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## **Birds of the Savannah Harbor Navigation Project, Dredged Material Disposal Areas, 1994 – 2012**

J. Stevan Calver, Michael P. Guilfoyle, Richard A. Fischer,  
and Ellie L. Covington

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# **Birds of the Savannah Harbor Navigation Project, Dredged Material Disposal Areas, 1994 – 2012**

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Final report

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## Abstract

The U.S. Army Corps of Engineers, Savannah District, has been responsible for monthly avian community monitoring on the dredged material containment areas (DMCAs) as part of the Savannah Harbor Navigation Project (SHNP) since 1994 to the present. This report summarizes the results of this monitoring effort from 1994 to 2012. During this period, over 6.9 million birds of 298 species were detected. These results are discussed in relation to the North American Bird Conservation Initiative, and specifically to the South Atlantic Region, where birds have been ranked according to their need of conservation effort. The SHNP DMCAs were found to support 22 of 36 designated Highest Priority Species, 70 of 90 High Priority Species, and 40 of 41 Moderate Priority Species. These results suggest that the SHNP DMCAs provide important habitat in the region, and may provide a critical link to buffer some priority species from becoming rarer. The report recommends that the Savannah District continue the monitoring efforts but should link the effort with Department of Defense (DoD) Coordinated Bird Monitoring approach. In addition, data for the monitoring effort could be subjected to rigorous statistical procedures to test hypotheses concerning the success of current management efforts for the benefit of the bird community. The management approach established on the DMCAs could serve as an example for management of other Confined Disposal Facilities nationwide.

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## Preface

This technical report was developed by the U.S. Army Engineer Research and Development Center (ERDC), Environmental Laboratory (EL), to introduce issues and to present preliminary results of monthly bird surveys conducted at the Savannah Harbor Navigation Project (SHNP), Confined Disposal Facility in the Savannah Harbor, GA (Figure 1), consisting of dredged material containment areas (DMCAs) in Georgia and South Carolina. Monthly bird surveys conducted on the South Carolina DMCAs were initiated in 1988. Beginning in 1994, regular monthly surveys were conducted through the present. This report summarizes the results of these surveys from 1994 to 2012. The majority of these surveys were conducted by U.S. Army Corps of Engineers (USACE), Savannah District biologist J. Stevan (Steve) Calver. The resulting dataset represents over 20 years of information on the relative abundance and species diversity of seasonal bird communities utilizing habitats created by dredged material deposition through USACE maintenance dredging in the Savannah Harbor. Such long-term datasets are relatively rare in ecological studies and therefore provides important documentation on the beneficial role of dredged material as a substrate for avian habitat, plus basic population and habitat utilization knowledge for dozens of important and declining bird species, including species federally listed as threatened, endangered, as candidate species for federal listing, or otherwise sensitive and in need of conservation. The purpose of this report is to provide a relatively short introduction to the efforts by the Savannah District to manage dredge disposal operations on the DMCAs and to monitor bird communities. This introduction will provide a description of survey methods used and an overview of all species observed along with basic trend patterns during the survey period.

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# 1 Introduction

## U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is responsible for maintaining many navigable waterways and channels throughout the United States. Dredged material obtained from various dredging techniques is often used beneficially in engineering and environmental restoration projects (e.g., maintenance dredging in waterways, beach nourishment, wetland and marsh mitigation) to create or enhance habitat for birds (Regional Sediment Management - Beneficial Use of Dredged Material, Section 204 of the 1992 Water Resources Development Act, as amended). In particular, numerous shorebird and wading bird species are frequently the targeted beneficiaries of wildlife habitat creation because of their well-documented population declines, sensitive or endangered status, and dependency on the early successional habitat made available through deposition of dredged material (Guilfoyle et al. 2006, 2007). In addition, the USACE has recognized that recent advances in the fields of engineering and ecology provide opportunities to combine these fields of practice into a single collaborative and cost-effective approach for infrastructure development and environmental management. Termed *Engineering With Nature* (EWN), this concept seeks to intentionally align both natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaborative processes (Banks et al. 2013; USACE 2013). The Savannah Harbor Navigation Project (SHNP) has provided a good example of EWN that has significant benefits to a wide range of species.

