma

**June 2023**

**U.S. Fish and Wildlife Service**
**Southeast Region**
**Florida Ecological Services Field Office**
**Vero Beach, Florida**

**5-YEAR REVIEW**
**Cape Sable Seaside Sparrow (*Ammodramus maritimus mirabilis*)**

# I. GENERAL INFORMATION

## A. Methodology used to complete the review:

In accordance with section 4(c)(2) of the Endangered Species Act of 1973, as amended (Act), the purpose of a status review is to assess each threatened or endangered species to determine whether its status has changed and if it should be classified differently or removed from the Lists of Threatened and Endangered Wildlife and Plants. The U.S. Fish and Wildlife Service (Service) evaluated the biology, habitat, and threats of the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*; hereafter "CSSS" or "sparrow") to inform this status review. In conducting this 5-year review, we relied on the best available information on historical and contemporary distributions, life history, genetics, and habitats of, and threats to, this species. This review includes information from the previous 5-year review (Service 2010) that is still applicable to the species, with updated or new information incorporated, as appropriate. We announced initiation of this review and requested information in a published *Federal Register* notice with a 60-day comment period in 2019 (84 FR 14669). We received two public comments during the open comment period and evaluated and incorporated comments as appropriate in this review. We used a variety of information resources, including monitoring reports, surveys, and other scientific and management information, augmented by conversations and comments from biologists familiar with the species. Specific sources for this review included the final rule listing this bird under the Act (32 FR 4001; Service 1967), the Recovery Plan (Service 1999), the last 5-year review (Service 2010), peer reviewed scientific publications, and unpublished field observations by Federal, State, and other experienced biologists. The review was conducted by the Florida Ecological Services Field Office (FESFO), Vero Beach, with assistance from the Louisiana Ecological Services Office. Literature, documents, and correspondences on file at the FESFO, Vero Beach were used for this review. All recommendations resulting from this review are a result of thoroughly reviewing the best available information about the CSSS. We did not seek peer review on this update to the 2010 5-year review.

## B. Reviewers

**Lead Region:** Southeastern Region, Carrie Straight (404) 679-7226

**Lead Field Office:** Florida Ecological Services Field Office, Mary Peterson (772) 469-4327

## C. Background

### 1. FR Notice citation announcing initiation of this review

84 FR 14669 (April 11, 2019)

**2. Listing history**

Original Listing
FR notice: 32 FR 4001
Date listed: March 11, 1967
Entity listed: Subspecies
Classification: Endangered

**3. Associated rulemakings**

Critical Habitat Designation
FR notice: 42 FR 47840
Date: September 22, 1977

Revised Critical Habitat Designation
FR notice: 72 FR 62736
Date: November 6, 2007

**4. Review History**

Each year, the Service reviews and updates listed species information for inclusion in the required Recovery Report to Congress. Through 2013, we performed a yearly recovery data call. In our 2010 5-year review, the species' status was considered declining, and we recommended no change to the CSSS listing classification as endangered (Service 2010).

Recovery Plan: 1999
Draft Recovery Plan Amendment: 2019
Previous Five-Year Reviews: 1987, 1991, 2010. None of these reviews recommended a change in status for the species.

**5. Species' Recovery Priority Number at start of review (48 FR 43098)**

3C.
Degree of Threat: High
Recovery Potential: High
Taxonomy: Subspecies
The "C" reflects a degree of conflict with economic activities.

**6. Recovery Plan or Outline**

Name of original plan: Cape Sable Seaside Sparrow Recovery Plan (Service 1983)
Date issued: April 6, 1983
Name of current plan: South Florida Multi-Species Recovery Plan (MSRP) (Service 1999)
Date issued: May 18, 1999
Date of Draft amendment to current plan: August 6, 2019 (Service 2019)

## II. REVIEW ANALYSIS

### A. Application of the 1996 Distinct Population Segment (DPS) policy

**1. Is the species under review listed as a DPS?**
No.

**2. Is there relevant new information that would lead you to consider listing this species as a DPS in accordance with the 1996 policy?**
No.

### B. Recovery Criteria

Cape Sable seaside sparrow range is currently defined by six subpopulations (i.e., A-F; Figure 1). These subpopulations will be referenced as CSSS-A through CSSS-F in the remainder of the text when referencing locations and specific subpopulations.

Note: When evaluating some of the reclassification criteria outlined below, it is important to understand survey methods for monitoring this species, so we describe the methods before discussing the reclassification criteria. This species is monitored using two methods:

1) Population-wide helicopter surveys – Helicopter surveys, which began in 1992, are conducted during the breeding season to estimate the number of CSSS in each subpopulation as well as the overall annual population size. These surveys use well-established point-count sampling techniques where a 1-kilometer (km) grid is overlaid on a map of the subpopulations, and a sampling point is established at the intersections of the grid lines. Since areas where CSSS occur are remote and in designated wilderness, a helicopter is used to fly observers to the sampling points. Two observers are dropped off at the sampling points for seven minutes to document all the singing male sparrows they hear and estimate the distance of the birds from the sampling point (see Benscoter et al 2021 and references within). Since the sampling plots represent 12.5 percent, or 1/8 of the total area, the number of singing males is multiplied by 16, assuming that there is a female with each singing male, all males in an area are detected and uniformly distributed, and there are sparrows throughout the habitat. This information is then added over all the survey plots to calculate an annual estimate (Kushlan and Bass 1983).

2) Localized demographic surveys (site specific on-the-ground surveys) – These surveys, which began at varying times (between 1994 and 2021) and frequencies in different subpopulations, are used to collect data about sex ratios, nesting success, and occupancy. Researchers have established permanent monitoring plots (demographic study areas) for these types of surveys over several years and return to these areas regularly to band individuals and monitor nest success (see La Puma et al. 2007, Boulton et al. 2009, Virzi et al. 2009, Virzi and Tafoya 2021). Although the permanent monitoring plots represent a very small proportion of the sparrow habitat, the

information collected is more comprehensive than the information collected during helicopter (point-count) surveys.

There are limitations and interannual variations in level of effort for both methods described above, depending upon factors like climatic conditions and resource availability. For example, the helicopter surveys are dependent on available helicopter time and weather conditions needed to ensure safe flights and allow researchers to hear male sparrows calling. Likewise, with the demographic surveys, helicopter support and antecedent weather conditions, among other factors, affect the frequency and duration of researcher visits to the study plots as well as banding and nest detections. Both survey types require low wind conditions early in the morning. In 1999 and 2000, duplicate full helicopter surveys were conducted while in other years some subpopulations were not surveyed at all (Appendix A). In addition, for the first time since 1992, there were no helicopter surveys in 2020 due to the COVID-19 pandemic but were resumed in 2021.

Both methods have historically been used to provide estimates of species and subpopulation status, but we recognize that these have limitations in assessing population stability or detecting population trends, especially increases over small spatial or temporal scales because the assumptions underlying the methods may not sufficiently account for variation in the data used for the population estimates (Benscoter et al. 2021). As an example, skewed sex ratios as seen in CSSS with males outnumbering females, common in small populations, can greatly overestimate effective population size (Virzi et al. 2016). Several investigators have recommended improvements to the range-wide surveys to account for variance in population estimates, which could better assess true population trends (Benscoter et al. 2021 and references therein). Although we acknowledge that there can be improvements, the current and past methodology provides us with a repeatable assessment of the species status which is presented below.

1. **Does the species have a final, approved recovery plan containing objective, measurable criteria?**

   No. Although the species has a final approved recovery plan (Service 1999), the 1999 Recovery Plan did not include recovery (i.e., delisting) criteria for the CSSS; it only outlined criteria for reclassifying the CSSS from endangered to threatened. Accordingly, in August 2019, a Draft Amendment to the Recovery Plan (Service 2019), which included recovery criteria, was noticed in the Federal Register (84 FR 38284) and released for public comment. Tribal consultation on the 2019 Draft Amendment to the Recovery Plan is ongoing. Therefore, since the Draft Amendment has not been finalized, the draft recovery criteria will not be discussed further in this review.

**2. List the recovery criteria as they appear in the recovery plan and discuss how each criterion has or has not been met, citing information.**

The criteria included in the approved recovery plan (Service 1999) to reclassify the CSSS from endangered to threatened are broken down into seven criteria (1-7 italicized and in bold below). These criteria address listing factors A) the present or threatened destruction, modification, or curtailment of its habitat or range; C) disease and predation; D) inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors affecting its survival. Factor B (overutilization for commercial, recreational, scientific, or educational purposes) is not believed to be a current threat to this subspecies.

***The CSSS may be reclassified from endangered to threatened when:***

***1) The loss of functional Cape Sable seaside sparrow habitat, as a result of current and past water management practices, and the invasion of woody and exotic plant species, is eliminated;***

This criterion has not been met because the loss of functional CSSS habitat continues (i.e., marl prairie that CSSS rely on for survival), primarily caused by incompatible water management practices and woody plant encroachment. The pre-drainage (before the 1950's) range of marl prairie habitat naturally shifted within the Everglades in response to natural flooding, drying, and fire intervals. However, human-induced hydrologic alterations across the landscape resulting from the Central and South Florida (C&SF) Project[1] begun in the 1950s, which has disrupted these natural processes and currently restricts the range and suitability of marl prairie habitat throughout the range of CSSS. Most of the pre-drainage flow followed a path of deepest sloughs from what is now central Water Conservation Area (WCA)-3A through WCA-3B and into Northeast Shark River Slough (NESRS) of Everglades National Park (ENP). The installation of levees and associated borrow canals resulted in the current condition where eastern marl prairie habitats have become too dry and susceptible to woody vegetation encroachment and frequent wildfires. These modifications have resulted in the western marl prairie becoming too wet allowing a majority of the habitat there to be converted to sawgrass dominant which is not suitable for sparrows.