The USACE SHNP is responsible for maintaining the Savannah Harbor in Savannah, GA. The shipping industry in Savannah has grown significantly over the past century. This harbor is now one of the largest harbor ports in the southeastern United States. The Savannah Harbor was created by the Savannah River, which forms the border between the states of Georgia and South Carolina, and the harbor consists of 33.8 km (21 miles) of inner harbor channel and 17.7 km (11 miles) of bar channel. Continued maintenance of the harbor is needed to ensure sufficient depth to permit passage of barges and large international container vessels from around the world. Annual maintenance dredging, plus recent efforts to expand the harbor to allow passage of larger vessels, yields significant amounts of dredged material annually. The SHNP includes eight DCMAAs (2A, 12A, 12B,

13A, 13B, 14A, 14B, and JOI [Jones Oyster Island]; Figure 1) designed to receive the dredged material and to isolate any contaminants present in the dredged material for the protection of the surrounding urban population. Note that the cross dike between DMCA 12B and 13A was removed in 2010 to yield one larger DMCA retaining the 13A designation.

Figure 1. An aerial view of the Savannah Harbor Navigation Project Dredged Material Disposal Areas (sections 2A, 12A, 12B, 13A, 13B, 14A, 14B, and JOI).



### Savannah District long-term management strategy

Beginning in 1996, The USACE Savannah District developed a long-term management strategy (LTMS) that would maximize use of the DMCAs and identify efficient dredging approaches to minimize environmental impacts (USACE 1996). This effort was developed in part to incorporate an additional DMCA (14A) and mitigate for wetland impacts in Georgia and South Carolina caused by ongoing disposal operations on the DMCAs from the SHNP (USACE 2012). Management actions adopted by the Savannah District include rotating the use of specific DMCAs, with some DMCAs simultaneously flooded and receiving dredged material (*on*) that provide habitat for wetland shorebirds and waterfowl for 3 years, and other

DMCAs simultaneously dried, yet do not receive dredged material (*off*), that provide habitat for terrestrial birds (USACE 1996; Calver 2006). Although there are an odd number of DMCAs, such that equal numbers cannot be in each on-off category, the LTMS ensures that approximately 204.4 hectares (505 acres) remain flooded at all times for waterfowl, and approximately 266.7 hectares (659 acres) of wetland and mudflats be available for shorebirds (USACE 1996). This on-off rotation schedule also provides habitat for other fish and wildlife species and serves to control mosquitoes by maintaining mosquito-eating fish populations. During dry periods, dikes surrounding the DMCAs are raised as needed (USACE 1996), and mowing operations are scheduled to minimize impacts to breeding birds within grassy areas, such as Willets (Calver 2006).

Another essential element in the LTMS is the construction of bird islands in the center of each DMCA (Calver 2006). When flooded, these islands provide isolated open-sandy breeding habitat for many rare species including the Least Tern. The original plan was to create two islands within each of seven DMCAs, such that each island will provide approximately 1 acre of nesting habitat when a DMCA is flooded, but actual area may vary depending on water levels. By 2011, islands had been completed in DMCAs: 12A, 12B, 14A, 14B, and JOI. Islands in 13B are incomplete. In 2011, DMCAs 12B and 13A were combined into 1 DMCA, and a 4-acre island was created to meet the 2-acre requirement per each DMCA (USACE 1996; and updated supplementary information, Calver 2006). Recent attempts to maximize nesting benefits and minimize maintenance costs resulted in a decision to replace the smaller islands with one larger island in most areas. To meet mitigation requirements, the islands must be usable by nesting birds. Target species, like the Least Tern and others, nest primarily on barren open sand habitats. Therefore, the islands are treated with herbicide, and vegetation is removed during the nonbreeding season. Uncleared islands may still meet mitigation requirements if a sufficient number of fledglings is still produced during the nesting season.