Incremental structural changes to the east side of Tamiami Trail were made between 2013 and 2019. These included a 1-mile bridge, 2.6-mile bridge and installation of 5-miles of seepage barrier along the L-31N canal to prepare for operational changes that would help restore water flow to northeast Shark Slough. Until 2020, there had not

[1] In response to years of drought followed by catastrophic flooding, the Central and Southern Florida Project was initiated through legislation passed by Congress in 1948. This project resulted in historical changes to the Florida's hydrology in central and south Florida via a series of canals, levees, water retention areas, pump stations, and water control structures (https://www.sfwmd.gov/who-we-are/history).

been an updated operational plan to make use of the new infrastructure. Starting in 2010, the Everglades Restoration Transition Plan (ERTP) was the Water Control Plan of record until the Combined Operational Plan (COP), was implemented in late 2020. System-wide extreme high-water levels during the first wet season following the implementation of COP in 2020 resulted in an Emergency Deviation from the plan. Emergency Deviations allow water managers to circumvent the normally defined rules of operation to alleviate emergency high-water conditions. The most recent deviation ended on January 31, 2021, after which, operations returned to the recently implemented COP Water Control Plan. The emergency deviation lasted until January 31st and resulted in a late start to the nesting season in all of the subpopulations. On March 1st, 2021, CSSS-Ax had only 10.2 percent of the 40 percent target dry habitat. CSSS-B through F had 28.7, 0.8, 1.6, 0.0 and 3.3 percent respectively. By March 31st, all except CSSS-E had reached the target available nesting habitat. While we are unsure the impact this had on 2021 breeding success, CSSS-D, according to demographic surveys was able to have another successful breeding year and the nesting season for all subpopulations was extended through July (delayed start of rainy season) providing the minimum 90-day nesting window in every subpopulation except CSSS-E.

The range of CSSS remains tied to the range of marl prairie habitat, which historically shifted within the Everglades in response to distinct flooding, drying, and fire intervals. Water management within the Everglades continues to restrict the range and suitability of this habitat, and there had not been any major operational changes to water management for CSSS since the 2010 species status review until the COP was initiated in 2020. The water management regime that has been in place since then is the ERTP. As described above, due to extremely high rainfall and water levels across the landscape, the system was operated under an Emergency Deviation, which caused a majority of sparrow habitat to be inundated past the March 1st beginning of nesting season. If the March 1st start of the nesting season is missed and this delay results in less than 90 dry days for sparrows to successfully fledge two broods in consecutive years, then the likelihood of increasing the population size is reduced.

The Service has consulted with the U.S. Army Corps of Engineers (Corps) related to the operations of water management structures since the mid-1980s. All projects maintained the seasonal closures of specific structures (e.g., structures S-12 A and B, S-344, and S-343 A and B) for the protection of CSSS habitat. These closures have been occurring since 2002 to conserve habitat because the C&SF Project of the 1950s redirected flow from SRS to the west in the direction of CSSS-A, thus making it too wet to support CSSS habitat. The S-12 closures were designed as temporary emergency actions starting in 2000 and continued with the completion of the Modified Water Deliveries (MWD) Project and authorization of COP in 2020. The closures were not meant to increase the population size in CSSS-A, rather, they were meant to keep the sparrow extant on the landscape until flow could be restored to its natural flow path in NESRS (Corps 1999). This intended purpose has not changed and was included in the ERTP 2010, ERTP 2016, and COP consultations. While closures of these structures may have helped, to a degree (e.g., although helicopter surveys in 2019 indicated no sparrows, an intensive study on selected study plots indicated four adults in 2019 and four adult and two juvenile sparrows in 2020 indicating a potential small population may remain in CSSS-A [Benscoter et al. 2021]), hydrologic conditions have remained too wet on the west side of SRS with consistent average annual hydroperiods in the 270-day range which promote vegetation that lacks structure for nesting and foraging. As shown by low population numbers in recent years, until the appropriate hydroperiod and marl prairie habitat are restored in CSSS-A, the viability of this subpopulation is uncertain.

In the fall of 2020, the Corps began implementing the COP, which governs the water management operations for the Water Conservation Areas and ENP. This includes structures in the L-31N and C-111 basins constructed as part of the C&SF Project and the recently constructed components of the MWD and C-111 South Dade (SD) Projects. The COP is intended to advance Everglades restoration initiatives which include conservation and recovery of federally-listed species, as well as all natural resources, by redistributing the existing WCA-3A and ENP water budget while remaining consistent with the original purposes of the C&SF Project. The original purposes were to provide flood control; water supply for agricultural irrigation, municipalities and industry, and ENP; regional groundwater control and prevention of saltwater intrusion; enhancement of fish and wildlife; and recreation.

Since the last 5-year review in 2010, consistently suitable hydrologic conditions for the CSSS habitat have only been present in subpopulations B and E (see Figure 1 for subpopulation locations). For other subpopulations, there are signs of altered hydrology and negative impacts to CSSS habitats. For example, in 2015 Sah et al. (2015) noted a transition away from the desired marl prairie habitat towards less optimal wetter prairie and marsh vegetation types due to excessive hydroperiods for subpopulations A and D. Conversely, habitats supporting subpopulations C and F located on the eastern side of ENP have exhibited woody vegetation encroachment and are more prone to fire due to shorter hydroperiods. Vegetation species composition can shift as a result of hydrologic alterations in as little as 3 to 4 years resulting in quicker shifts away from suitable habitat; it takes longer to shift from unsuitable more hydric marsh conditions to more suitable wet prairie conditions (Armentano et al. 2006; Benscoter et al. 2021). Since the COP was implemented in 2020, we expect that habitat conditions for CSSS will continue to shift in each of the subpopulations as flows continue to change. Once hydrology is restored fully to historic flow paths, the change is expected to improve general habitat conditions for CSSS in subpopulations A and F, but result in parts of E, D, and C becoming wetter than optimal.

***2) Cape Sable seaside sparrow habitat west of Shark River Slough and in Taylor Slough, which has been degraded by current and past water management practices, is restored;***

This criterion has not been met. Habitat west of Shark River Slough (SRS) and adjacent to Taylor Slough has not been restored. Recent vegetation monitoring in northern CSSS-A indicates a drying trend and increases in percent muhly grass cover in some sampling locations (Sah et al. 2020). This is a positive reversal of conditions in the 1990s and early 2000s which were too wet and resulted in vegetation transitioning to wetter conditions unsuitable for sparrows. However, it is still unclear to what point the habitat must recover to once again support a large number of sparrows. Recent modeling by USGS (Haider et al. 2021) shows very low probability of presence across the vast majority of the western marl prairie. It is thought that COP will continue improving the hydrology in the northern regions of CSSS-A.

In sparrow habitat east of Taylor Slough (CSSS-D) the C-111 Spreader Canal project was implemented in 2010 (Service 2009) to help retain water in Taylor Slough. While this project was not designed to benefit sparrows, several management actions to benefit sparrows were defined in the Biological Opinion (BO) and carried out by the South Florida Water Management District. Specific actions conducted over the ten years include exotic vegetation removal, remnant Aerojet canal gapping/plugging, prescribed fire, and demographic monitoring. It is possible, but still unclear, that these actions contributed to the recent increase in successful sparrow nesting in this area. Though recent increases in CSSS-D have been documented, Virzi and Tafoya (2021) and Sah et al. (2020) have not seen a transition to dryer, more suitable habitat outside of the core nesting area. Outside of a small core nesting area within CSSS-D, the vegetation community has shifted to a sawgrass marsh community, which is unsuitable to successful CSSS breeding (Haider et al. 2021, Benscoter et al. 2021). Therefore, continued monitoring and research is needed to determine if this recent increased nesting is sustainable.