In 2005, as an additional mitigation requirement, another bird island was created nearshore called Tomkins Island. This island provides approximately 5 acres of isolated nesting habitat in the ocean environment. The island is maintained by the USACE Savannah District, and use of this island by nesting and roosting birds also serves to mitigate for loss of wetland

habitat in South Carolina due to USACE dredging operations in the Savannah Harbor.

The Savannah District has responsibility to monitor bird communities in the DMCAs throughout the year, especially during the breeding season, to ensure that the District is successfully mitigating for habitat losses from dredging activities and successfully providing nesting habitat for regional species. Monitoring efforts include estimates of nesting habitat available and nesting birds and nesting success rates. Specific habitat areas surveys include waterfowl feeding acreage, shorebird feeding area acreage, wetland nesting acreage (for black-necked stilts and waterfowl), rookery acreage (for herons and egrets), interior nesting island acreage, and bare-ground nesting acreage (e.g., nesting areas used by terns and skimmers) (USACE 1996; and updated supplementary information). The District also provides monthly waterfowl and shorebird surveys during the year to document success of the mitigation plan. The results of these surveys are part of the data presented in this report. Although acreages of habitat on Tomkins Island are included annually in total habitat acreages available for mitigation purposes, data from any bird community monitoring are not included in this report. Bird community monitoring on Tomkins Island usually includes annual visits to determine nesting pairs and is performed by the South Carolina Department of Natural Resources with the assistance of interested agencies including the USACE and U.S. Federal Wildlife Service (USFWS).

## 2 Monitoring Objectives, Study Area, and Methods

### Objectives

The objective of the monthly bird surveys conducted by J. Stevan Calver was to document monthly and seasonal trends of birds utilizing DMCAs within the SHNP, with an emphasis on shorebirds and waterfowl.

Complete surveys of these areas were conducted during a period of approximately 20 years on six of eight DMCAs (12A, 12B, 13A, 13B, 14A, 14B; Figure 1). The objective of this technical report is to summarize the results of birds detected annually from completed surveys of these six DMCAs from 1994 to 2012.

### Description of project area

The six DMCAs in the SHNP that were surveyed in this effort consist of approximately 2,007 hectares (4,960 acres) of land (Figure 1). Two areas (12B, 13A) were combined in 2010 by removing the dividing dike, resulting in five containment areas to be surveyed. The total area within the containment areas that received dredged material is estimated at 1,766 hectares (4,364 acres). Along the periphery of the site, there exist approximately 60 hectares (148 acres) of woodland, varying in width from approximately 23 to 91 m (75 to 300 ft). The remaining 181 hectares (448 acres) consists primarily of roads, dike slopes, and other open high ground; these areas are usually mowed at least once a year. Prior to removal in 2006, an additional 3.35 hectares (8.27 acres) of hardwood forest existed outside the dikes at the eastern end of 14B (Figure 1); dimensions of this woodland were approximately 113 m × 271 m (370 ft × 890 ft). Further clearing for bank protection work began in February of 2010 and removed additional trees along the Area 13A and 13B riverbank.

### Composition of forested areas

The forested area is comprised mostly of hackberry (*Celtis laevigata*), red and white mulberry (*Morus rubra* and *M. alba*), Chinese tallow (*Sapium sebiferum*), and Chinaberry trees (*Melia azedarach*) (in isolated areas). Minor components consist of red cedar (*Juniperus virginiana*), Jerusalem thorn (*Parkinsonia aculeata*), Hercules'-club (*Zanthoxylum clava-herculis*), black cherry (*Prunus serotina*), Carolina laurel cherry (*Prunus*

*caroliniana*), and salt cedar (*Tamarisk* sp.). There are a few American elm (*Ulmus americana*), red maple (*Acer rubra*), mimosa (*Albizia julibrissin*), palm (*Sabal palmetto*), and black and Carolina willows (*Salix nigra* and *S. caroliniana*). High marsh shrub edges contain primarily wax myrtle, yaupon (*Ilex vomitoria*), Groundsel-tree (*Baccharis halimifolia*), salt-cedar (*Tamarisk* sp.), marsh-elder (*Iva frutescens*), winged-sumac (*Rhus copallina*), and Chinese privet (*Ligustrum sinense*). Major vines include pepper vines (*Ampelopsis arborea* and *A. cordata*), wild cucumber (*Cucumis sativus*), morning glory (*Ipomea cordatotriloba*), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), greenbriers (*Smilax bona-nox* and *S. smallii*), and marine vine (*Cissus trifoliata*).