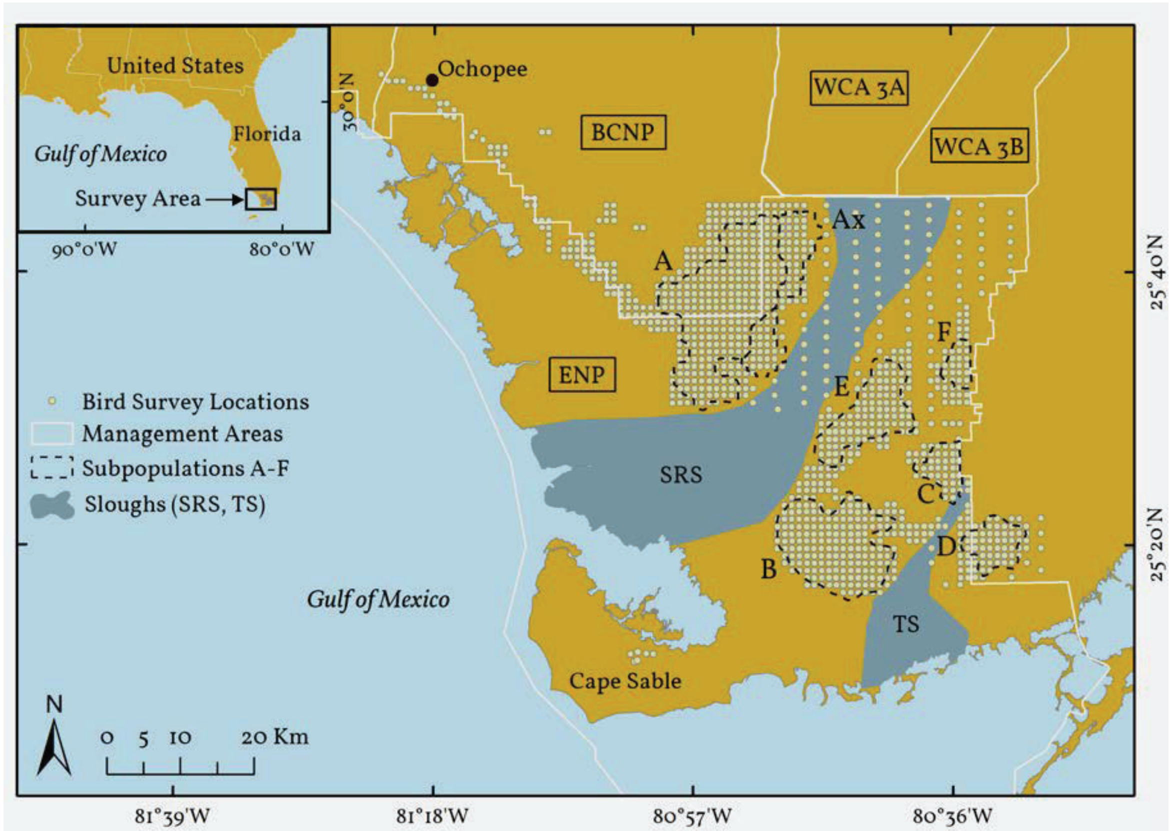


Figure 1. Cape Sable seaside sparrow subpopulation (designated as A-F) locations in south Florida (source: Figure 1 from Benscoter et al. 2021). Subpopulation A is located west of Shark River Slough (SRS); subpopulations B through F are located east of SRS.

***3) Demographic information on the Cape Sable seaside sparrow supports, for a minimum of 5 years, a probability of persistence [T(N)] that is equal to or greater than 80 percent (±0.05), for a minimum of 100 years;***

We likely have sufficient demographic information to calculate a probability of persistence; however, no one has conducted a population viability analysis yet to determine whether the probability of persistence stated in this criterion has been met. However, a risk analysis performed by Pimm and Bass (2002) suggested that CSSS can persist with at least three viable subpopulations, including one west of Shark River Slough (CSSS-A), and suitable dry season nesting conditions during the breeding season (Benscoter et al. 2021). Currently population numbers in CSSS-A (the only subpopulation west of Shark River Slough) have been very low and is considered at risk of extirpation (see details below), and we do not believe that subpopulation would be considered viable at this time (Benscoter et al. 2021; see below and Appendix A).

***4) The rate of increase (r) for the total population is equal to or greater than 0.0 as a 3-year running average for at least 10 years;***

*Note: An r greater than 0.0 indicates an increasing population, and an r less than 0.0 indicates a declining population.*

Based on estimates of the total population size for each year, the 3-year running average of the intrinsic rate of increase (*r*) over the period from 2004 to 2019 was calculated (Figure 2; Appendix A). From 2010-2019, the 3-year running average of *r* has been less than 0.0 in 7 years and greater than 0.0 in 3 years. This is consistent with the observation that the total sparrow population size has slowly declined over the past decade and has fluctuated over time. Therefore, this criterion has not been met.

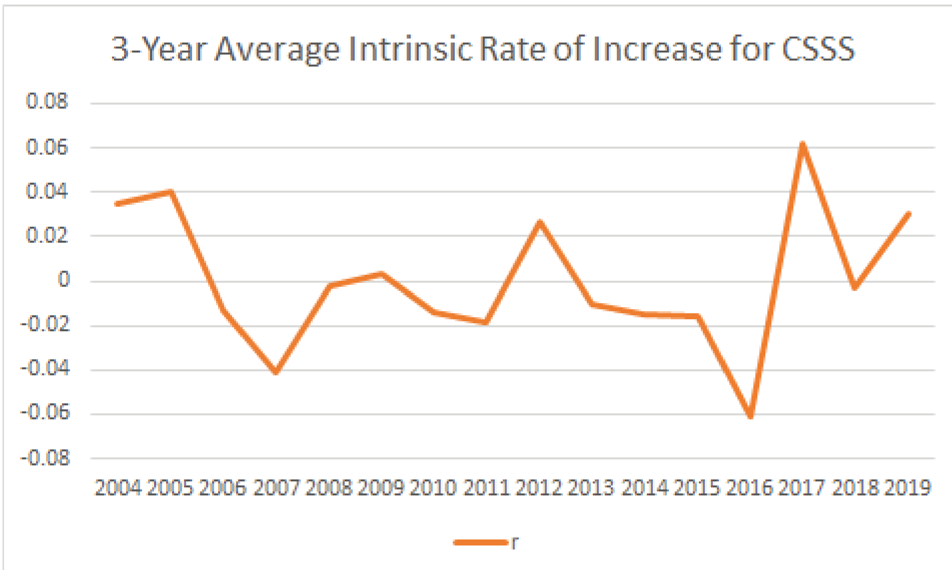


Figure 2. 3-year average intrinsic rate of increase (*r*) for CSSS from 2004 to 2019.

***5) A minimum of three stable, self-sustaining core breeding areas are secured;***

The three subpopulations considered as "core" for this criterion are A, B, and E (Walters et al. 2000; Slater et al. 2009).

Subpopulation A. Since the 2010 5-year review, the population estimate for subpopulation A has declined drastically. In 2013, subpopulation A reached an estimated 288 birds, but by 2017, the estimated population had dropped to only 16 individuals. Following Hurricane Irma in 2017, only 32 birds were estimated there in 2018 and zero were estimated in 2019 (Appendix A). No range-wide helicopter surveys were conducted in 2020, therefore no population estimates are available for that year. Localized demographic surveys have been conducted by field crews in recent years. These demographic surveys cover a very small percentage of the area of CSSS-A. The demographic surveys detected four sparrows in subpopulation A during the 2018 nesting season (Virzi and Tafoya 2021), and four adults and two juvenile sparrows, were observed in 2019 (Virzi and Tafoya 2019). In 2020, the field crew was only able to make two visits CSSS-A, but during those visits, three adult males, one adult female, and a small number of free-flying juveniles were observed (Virzi 2021). Though very few birds have been detected in CSSS-A in recent years, successful breeding has been recorded annually since 2008, except for 2021 where though at least one nest attempt was recorded, no evidence of successful breeding could be confirmed (Virzi and Tafoya 2021).

Subpopulations B and E. The population estimates for subpopulations B and E have remained relatively stable compared to the other subpopulations since the 2010 5-year review (Appendix A), though the estimates for subpopulation E have fluctuated more during that time than the estimates for subpopulation B, and both populations have declined overall. Subpopulation B continues to be the largest subpopulation, but study plots monitored from 2017-2020 revealed a highly male-biased subpopulation with a decreasing trend of breeding birds, though fledging rates were high (Virzi and Tafoya 2021).

The proximity of subpopulation E area to SRS will make the habitats in CSSS-E and the sparrows that they support vulnerable to hydrologic effects during restoration activities that rehydrate SRS (Benscoter et al. 2021). The western portions of the area may become too deeply inundated at higher frequencies to provide suitable habitat for sparrows under some conditions such as what occurred during the 2016 and 2020 nesting seasons. Large-scale hydrologic modifications, such as those proposed under the COP and future Comprehensive Everglades Restoration Plan (CERP), have the potential to influence habitat conditions in this area, and may require special management attention.

With the continued decline of CSSS-A to a record low population estimate of zero birds in 2019 based on the helicopter survey and anticipated impacts to CSSS-E, the second largest relatively stable population, from increased flows to SRS, this criterion has not been met.

***6) A stable age structure is achieved in the core populations;***

*Note: this criterion from the 1999 MSRP, refers to core populations, which we now refer to as subpopulations.*

Data are insufficient (i.e., not enough resight data from banding) to determine if a stable age structure has been achieved in the core subpopulations. In addition, since the population estimate for CSSS-A dropped to zero in 2019, we assume a stable age structure has not been achieved there.

***7) A minimum population of 6,600 birds is sustained for an average of 5 years, with all fluctuations occurring above this level.***

The last complete CSSS population survey of all subpopulations (2021) resulted in a population estimate of 2,448 CSSS (Appendix A). The average estimated population size for the 5-year period of 2015-2019 was 2,957 CSSS (Appendix A), which is less than half the minimum population size of 6,600 birds identified in the reclassification criterion. Therefore, this criterion has not been met.