### **Composition of open and interior containment areas**

The interior of the containment areas contain a large amount of grasses and weedy herbaceous vegetation. Some of the herbaceous species include rattlebeans and their relatives (*Sesbania exaltata*, *S. macrocarpa*, *S. vesicaria*, *S. punicia*, and *S. drummondii*), ragweed (*Ambrosia artemisiifolia*), aster (*Aster subulatus*), mustard (*Brassica* sp.), sicklepod (*Cassia obtusifolia*), pigweed (*Chenopodium album*), goldenrod (*Solidago altissima* and *S. sempervirens*), sticky nightshade (*Solanum sisymbriifolium*), Brazilian vervain (*Verbena brasiliensis*), cocklebur (*Xanthium strumarium* var. *canadense*), golden aster (*Heterotheca subaxillaris*), and sour clover (*Melilotus indica*). Some of the dominant grasses include *Phragmites* sp., giant cane (*Arundo donax*), crab grass (*Digitaria sanguinalis* and *D. ciliaris*), various types of lovegrass (*Eragrostis curvula*, *E. hirsute*, and *E. pectinacea*), Vasey's grass (*Paspalum urvillei*), Carolina canarygrass (*Phalaris caroliniana*), and broomsedge bluestem (*Andropogon virginicus*).

### **National initiatives**

*The North American Bird Conservation Initiative.* As of 2000, numerous initiatives (e.g., Shorebirds, Waterbirds, and Landbirds) were independently developing management plans for North American birds. The North American Bird Conservation Initiative (NABCI) was established in 2000 and was designed to integrate these diverse efforts into a more effective and efficient approach to bird conservation (U.S. NABCI Committee 2000). The NABCI is a voluntary, international coalition of government agencies, conservation groups, academic institutions, private



businesses, and everyday citizens dedicated to the conservation of birds and their habitats through cooperative efforts in North America and the Neotropics. NABCI integrates efforts for specific taxa including the North American Waterfowl Management Plan (U.S. Fish and Wildlife Service 1998), Partner's in Flight (PIF) (Pashley et al. 2000), United States Shorebird Conservation Plan (Brown et al. 2001), North American Waterbird Conservation Plan (Fitzgerald and Pashley 2000), and Waterbird Conservation for the Americas (Kuslan et al. 2002) into an overall approach to conserve all bird species (U.S. NABCI Committee 2000).

The NABCI builds upon past efforts and utilizes bird-conservation regions (BCR) developed by the Atlantic Coast Joint Venture (ACJV). Bird conservation plans are then developed for each region. These plans identify species and habitats most in need of conservation and establish objectives for the bird populations and habitats in each physiographic areas (ecoregions) and states. The plans identify the general habitat requirements of priority species at the site level and then identify the quantity and quality of habitat required by birds at the landscape scale. These plans were drafted for most of the physiographic regions in the contiguous United States. The SHNP and associated DMCA lie in the Southeastern Coastal Plain BCR (Region #27). Currently, no plan is available for this specific BCR; however, there is the South Atlantic Migratory Bird Initiative (SAMBI) (Watson and Malloy 2008) that includes much of the eastern portion of the Southeastern Coastal Plain BCR and therefore, the region that includes the Savannah Harbor (Watson and Malloy 2008). The details of the SAMBI plan can be found <http://acjv.org/planning/bird-conservation-regions/sambi/> at <http://acjv.org/sambi.htm>. Plans for BCRs throughout North America can be found on the PIF website: <http://www.partnersinflight.org/> (Partners in Flight 2014).

A species-prioritization scheme was developed to determine which species in each region are the most in need of conservation attention (Carter et al. 2000; Pashley et al. 2000). The scheme ranks each species of North American breeding bird by physiographic region based upon seven measures of conservation *vulnerability*. These factors include the following: (1) relative abundance (interspecific), (2) size of breeding range, (3) size of nonbreeding range, (4) threats to the species on the breeding grounds, (5) threats to the species on the wintering grounds, (6) current known population trends, and (7) relative density (intraspecific) in a given planning unit compared to the maximum reached within its range. While



focus is generally on breeding birds, information for all birds, including Neotropical migrants, Nearctic migrants, and resident species are included in the measure of conservation vulnerability. For the SAMBI (Watson and Malloy 2008), birds have been grouped into three categories of priority levels: Highest, High, and Moderate. Species categorized as Highest Priority are those continental or regional species in need of immediate management attention; those species categorized as High Priority are continental or regional species in need of management attention; and those species categorized as Moderate Priority are those continental or regional species where monitoring is recommended to ensure long-term persistence of extant populations (Watson and Malloy 2008).

## Methods

### Summary of methods used to monitor birds

1. Surveys for shorebirds, waterfowl, wading birds, raptors, and other passerines were conducted monthly by area searches on DMCA's 12A, 12B, 13A, 13B, 14A and 14B (Figure 1).
2. Surveys were begun in the early morning hours (generally before 0730 EST) and ended at dusk (generally approximately 1830 EST); surveys periods varied according to time of year and day length available for surveys.
3. Surveys were conducted during periods of relatively good weather; surveys were usually not conducted on days with heavy wind, rain, or other precipitation.
4. Surveys were conducted using a vehicle to drive along the top of the dikes and roads covering the entire perimeter of the disposal areas.
5. The goal for all surveys was to count all individuals detected, with an emphasis on shorebirds and waterfowl in the containment areas. No attempt was made to count all individuals of smaller species residing within the disposal areas. Detection of small passerines such as doves, woodpeckers, flycatchers, vireos, warblers, thrushes and mimic thrushes, wrens, sparrows, buntings and their relatives, blackbirds and their relatives were noted during counts, but survey efforts did not focus on these species. During periods when areas were found to be supporting large numbers of birds, the areas were revisited during the count, and the highest counts for numbers and species richness were recorded.
6. Observer used a tripod or window-mounted scope. From 1988 to 1998, vehicle surveys were conducted using a Baush & Lomb tripod mounted scope and 25X eyepiece. During the survey, the observers exited the

- vehicle and set up the mounted scope to count shorebirds and waterfowl. Beginning on 14 September 1998, a Swarovski HD80 scope with 60X zoom eyepiece was used. Beginning in 2002, shorebird and waterfowl counts were made primarily using a window-mounted scope.
7. As part of the area search approach, the observer would occasionally walk through the disposal areas carrying a tripod mounted scope to get close enough to identify unknown birds.
  8. During the nesting period, individual nests were recorded during walks through the disposal areas.
  9. A log of vehicle miles was taken, but no estimate of miles walked was made. Time logs were used to assess the amount of time expended searching for ducks/shorebirds and the amount of time expended searching for small birds. Beginning in June 2001, the time required to count shorebirds and the time allocated to counting smaller passerines were recorded separately. Before this date, search times (focused on shorebirds/waterfowl vs. other passerines) were estimated for all previous surveys.
  10. Generally, the effort to count hawks, egrets, waterfowl, and shorebirds was counted as “shorebird hours” and the effort to count small passerines was counted as “small-bird hours”. Small birds were sometimes counted by walking and sometimes by vehicle, dictated by the weather, time available, and whether an area was available to foot traffic.
  11. Generally, the distance between vehicle stops was estimated to range between 90 to 300 m (300 to 1,000 ft); this distance was used to minimize double-counting of birds between regular vehicle stops.
  12. The observer would initially listen, observe, and record all birds detected, before exiting vehicle. The observer would exit the vehicle when bird activity indicated that more birds and/or species could be detected with further effort. At moments when no bird activity was detected, the observer would use vocalizations (e.g., pishing sounds or a mimicked or recorded screech owl call, or a combination of both). If no birds were detected within 15 to 30 seconds, the observer would drive to the next stop.
  13. All birds detected by sight or sound within the DMCA boundaries were counted, whether they were flying or sitting. Survey boundaries were judged to be the boundary of impact between property associated with the disposal area and adjacent habitats.
  14. On the river side, the boundary was considered to be the low-tide line at the edge of the river. No birds were counted in the river beyond the low-tide line or flying over the river. Birds feeding near the shoreline on a high tide were counted.