## C. Updated Information and Current Species Status

### 1. Biology and Habitat

Information regarding CSSS biology and habitat can be found within the recovery plan (Service 1999), the critical habitat designation (proposed - 71 FR 63979, Service 2006; final - 72 FR 62736, Service 2007), and the 2010 5-year review (Service 2010). A recent review of the knowledge of CSSS biology, life history, and population information is also available in Benscoter et al. 2021. A summary, with the addition of updated information, is provided below.

#### a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

The overall CSSS population and subpopulation estimates from helicopter surveys discussed below are also shown in tabular and graphical format in Appendices A and B, respectively.

*Overall Population*
Annual CSSS population (helicopter) surveys have resulted in estimates of population size every year since 1992 except for 2020 (Pimm et al. 2002; Appendix A). In 1993, the total CSSS population declined by approximately half from 1992, from an estimated 6,576 individuals to 3,312 individuals. The majority of the decline occurred within subpopulation A, because of flooding that occurred in the area starting in 1993 and continuing through 1995 (Pimm et al. 2002). Since 1993, the total population size has fluctuated, but has remained between 2,416 and 4,048, though significant declines have occurred within several subpopulations (described below). Only two subpopulations, CSSS-B and CSSS-E, have consistently reported estimates of hundreds or thousands of birds (Benscoter et al. 2021). Counts for 2021 based on the range-wide helicopter surveys estimate the total population at 2,448 birds, with the following break down; CSSS-A at 0 birds, CSSS-B at 1,448 birds, CSSS-C at 112 birds, CSSS-D at 288 birds, CSSS-E at 528 birds, and CSSS-F at 32 birds (Appendix A). Although in correspondence with the Miccosukee Tribe in 2020 we discussed stable subpopulations other than subpopulation A, surveys show that some fluctuations appear to have a downward trend. Surveys conducted from 2015

through 2021 show fluctuating subpopulation numbers: appearance of stability or increases in subpopulations C, D, and F, slight declines apparent in subpopulation B and E, and continued low numbers in subpopulation A (Appendix A).

During the 2006 to 2008 nesting seasons, intensive localized ground surveys were conducted in subpopulations C, D, and F to better understand these small subpopulations (Lockwood et al. 2006; Boulton et al. 2009). Data collected in these surveys included territory size, fecundity, nest success and survival rates. Results indicate that the small subpopulations exhibit: 1) suppressed breeding, 2) an excess of single males, 3) nest survival comparable to larger subpopulations, 4) low hatch rate, and 5) larger territory sizes than birds in the larger subpopulations. Boulton et al. (2009) concluded that the small subpopulations are demographically dynamic and subject to the negative effects of low densities (e.g., Allee effects); however, Gilroy et al. (2012) did not find evidence of Allee effects when analyzing CSSS nest survival data (see below in section II.C.1.b.)

*Subpopulation A*

Subpopulation A inhabits the marl prairies west of SRS in ENP and eastern Big Cypress National Preserve (BCNP) (Figure 1). In 1981 and 1992, subpopulation A supported over 40 percent (2,600 sparrows) of the total CSSS population. CSSS-A experienced the most dramatic decline, dropping from more than 2,600 birds in 1992 to 432 birds in 1993, a decrease of 84 percent (Curnutt et al. 1998, Pimm et al. 2002). It is likely that Hurricane Andrew, in August 1992, caused mortality within most subpopulations, but information suggests that Andrew was not the major cause of the overall population decline in CSSS-A (Curnutt et al. 1998, Nott et al. 1998). Hurricane Andrew was followed by several wet years and high discharges of water through water control structures which caused several years of poor conditions for CSSS-A (flooding of CSSS habitat), reducing the sparrow's ability to recover from the impact of the hurricane (Curnutt et al. 1998, Nott et al. 1998, ENP 2005). Since the last 5-year review (Service 2010), CSSS-A averaged 267 birds between 2011 and 2013. The estimate dropped to 64 in 2014 followed by an increase to 208 in 2015. Monitoring revealed subpopulation estimates that declined from 48 in 2016 to a subpopulation estimate of 0 in 2019 (Appendix A). However, localized demographic surveys by field crews indicated the presence of four adult sparrows in 2019 and four adult sparrows in 2020, not including juveniles in both years. One breeding pair and one failed nest was opportunistically observed during the 2021 nesting season (Virzi 2021). Though the one nest documented in 2021 failed, successful breeding has been documented annually since 2008, but the subpopulation has become increasing male biased (Virzi and Tafoya 2021).

*Subpopulation B*

Subpopulation B, inhabiting the marl prairies southeast of SRS near the center of ENP, has remained above an estimated 1,500 individuals over the period of record (Figure 1; Appendix A). When first surveyed in 1981, subpopulation B contained an estimated 2,352 sparrows (35 percent of the total population). Subpopulation B remains one of the most abundant subpopulations, with the estimated size from 1981 to 2019 ranging from 1,536 to 3,184 sparrows. Even though subpopulation B is the largest remaining subpopulation, a general downward trend in the estimated population has been noticed over the period of record. The subpopulation averaged 2,320 birds between 1992 and 2007. However, the average estimated size of subpopulation B since that period has been 1,958 birds. In 2019, subpopulation B reached its lowest estimate on record of 1,536 birds and the subpopulation has become increasingly male biased from 0.58 from 2012-2015, 0.69 in 2017, and 0.89 in 2017 (Virzi and Tafoya 2021). As mentioned above, there is no population estimate for 2020 since there were no helicopter surveys that year. Since subpopulation B has been one of the largest subpopulations, regularly comprising 60 percent or more of the total population, this recent downturn is cause for concern. Thirteen male territories, six pairs (two of the males nested with the same female), and nine nests were documented in 2021 (Virzi 2021).

*Subpopulation C*

In 1981, subpopulation C, located in the vicinity of Taylor Slough and along the eastern boundary of ENP (Figure 1), contained an estimated 432 sparrows (6 percent of the total population). By the 1992 survey, subpopulation C had declined nearly 90 percent, to 48 sparrows. The population has remained very low since 1992, with two years where no sparrows were detected during helicopter surveys (1993 and 1995). Demographic surveys were not being conducted in this area during that time. Prior to ENP fire suppression efforts beginning in 1999, CSSS-C was impacted nearly every year by human-caused fires and overly dry conditions (Benscoter et al. 2021). There were only 48 sparrows estimated in this area in 1996 and 1997, and 80 sparrows estimated in 1998. Between 2007 and 2010, the population declined to an estimated 32 to 48 sparrows. However, since 2010, the sparrow numbers in subpopulation C have increased slightly and has been hovering around an estimated average of 104 sparrows (24 percent of its 1981 estimated population size), with 80 sparrows estimated in the most recent helicopter survey in 2019. As mentioned above, there is no subpopulation estimate for 2020 since there were no helicopter surveys that year. As described above, subpopulation C was estimated to contain 112 individuals (Appendix A). Demographic surveys documented twelve male territories and two nests from two pairs including one multi-brooding pair, were documented in 2021 (Virzi 2021).

*Subpopulation D*

Subpopulation D, just to the southeast of subpopulation C (Figure 1), supported an estimated 400 sparrows in 1981 (approximately 6 percent of the CSSS population), but declined to approximately 96 sparrows in 1993. High water levels likely led to the decrease in population since 1999 (Slater et al. 2009), with 32 sparrows estimated in 2000. No sparrows were detected during helicopter population surveys within CSSS-D in 1995, 2002, 2003, 2004, 2006, and 2007. However, localized demographic surveys performed in 2006 and 2007 each found

2 males and 1 female, indicating that sparrows were still present. Localized demographic surveys in CSSS-D were not performed prior to 2006.

Lockwood et al. (2008) observed that the continued population decline since 1981 had possibly left this subpopulation functionally extirpated. However, more recent information shows that subpopulation D is still extant, and surveys indicate it is increasing in numbers. Surveys from 2008 through 2015 documented a few sparrows in this subpopulation with an estimated population range of 16 to 64, except for 2012 when the estimate increased to 224 sparrows. Recent population estimates in 2018 and 2019 have indicated a significant increase in sparrows with 256 in 2018, the most since 1981, and 176 in 2019 (Virzi et al. 2018, Virzi and Tafoya 2020). Additionally, intensive ground surveys observed and banded 64 fledglings during 2019. As mentioned above, there is no population estimate for 2020 since there were no helicopter surveys that year. The population estimate for 2021 was 288 individuals (Appendix A). Demographic surveys in 2021 included 28 male territories, with at least 21 paired with females, and eighteen nests (12 successful) were documented (Virzi 2021). Evidence suggests that additional sparrows were breeding outside the study plot and more nests were attempted but not monitored (Virzi 2021).

Prior to 2018 and 2019, which saw significant increases in production, intensive ground monitoring activities in this subpopulation indicated that the actual number of birds in this subpopulation may be far fewer than what was being estimated by the helicopter surveys. Subpopulation estimates based on helicopter surveys assume a 1 to 1 male to female ratio, but when birds have been detected during demographic surveys in subpopulation D, the number of males consistently exceeded the number of females (Virzi et al. 2011, Virzi and Davis 2012, Virzi and Davis 2013), though the ratio of males to females has improved (i.e., have become more even) since 2017 (Virzi and Tafoya 2021). Therefore, the helicopter surveys were likely over-estimating subpopulation sizes because there was a strongly biased male to female ratio in subpopulation D prior to 2017. In addition, this area, like subpopulation A, has suffered from persistent high water levels that may have precluded sparrows from nesting in many years (Virzi at al. 2018). Though CSSS-D appears to have recovered somewhat in recent years, an anticipated future trend towards wetter, sawgrass-dominated, marsh-like conditions is expected to decrease the suitable breeding habitat for sparrows (Virzi and Tafoya 2021).

*Subpopulation E*

Subpopulation E, north of subpopulation B and east of SRS (Figure 1), contained over 10 percent of the total population (approximately 672 sparrows) in 1981. Following Hurricane Andrew, subpopulation E declined by about 50 percent to 320 sparrows (Curnutt et al. 1998). However, due to the presence of suitable conditions, this subpopulation has remained above 350 individuals even though it sometimes fluctuates widely from one year to the next. Between 2010 and 2021, the estimated population ranged from 384 to 1,200 sparrows, with the most recent helicopter survey in 2021 estimating a population of 528 sparrows (Appendix A). Hydrologic changes as a result of CERP projects have led to areas of increased hydroperiods and wetter habitat to in the northwest and drier habitat in the southeast, and sparrows appeared to shift their territories toward those drier areas accordingly (Virzi 2021). The 2021 estimated subpopulation size was 528 individuals. In 2021, demographic surveys revealed 57 male territories were documented with many of the males paired (Virzi 2021). Nest monitoring was not conducted in this area in 2021, though juveniles were seen and heard throughout the study area (Virzi 2021).

*Subpopulation F*

Subpopulation F, located between SRS and the western edge of the Atlantic coastal ridge along the eastern boundary of ENP (Figure 1), was the smallest subpopulation in 1981, containing an estimated 112 sparrows or just 2 percent of the total population. Estimates for subpopulation F declined from 1981 to 1992, from 112 sparrows to 32 sparrows. In several years (1993, 1995, 1999, 2000, 2007, 2008, and 2009), no birds were detected during the range-wide helicopter surveys. Only 16 sparrows were estimated for each year from 1996 to 1998, 2002, 2004, 2010, 2013, and 2014. Since 2010 the estimated population has ranged between 16 and 64 sparrows (Appendix A). As mentioned above, there is no population estimate for 2020 since there were no helicopter surveys that year. Surveys for 2021 estimated 32 individuals (Appendix A). Demographic monitoring in subpopulation F was only conducted from 2006-2008.

**b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.):**

Nelson et al. (2000) investigated the relatedness of CSSS to other seaside sparrow subspecies and reported that CSSS are most likely related to those that occur along the Atlantic coast and are less related to Gulf Coast subspecies.

Gilroy et al. (2012) did not find evidence of Allee effects (declines in individual fitness resulting from low population densities) when analyzing CSSS nest survival data. Variations in nest survival across all subpopulations was best explained by environmental variables including seasonal water table depths, timing of nest activity relative to the onset of flooding, and to a lesser extent, the number of days of flooding during the nesting period.

Beaver et al. (in prep) evaluated genetic connectivity across five of the six subpopulations (A-E). Results indicate low haplotype and nuclear diversity across all subpopulations, with evidence of past bottlenecks occurring more than 100 years ago in subpopulations A and B. Subpopulation A had the lowest diversity and highest inbreeding coefficient. Though the estimated census population size for all subpopulations was 3,152 birds in 2018, the effective population size ($N_E$) was 202.4, indicating unique genetic variation could be lost quickly in stochastic events.

## c. Taxonomic classification or changes in nomenclature:

There have been no recent changes to taxonomy or nomenclature (Integrated Taxonomic Information System 2021). However, recent genetic research recommends that the genus *Ammospiza* be reestablished as the clade that includes *maritimus* (Klicka et al. 2014), and the Integrated Taxonomic Information System is in the process of changing the genus to *Ammospiza* for the CSSS (Benscoter et al. 2021). A proposed rule was published in 2022 to make taxonomic revisions to the List which included correcting this taxonomic nomenclature of this species from *Ammodramus maritimus mirabilis* to *Ammospiza maritima mirabilis* (Service 2022). However, a final rule has not been published at this time. This change in the genus does not impact the status of the listed entity or the review in this document. Until the genus change is finalized, we will continue to refer to genus as it is included in the List (i.e., *Ammodramus*).

## d. Spatial distribution, trends in spatial distribution

Approximately 150,000 acres of potential CSSS habitat remains, however, this includes habitat of various quality and intermittent availability due seasonal hydroperiod fluctuations and extent and frequency of fire. The current range of the CSSS is reduced relative to its historical range, and sparrows have been extirpated from two areas of historical occurrence (Cape Sable and the Ochopee area; Kushlan and Bass 1983). Since the early 1990s, the distribution of the total population has remained relatively unchanged (i.e., the general locations of the subpopulations are the same), but as some subpopulations have declined in numbers of CSSS, they now occupy smaller areas within the overall area of potential breeding habitat for each subpopulation. The distributions, particularly within subpopulations A and D, have contracted in conjunction with hydrologic alterations and habitat degradation in these areas. The distribution of larger subpopulations (i.e., B and E) has remained relatively unchanged, and most birds, often over 95 percent of the total population, inhabit these two subpopulations.

Of the six currently occupied subpopulation areas, A, B, and E have historically been considered core subpopulation areas that were potentially capable of supporting relatively large and stable sparrow populations. These areas were identified as important to the persistence of the sparrow (Walters et al. 2000) and could together provide the spatial distribution necessary for the species to persist across its range (Slater et al. 2009). However, the viability of subpopulation A is uncertain because recent population estimates show few birds remain there.

Subpopulations C, D, and F are the smallest in terms of available habitat and number of sparrows (Figure 1; Appendix A). Since monitoring began in 1992, subpopulation C approached extirpation twice (e.g., zero birds detected during helicopter surveys), and subpopulations D and F approached extirpation during six and seven years, respectively (Boulton et al. 2009; Slater et al. 2009;

Appendix A). Localized demographic surveys were not conducted during all (subpopulation C) or some (subpopulations D and F) of those years where no birds were recorded during helicopter surveys, so we cannot say with certainty that no birds were present in those years. However, in some years when helicopter surveys did not find sparrows in subpopulations D and F, demographic surveys were conducted and did detect birds (similar to the situation for subpopulation A in 2019). Conversely, neither the demographic survey nor the helicopter survey detected birds prior to the Mustang Corner Fire, which burned the survey plot and most of the habitat in subpopulation F in May 2008 resulting in lost breeding opportunities during that year (Virzi et al. 2009).

Scientists have been banding CSSS since 1994 with the greatest effort concentrated in the larger subpopulations (B and E). Most birds have shown high site fidelity and only involve short movements (<500m) in the vicinity of where they were originally banded (Benscoter et al. 2021 and references therein). During the period 1994 to 2005, of the approximately 850 banded individuals (Pimm et al. 2002, Lockwood et al. 2007), only four instances of long-range sparrow movement between subpopulations A, B, and E were documented (Lockwood et al. 2007). Since the intensive surveys began in 2006, movements have been documented between five subpopulations. This included two single males from subpopulations D and F that moved to subpopulation C and a male that migrated 31 kilometers (km) (19.3 miles [mi]) from subpopulation F to B (Lockwood et al. 2006, 2007). Virzi et al. (2009) documented long-range movements ranging from 10.7-11.4 km (6.6-7.1 mi).

A consistent trend throughout all survey seasons is that localized distribution within subpopulations changes in response to water levels and habitat conditions, but dispersal among subpopulations is limited (Dean and Morrison 2001; Virzi et al. 2018). Subpopulation A is especially isolated from the other subpopulations and immigration from other larger populations is likely very rare to nonexistent (Slater et al. 2014; Virzi et al. 2018). With very limited dispersal among subpopulations, the subpopulations essentially function independent of each other. This makes the smaller subpopulations especially vulnerable to extirpation from loss of genetic diversity, uneven sex and age distributions, and stochastic events (Pimm and Bass 2002; Slater et al. 2009).

**e. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem):**

Sparrows build their nests 14 cm, on average, above ground surface and often walk along the ground to forage. If water levels rise above ground surface during the nesting season (March through July), breeding is disrupted, and nests and nestlings can drown (Lockwood et al. 2001). Much of the population decline that has occurred since 1993 has resulted from habitat degradation associated with unfavorable hydrologic conditions (Pimm et al. 2002; Beerens and Romañach 2016). Long hydroperiods (greater than 210 days) over several years will change the vegetative character of the habitat from marl prairie to freshwater marsh and eliminate use of this habitat by the sparrow (Pimm et al. 2002; Ross et al. 2006; Sah et al. 2008). Additionally, reduced hydroperiods may result in woody vegetation encroachment and increased risk of fires (Pimm et al. 2002; Ross et al. 2006; Hanan et al. 2009), which also results in degradation of suitable habitat (Pimm et al. 2002). Hydrologic infrastructure and operations have resulted in longer hydroperiods than those that will support CSSS habitat within portions of subpopulations A and D. At the same time, over-drainage of areas along the eastern boundary of ENP adjacent to urban and agricultural areas, in the vicinity of subpopulations C and F, has resulted in shorter hydroperiods than those that will support CSSS habitat.