15. Birds resting along the bank at the edge of the river were counted. The remaining survey boundary is situated primarily between the disposal area property and adjacent marsh. Birds were counted in any vegetation that appeared to be influenced by the disposal area but not in the adjacent marsh.
16. Surveys occur in two categories: (1) Surveys considered *complete* included visits to all disposal areas, and (2) surveys considered *incomplete* did not cover all areas and may have concentrated on certain species such as waterfowl during the winter, tern or egret colonies during the summer, or migrant passerines during the spring or fall. A determination of suitability of each count for shorebird/waterfowl assessment and small-bird assessment was made. For example, an incomplete survey would still be considered to be appropriate for shorebird/waterfowl assessment if only the areas with water or other wet conditions were surveyed.
17. Specific conditions in each DMCA often varied from year to year, season to season, month to month, and even day to day, depending on weather, USACE dredged material disposal activities, mowing operations, etc. At times, not all roads were accessible or passable, and areas available for surveys could be restricted. All areas with significant standing water were surveyed from the dikes; in dry situations, surveys were conducted according to bird activity and habitats birds were thought to utilize.
18. In some sections of the disposal areas, dense vegetation made walking impossible; therefore, such surveys were conducted from the dikes.

### Data analyses

For this report, there is provided a summary of all birds detected over the course of the 19-year monitoring period (1994 to 2012), focusing only on maximum counts. For clarity on total counts and species richness, only data on detections that were identified to species was used. Observations of groups of birds (e.g., Blackbird sp., Ducks sp.) were removed. Note that this considerably underestimates bird use, especially because at times large numbers of shorebirds had to be recorded as “peep” and “dowitcher sp.” One exception was the designation of birds in the genus *Empidonax*. These birds constitute sensitive Neotropical migrants but are very difficult to identify if the bird is not vocalizing. For illustration purposes, there is a presentation of graphs of maximum counts of species groups to show how such groups and individual species within the group varied over the course of the monitoring period. Shorebird, waterfowl, wader, and hawk counts are thought to represent the approximate number of individuals present in the areas. Small-bird counts were highly dependent on the time available

for counting them. Therefore, the total and high count data for small birds presented here should be viewed only in general terms. Assessment of rare and sensitive birds detected on the DMCA is based on the draft SAMBI plan (Watson and Malloy 2008) and assessment of specific breeding, wintering, migrant, or transitory occurrence derived from the data presented here. More in-depth trend analyses are possible for future examinations of the data, including, for example, counts per hour for small birds. In addition, there is the possibility of conducting significant analyses between bird trends and habitat availability; however, GIS databases of the DMCA will require more time and analyses than are possible in the current report.

### 3 Monitoring Results

#### Survey efforts

Survey efforts on the six DMCAs were largely completed during the 19-year period from 1994 to 2012 (Table 1). During this time, surveys were conducted on over 700 days (n=753), constituting over 5,500 survey hours (total = 5,592 hours) (Table 2). Over 3,600 hours were dedicated to shorebird surveys (total = 3,605 hours), and over 1,900 hours were dedicated to small-bird surveys (total = 1,987 hours) (Table 2).