Within areas where habitat degradation has occurred, efforts to restore appropriate hydroperiods have often not resulted in recovery of vegetation to conditions favorable for CSSS (Nott et al. 1998; Ross et al. 2006). Prolonged hydroperiods tend to quickly shift the vegetation towards unsuitable conditions compared to the length of time it takes to restore the habitat to suitable conditions. Degraded vegetation conditions may require long periods of favorable hydrologic conditions to recover and return to favorable marl prairie (M. S. Ross pers. comm. 2006). There have not been sustained optimal conditions for habitat to shift because good years are punctuated by frequent poor years.

Fires also cause temporary habitat degradation. While marl prairie vegetation normally grows rapidly following fires, CSSS do not consistently occupy or nest within burned areas until 2- to 4-years following fire because the vegetation structure necessary to support breeding is not present immediately post-fire (Lockwood et al. 2005; La Puma et al. 2007). As a result, the effects of frequent fires may result in vegetation that contains a species composition like that which supports CSSS, but that CSSS are not regularly able to occupy. Low surface water levels during the early breeding season may increase the risk or intensity of fires due to low fuel moisture content and frequent lightning strike ignitions (Beckage and Platt 2003), which renders sparrow habitat unsuitable for up to three years and has the potential to kill adult sparrows. Prolonged inundation of habitat post-burn can lengthen the recovery interval of the habitat by as much as seven years (Sah et al. 2008). In August of 2017, a lightning strike caused a wildfire known as the Keyhole Hammock Fire to burn approximately 691 hectares (1,707 acres) occupied by subpopulation B. This led to substantial population declines observed during the 2018 and 2019 survey seasons. CSSS may return to a site three years post-burn, but fire return intervals of 5 to 8 years may be more suitable and support higher sparrow numbers (Benscoter et al. 2019). Two wildfires occurred in ENP during the 2020 nesting season, the Moonfish and Guava fires, burning roughly 56 percent of CSSS-A. A majority of this was on the unoccupied western and southwestern sides of the subpopulation. These fires were followed by extremely high-water levels across much of the landscape which may affect the ability of the area to revegetate as suitable habitat in the near term. It has been noted that it may take longer for the habitat to recover, especially if it is flooded shortly after a fire (Sah et al. 2009).

Beyond hydrologic concerns and stochastic events, loss of CSSS habitat from invasion of mangroves due to sea level rise on the southwest Florida coast into CSSS habitat and from land use changes, i.e., agriculture, east of ENP continues to threaten CSSS recovery (Ogden 2007).

The area occupied by subpopulation A, which had persisted with only a few sparrows in recent years, was hit hardest by Hurricane Irma in 2017. High water levels that winter (2017-2018) also may have contributed to population declines, but we are unaware if there are any long-term changes to suitable habitat as a result of the hurricane and subsequent high-water levels. Still considered important to the overall population viability of the CSSS, Virzi and Tafoya (2020) recommend a combination of translocation and prescribed fire to the recover CSSS-A.

**2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)**

**a. Present or threatened destruction, modification or curtailment of its habitat or range:**

The habitat that CSSS relies on is a short-hydroperiod (90- to 210-day discontinuous) fresh-water marl prairie (Nott et al. 1998). When this habitat becomes too dry it is converted to more woody vegetation and when it is too wet it is converted to taller grasses and sedges. As woody vegetation encroaches, a prescribed or natural fire return interval of 5- to 8-years may be needed to prevent woody encroachment and would be more suitable to support higher sparrow numbers (Benscoter et al. 2019, 2021). Lack of maintaining the appropriate habitat conditions in a highly human-modified landscape is one of the largest threats to this species.

Flooding that occurs because of managed water releases, rainfall, and the combined effects of the two, continues to pose a threat to CSSS reproduction and habitat suitability in many areas occupied by CSSS. Similarly, excessive drainage in some areas of CSSS habitat has resulted in woody vegetation encroachment that reduces suitable habitat and results in increased risk of fires.

Implementation of the COP in 2020, marks the first significant shift in water flow back to its historical flow path (Northeast SRS of ENP), which should generally improve habitat for CSSS. After a few years, the shift in water flow should reduce the hydroperiods on the west side in the vicinity of CSSS-A (thus improving the suitability of this area for CSSS nesting and help maintain appropriate habitat) and rehydrate some of the areas in eastern ENP that have been too dry. The Service expects minor benefits in northern CSSS-A through shortening the average annual hydroperiod, and CSSS-F through increasing the hydroperiod. Modelling for COP indicates that some areas to the northeast and southeast of CSSS-A are expected to experience shortened hydroperiods which may benefit CSSS habitat (Corps 2019). These areas are designated as CSSS-Ax in Figure 1. Model results show that the hydrology may get longer in CSSS-F which would be beneficial since that area is frequently too dry. These changes to hydroperiod will bring the hydroperiod closer to the 90- to 210-day discontinuous hydroperiod that is needed to maintain marl habitat. The Service expects moderate impacts to CSSS-C, D, and E as a result of increased hydroperiod, however, the moderate impacts to these subpopulations should only result in shifts of suitable habitat locations within those areas, not a net loss of suitable habitat (Service 2020). Overall, the Service believes that COP and future (CERP) projects will give the sparrow the best chance for survival and possible recovery, as well as benefiting other listed species in the Greater Everglades.

Overall, current ecological and hydrologic models appear to indicate that the COP and future CERP projects will likely have a net benefit to CSSS habitat. However, there also appear to be impacts to some areas within CSSS habitat due to these projects. The Service is optimistic that the benefits will offset the impacts over time, and the improved habitat is expected to contribute to increased resiliency of CSSS subpopulations. Restoration of CSSS habitat related to COP and other management activities is expected to be slow and CSSS subpopulation recovery may lag habitat improvements because of the very specific habitat needs and biological limitations of the species. The CSSS has shown large variability in year-to-year numbers and some subpopulations (e.g., CSSS-A, CSSS-C, CSSS-D, and CSSS-F) are still at risk of extirpation before restoration successes might be realized.

Because CSSS and their habitat currently occur on public lands, the direct threat that development-related impacts pose to the CSSS population is not currently considered significant. However, development and maintenance of canals, levees, water detention areas, and other infrastructure may continue to impact small areas of potential CSSS habitat. Additional impacts are expected to CSSS habitat related to climate change and are addressed in section 2.e., below.

**b. Overutilization for commercial, recreational, scientific, or educational purposes:**

This is not currently considered a threat to this species.

**c. Disease or predation:**

Predation is one of the most common causes of nest failure and may affect more than half, and up to 97 percent, of all CSSS nests (Lockwood et al. 1997; Baiser et al. 2008). Predation events occur throughout the day and night (Boulton et al. 2009); snakes, rice rats (*Oryzomys palustris*), raptors, and other predators have been identified as nest predators (Ogden 1972; Dean and Morrison 2001; Pimm et al. 2002; Lockwood et al. 2006). The risk of nest depredation is related to hydrologic conditions, and as water levels rise, nest losses to predators increase (Lockwood et al. 1997). Although CSSS evolved with much of the above-listed predation, the rarity of CSSS makes any predation event significant to the species and becomes especially problematic if a predation event involves death or injury of a breeding adult or prevents another nesting attempt that season.

Predator exclosure fences have been tested to reduce nest predation events. Following several trials, this management technique's effectiveness could not be determined, it required significant setup time (requiring 6 to 8 days to fully enclose one nest), and most females were not tolerant of the added structure and would not return to the nest (Boulton et al. 2009). Therefore, this method of nest protection was abandoned. More recent efforts to monitor CSSS nests have utilized iButton® thermal dataloggers and trail cameras to detect when nests fail and by what predator. To date, these have been inconclusive.

Non-native animals such as the Burmese python (*Python molurus bivittatus)* have become established in southern Florida, and this species is now breeding and expanding its range in the greater Everglades ecosystem. Their population numbers are now estimated to be in the thousands in ENP, potentially impacting a wide variety of listed and native species (Dorcas et al. 2012), and likely includes impacts to CSSS. The pythons' rapid and widespread invasion is facilitated by aspects of their natural history such as diverse habitat use, broad dietary preferences, long lifespan (15 to 25 years), high reproductive output, and ability to move long distances. Although CSSS have not been documented to have been predated upon by pythons, other bird species have been found in the digestive tracts of Burmese pythons, including pied-billed grebe (*Podilymbus podiceps*), limpkin (*Aramus guarauna*), white ibis (*Eudocimus albus*), American coot (*Fulica americana*), house wren (*Troglodytes aedon)*, domestic goose (*Anser sp.),* and a juvenile wood stork *(Mycteria americana).* There is documented overlap of CSSS subpopulations and python-occupied areas in ENP. Pythons may represent an increased threat of predation of CSSS nests and adults, but relative risk of python predation on sparrows is unknown at this time.

Non-native large lizards such as Argentine black and white tegus (*Salvator merianae*) have also established populations in south Florida and are expanding their distribution. These large lizards were introduced through the pet trade and are a threat to native wildlife, but most concerning is their preference for reptile and bird eggs. Tegus are likely to eat the eggs and young of ground-nesting birds and turtles and could impact threatened and endangered species like CSSS.

There is no information available about specific threats of disease to CSSS.

**d. Inadequacy of existing regulatory mechanisms:**

Because CSSS occurs entirely on publicly owned lands that are managed primarily for conservation purposes by federal and state agencies, there are many regulatory mechanisms available to provide protection to CSSS. Hydrologic management actions that affect all areas occupied by CSSS, including hydrologic restoration projects, require Corps' permits, and consequently require review and consultation, as appropriate, under the Act and the Migratory Bird Treaty Act. The CERP contains more than 60 individual hydrologic restoration projects and was authorized by the Water Resources Development Act of 2000. While much progress has been made, it has been slow, and we are now on the cusp of implementing projects within the interior of the Greater Everglades ecosystem which should begin providing the greatest amount of benefit to natural resources. Guidelines and conservation measures are in place to avoid and minimize impacts to CSSS on Federal and State-owned lands. Annual interagency meetings are held to discuss topics such as fire strategies, recent research, and information gaps. Several interagency teams have been developed to provide recommendations for hydrologic operations affecting CSSS during the transition to the completion of the CERP and provide guidance on ongoing hydrologic issues.

The FWC lists CSSS as Federally-designated endangered on the Florida Endangered and Threatened Species List (Rule 68A-27, Florida Administrative Code). This legislation prohibits take, except under a permit, but does not provide any direct habitat protection. Wildlife habitat is protected on FWC wildlife management areas and wildlife environmental areas according to Florida Administrative Code 68A-15.004.

Existing regulatory mechanisms provide a framework for agencies to actively address the conservation needs of the CSSS. There has been, and continues to be, extensive, proactive, detailed, and robust coordination between state and federal agencies. Ongoing coordination is essential due to the complexity of the ecological, biological, and hydrological issues, coupled with individual agency's mandates and constraints, which result in this factor being a significant challenge to management of the Everglades ecosystem.

**e. Other natural or manmade factors affecting its continued existence:**

Several other factors also impact the CSSS and contribute to its current status. These factors are described below.

*Small population size*

Threats resulting from a limited distribution and small population size are relevant to CSSS. The small size of subpopulations A, C, D, and F result in reduced resiliency and reduced ability to withstand unfavorable conditions that occur within the scope of natural environmental variability. These subpopulations may consequently be at higher risk of extirpation. This is demonstrated by the frequent decreases in population counts in these subpopulations, frequently going to zero in several years. The limited distribution of the total population also makes it subject to impacts from catastrophic events such as severe weather events (e.g., hurricanes, see below) or disease outbreaks. The limited dispersal of individuals may also reduce chances of recovery or quick recolonization after an extirpation event. Because the three smallest subpopulations (A, C, and F) also occur at the perimeter of the current species' range, extirpation of any of these small subpopulations would result in a further reduction in the species' range.

*Contaminants*

Environmental contaminants, specifically methylmercury, could present a threat to CSSS. "Hot spots" have been identified within ENP (Rumbold et al. 2008), and elevated methylmercury levels have been documented in CSSS feather and egg samples (Krabbenhoft 2009). More recently, Virzi et al. (2018) reported preliminary results of their study measuring methylmercury concentrations in CSSS tissue samples collected from 2016-2017. Researchers collected breast feather samples, a less invasive sampling technique than drawing blood, from 128 sparrows in 5 subpopulations, A, B, C, D and E. Mainly adult males were sampled as they are more easily caught, however, female and free roaming juvenile sparrow samples were also collected. Reported methylmercury concentrations were highest in the eastern subpopulations, where known methylmercury hotspots have previously been identified. The other subpopulations, located further west in the Everglades, reported lower concentrations of mercury. Virzi et al. (2018) and other researchers such as Jackson et al. (2011) concluded that these levels are high enough to cause sublethal impacts to reproductive success (e.g., abnormal incubation behavior, embryo mortality, suppressed "begging" cues from nestlings). In general, those birds showing the lowest concentrations of methylmercury had the highest reproductive success (Virzi et al. 2018). However, the sparrow with the highest concentration of methylmercury in the study successfully fledged three young in a single nest.

*Hurricanes and Fire*

Surveys following Hurricane Irma and the Keyhole Hammock Fire indicate that natural disasters pose a serious threat to the continued existence of CSSS. Fire and flood regimes have a significant influence on marl prairie structure and composition; thus, water management decisions, fire management decisions, and hurricanes, can affect the suitability of marl prairie habitat for CSSS.

*Climate Change and Sea Level Rise*

Climate change and sea level rise (SLR) represent significant short- and long-term threats to CSSS and their habitat (Miller and Traxler 2018). In south Florida, climate predictions include increases in mean and extreme precipitation, increase in pluvial flooding (i.e., flooding expected to exceed natural and engineered drainage systems), increases in extremes of tropical cyclones and severe storms, and increases in mean and extreme temperatures (Intergovernmental Panel on Climate Change (IPCC) 2021). Although the magnitude of the CSSS response to these changes is uncertain, all of these changes have the potential to negatively impact the viability and habitat of CSSS, primarily through increases in flooding events and direct loss of individuals during hurricanes (see Benscoter et al. 2019 for additional discussion).

Sea level rise has been estimated by various sources to potentially increase by as much as 12 to 48 inches by the end of the century (Rahmstorf 2007; Pfeffer et al. 2008; Walsh et al. 2014). Because the entire population of CSSS occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and SLR over the next several decades. Recent analyses by Romañach et al. (2023) support this assumption that with increasing sea level rise the probability of CSSS presence will decline due to reduced habitat availability.

Modeling scenarios provided by the Corps for South Florida at the +1, +2, and +3 ft above mean higher high water (MHHW) levels indicate that subpopulations A, B, and D are particularly vulnerable, even in the lower end of these scenarios (Service 2016a). This modelling is also supported by work by Romañach et al. (2023), showing potential loss of subpopulation D and drastic reduction in probability of presence in subpopulation B at the highest SLR model (+0.73m / +2.4 ft model). The baseline model scenario indicates that these areas may already be experiencing detrimental habitat effects due to SLR. Based on the Corps' model projections, a SLR of only 1-foot MHHW could result in a loss in area of approximately 40 percent of subpopulation A and 60 percent of subpopulations B and D. If sea levels were to rise 2-feet MHHW, it could result in a loss of almost 60 percent of subpopulation A and nearly 100 percent of subpopulations B and D. In the long term, all subpopulations could potentially experience major flooding effects, and if the CSSS is to be conserved as a species, accommodations for expanded habitat or relocation of individuals will need to be considered.

## D. Synthesis

Cape Sable seaside sparrow is a secretive subspecies of seaside sparrow native to periodically flooded and burned marl prairie of southern Florida. Habitat destruction and modification, predation, and other factors like small population sizes, skewed sex ratios, contaminants, and climate change continue to impact the species. South Florida's ecosystems have been severely degraded by hydrologic manipulations by humans, which have disrupted the natural volume, timing, quality, and flow of surface and ground water throughout the Everglades. The CSSS short hydroperiod prairie habitat is contained entirely within this impacted area and has been extensively altered (Nott et al. 1998), with too much water in the western habitats, interrupting breeding and changing vegetation; and too little water in the eastern habitats, allowing invasion of trees into the prairie habitat and allowing frequent, damaging fires. Recent studies within the six subpopulation areas (A through F) have documented such changes in vegetation that reflect a shift from short-hydroperiod prairie habitats suitable for CSSS to conditions that are less suitable (either too dry or too wet) for CSSS in several areas (Sah et al. 2020). These conditions are expected to continue into the near future for all populations.

Three of the six subpopulations, A, B, and E were considered core breeding areas potentially capable of supporting relatively large and stable subpopulations in 1999. The number of CSSS in subpopulation A decreased by 84 percent from 1992 to 1993, a decline from over 2,600 birds to just over 400 birds (Pimm et al. 2002) and the estimated population has remained low since that time, reaching zero in 2019 and again in 2021 Subpopulations B and E have maintained the highest numbers of the subpopulations over time, however, subpopulation E has roughly half the number of sparrows that subpopulation B has. In addition, subpopulation B has been showing signs of decline in the last few years and will likely be one of the first subpopulations (in addition to subpopulation D) impacted by sea level rise.

Although Everglades restoration projects are currently being planned that may improve hydrologic conditions for CSSS, the species continues to meet the definition of endangered under the Act, because a variety of threats affecting CSSS and its habitat remain, the level of threats have not been reduced appreciably, and subpopulation numbers appear to be declining or at consistently low levels in the majority of the subpopulations making them vulnerable to extinction.

## III. RESULTS

### A. Recommended Classification

__X__ **No change is needed**

## IV. RECOMMENDATIONS FOR FUTURE ACTIVITIES

- Planning is ongoing for CERP and other restoration projects. Planning and restoration efforts balance a variety of objectives and constraints, some of which may affect the timing or magnitude of the benefits of these actions with regards to CSSS. However, every effort should be made to ensure that restoration plans are consistent with the recovery objectives for CSSS, including water management plans that provide suitable conditions for CSSS to breed within the three core subpopulations (CSSS-A, CSSS-B, and CSSS-E) and provide conditions that allow for habitat restoration in degraded areas. Restoring appropriate hydrological conditions to subpopulation A should be a priority. This area contains the largest amount of potential sparrow habitat and may have supported more CSSS than any other subpopulation prior to 1981 (Slater et al. 2009).

- Near-term implementation of the MWD to Everglades National Park Project and the associated COP should also be consistent with CSSS recovery objectives and aid in improving habitat conditions to allow population recovery. The Service will continue to serve as an active participant in the multi-agency planning efforts for CERP, MWD, and other restoration efforts.

- Habitat management and enhancement activities, such as prescribed fire and woody vegetation removal, should be conducted where appropriate in all subpopulations to increase the amount of suitable breeding habitat.

- Consistent and intensive population monitoring and research related to habitat management and restoration should continue.

- Efforts should be made to maintain and enhance habitat within each subpopulation to improve the potential for dispersal between subpopulations so that genetic diversity can be maintained without the need for captive breeding, translocation, or other artificial genetic augmentation. However, possible translocation projects and genetics research should be considered as translocation may ultimately be the only way to achieve genetic movement between subpopulations.

- Consolidate and evaluate the best available scientific information in a Species Status Assessment (SSA) Report (Service 2016b), which includes in-depth evaluation of the species' needs, current condition, and future condition (using threats-based scenarios) to help inform future management actions. Consider developing a Population Viability Analysis to incorporate into an SSA Report.

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**U.S. FISH AND WILDLIFE SERVICE**
**5-YEAR REVIEW of Cape Sable Seaside Sparrow**

**VI. SIGNATURES / APPROVALS**

On the basis of this review, we recommend the following status for this species. A 5-year review presents a recommendation of the species status. Any change to the status requires a separate rulemaking process that includes public review and comment, as defined in the Act.

- ____ Downlist to Threatened
- ____ Uplist to Endangered
- ____ Delist:
  - ____ The species is extinct
  - ____ The species does not meet the definition of an endangered or threatened species
  - ____ The listed entity does not meet the statutory definition of a species
- __X_ No change needed

**Review Conducted By:** Seth Bordelon, Mary Peterson, Kevin Palmer

**FIELD OFFICE APPROVAL**

**Division Manager, Florida Classification and Recovery, Florida Ecological Services Field Office, Fish and Wildlife Service**

Approve LOURDES MENA  Digitally signed by LOURDES MENA Date: 2023.06.02 12:22:11 -04'00' Adobe Acrobat version: 2023.001.20174
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**LEAD REGIONAL OFFICE APPROVAL:**
**Assistant Regional Director – Ecological Services, U.S. Fish and Wildlife Service**

Approve CATHERINE PHILLIPS CZARNECKI  Digitally signed by CATHERINE PHILLIPS CZARNECKI Date: 2023.06.02 11:29:56 -04'00'
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**Appendix A**

Cape Sable seaside sparrow population estimates by year and subpopulation (A through F). Headers identified as BC denotes the base count identified during helicopter surveys, and Est denotes the subpopulation estimates (see Section II.B. for details on subpopulation estimates). Cells with NS denotes that the area was not surveyed. No systematic helicopter surveys were not conducted in 2020 (ENP, unpublished data 2021).

| Subpopulation | A | A | B | B | C | C | D | D | E | E | F | F | Species Total | Species Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Count** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** |
| **1981** | 168 | 2,688 | 147 | 2,352 | 27 | 432 | 25 | 400 | 42 | 672 | 7 | 112 | 416 | 6,656 |
| **1992** | 163 | 2,608 | 199 | 3,184 | 3 | 48 | 7 | 112 | 37 | 592 | 2 | 32 | 411 | 6,576 |
| **1993** | 27 | 432 | 154 | 2,464 | 0 | 0 | 6 | 96 | 20 | 320 | 0 | 0 | 207 | 3,312 |
| **1994** | 5 | 80 | 139 | 2,224 | NS | NS | NS | NS | 7 | 112 | NS | NS | 151 | 2,416 |
| **1995** | 15 | 240 | 133 | 2,128 | 0 | 0 | 0 | 0 | 22 | 352 | 0 | 0 | 170 | 2,720 |
| **1996** | 24 | 384 | 118 | 1,888 | 3 | 48 | 5 | 80 | 13 | 208 | 1 | 16 | 164 | 2,624 |
| **1997** | 17 | 272 | 177 | 2,832 | 3 | 48 | 3 | 48 | 52 | 832 | 1 | 16 | 253 | 4,048 |
| **1998** | 12 | 192 | 113 | 1,808 | 5 | 80 | 3 | 48 | 57 | 912 | 1 | 16 | 191 | 3,056 |
| **1999a** | 25 | 400 | 128 | 2,048 | 9 | 144 | 11 | 176 | 48 | 768 | 1 | 16 | 222 | 3,552 |
| **1999b** | 12 | 192 | 171 | 2,736 | 4 | 64 | NS | NS | 60 | 960 | 0 | 0 | 247 | 3,952 |
| **2000a** | 28 | 448 | 114 | 1,824 | 7 | 112 | 4 | 64 | 65 | 1,040 | 0 | 0 | 218 | 3,488 |
| **2000b** | 25 | 400 | 153 | 2,448 | 4 | 64 | 1 | 16 | 44 | 704 | 7 | 112 | 234 | 3,744 |
| **2001** | 8 | 128 | 133 | 2,128 | 6 | 96 | 2 | 32 | 53 | 848 | 2 | 32 | 204 | 3,264 |
| **2002** | 6 | 96 | 119 | 1,904 | 7 | 112 | 0 | 0 | 36 | 576 | 1 | 16 | 169 | 2,704 |
| **2003** | 8 | 128 | 148 | 2,368 | 6 | 96 | 0 | 0 | 37 | 592 | 2 | 32 | 201 | 3,216 |
| **2004** | 1 | 16 | 174 | 2,784 | 8 | 128 | 0 | 0 | 40 | 640 | 1 | 16 | 224 | 3,584 |
| **2005** | 5 | 80 | 142 | 2,272 | 5 | 80 | 3 | 48 | 36 | 576 | 2 | 32 | 193 | 3,088 |
| **2006** | 7 | 112 | 130 | 2,080 | 10 | 160 | 0 | 0 | 44 | 704 | 2 | 32 | 193 | 3,088 |
| **2007** | 4 | 64 | 157 | 2,512 | 3 | 48 | 0 | 0 | 35 | 560 | 0 | 0 | 199 | 3,184 |
| **2008** | 7 | 112 | NS | NS | 3 | 48 | 1 | 16 | 23 | 368 | 0 | 0 | 34 | 544 |
| **2009** | 6 | 96 | NS | NS | 3 | 48 | 2 | 32 | 27 | 432 | 0 | 0 | 38 | 608 |
| **2010** | 8 | 128 | 119 | 1,904 | 2 | 32 | 4 | 64 | 57 | 912 | 1 | 16 | 191 | 3,056 |
| **2011** | 11 | 176 | NS | 1,904 | 11 | 176 | 1 | 16 | 37 | 592 | 2 | 32 | 62 | 2,896 |
| **2012** | 21 | 336 | NS | 1,904 | 6 | 96 | 14 | 224 | 46 | 736 | 4 | 64 | 91 | 3,360 |
| **2013** | 18 | 288 | 112 | 1,792 | 8 | 128 | 1 | 16 | 45 | 720 | 1 | 16 | 185 | 2,960 |
| **2014** | 4 | 64 | 114 | 1,864 | 7 | 112 | 2 | 32 | 42 | 672 | 1 | 16 | 170 | 2,760 |
| **2015** | 13 | 208 | 120 | 1,920 | 7 | 112 | 4 | 64 | 55 | 880 | 2 | 32 | 201 | 3,216 |
| **2016** | 3 | 48 | 112 | 1,792 | 7 | 112 | 5 | 80 | 24 | 384 | 0 | 0 | 151 | 2,416 |

| **Subpopulation** | **A** | **A** | **B** | **B** | **C** | **C** | **D** | **D** | **E** | **E** | **F** | **F** | **Species Total** | **Species Total** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Count** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** | **BC** | **Est** |
| **2017** | 1 | 16 | 121 | 1,936 | 3 | 48 | 4 | 64 | 75 | 1,200 | 1 | 16 | 205 | 3,280 |
| **2018** | 2 | 32 | 120 | 1,920 | 9 | 144 | 16 | 256 | 50 | 800 | 2 | 32 | 199 | 3,184 |
| **2019** | 0* | 0 | 96 | 1,536 | 5 | 80 | 11 | 176 | 55 | 880 | 1 | 16 | 168 | 2,688 |
| **2020** | NS* | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS | NS |
| **2021** | 0* | 0 | 93 | 1,488 | 7 | 112 | 18 | 288 | 33 | 528 | 2 | 32 | 153 | 2,448 |

* Although helicopter surveys did not detect any individuals, limited, site-specific demographic surveys in 2019 and 2020 did document a few adult and juvenile birds, and one unsuccessful nest attempt in 2021 (see discussion in II.C.1.a.).

**Appendix B**

Cape Sable seaside sparrow population size estimates (total) and subpopulation (A-F) size estimates for the years 1981-2021. Red line is the Combined Operations Plan re-initiation trigger of an estimated 2,387 individuals. Corresponding data can be found in Appendix A.