**Table 1. Summary of completed monthly bird surveys conducted on all seven DMCAs on the Savannah Harbor Navigation Project, Savannah, GA, 1994 to 2012.**

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1994	.	C	I	I	C	C	C	C	C	C	C	C
1995	C	C	C	C	C	C	C	C	C	C	C	C
1996	C	C	C	C	C	C	C	C	C	C	C	C
1997	C	C	C	C	C	C	C	C	C	C	C	C
1998	I	C	C	C	C	C	C	C	C	C	C	C
1999	C	C	C	C	C	C	C	C	C	C	C	C
2000	C	C	C	C	C	C	C	C	C	C	C	C
2001	I	C	C	C	C	C	C	C	C	C	C	C
2002	C	C	C	C	C	C	C	C	C	C	C	C
2003	C	C	C	C	C	C	C	C	C	C	C	C
2004	C	C	C	C	C	C	C	C	C	C	C	C
2005	C	C	C	C	C	C	C	C	C	C	C	C
2006	C	C	C	C	C	C	C	C	C	C	C	C
2007	C	C	C	C	C	C	C	C	C	C	C	C
2008	C	C	C	C	C	C	C	C	C	C	C	C
2009	C	C	C	C	C	C	C	C	C	C	C	C
2010	C	C	C	C	C	C	C	C	C	C	C	C
2011	C	C	C	C	C	C	C	C	C	C	C	C
2012	I	C	.	C	C	C	C	C	C	C	I	C

C =  $\geq 1$  completed survey on all 6 DMCAs

I = Incomplete Survey (i.e., not all DMCAs surveyed).

. = No surveys conducted.

**Table 2. Total number of survey days, total hours surveyed for shorebirds and small birds, and total number of survey hours conducted on seven DMCAs in the SHNP, Savannah, GA, 1994 to 2012.**

Year	Total Number of Days Surveyed	Total Number of Shorebird Hours Surveyed	Total Number of Small-Bird Hours Surveyed	Total Number of Survey Hours
1994	18	45.4	21.6	67.0
1995	31	85.0	36.9	121.9
1996	38	121.9	73.7	195.6
1997	50	164.6	86.8	248.4
1998	51	177.9	58.2	236.1
1999	37	129.0	119.1	248.1
2000	46	148.5	124.3	273.8
2001	45	208.5	116.4	324.9
2002	38	138.5	135.5	273.0
2003	44	240.9	99.7	340.6
2004	52	251.6	155.8	407.4
2005	49	228.9	162.6	391.5
2006	30	142.2	89.9	232.1
2007	38	245.9	125.1	371.0
2008	32	230.9	77.7	308.6
2009	54	360.4	154.3	514.7
2010	34	263.8	124.1	387.9
2011	40	261.1	113.7	374.8
2012	23	103.8	99.7	210.6
TOTAL	746	3,546.1	1,975.3	5,539.4

## Survey results

Over 1.663 million detections of 299 species were recorded during survey efforts on the Savannah Harbor DMCAs over the 19-year survey period (Appendix A). Fifteen species are temperate migrants that breed on site but winter or migrate elsewhere in North America; 38 species were Neotropical migrants that breed in the area but undergo a long-distance migration to Central and South America during the winter months; 39 species were long-distance migrants that are only observed in the area during fall and/or spring migration seasons; 81 species occur year-round and likely breed on site; and 87 species were temperate migrants that winter in the area and breed farther north in the United States and/or Canada. An additional 39 species are rare transients that are known to

have irregular or only occasional occupancy in the area during the breeding, wintering, or migration seasons (Appendix A).

Over the survey period, by far the most commonly recorded species was the Tree Swallow (525,299), followed by the Semipalmated Sandpiper (164,145), Dunlin (78,528), Green-winged Teal (66,219), Least Sandpiper (65,330), Western Sandpiper (62,131), Northern Shoveler (60,544), Common Grackle (55,950), and the Red-winged Blackbird (37,880) (Appendix A).

The Least Tern was the most common Neotropical migrant (7,947), followed by the Barn Swallow (5,858), Bobolink (4,447), Chimney Swift (4,239), Bank Swallow (2,111), and Indigo Bunting (800) (Appendix A). Other common migrants include Semipalmated Sandpiper, Stilt Sandpiper (10,441), Pectoral Sandpiper (1,477), White-rumped Sandpiper (1,269), and the Yellow Warbler (1,009) (Appendix A).

The Common Grackle (55,950) and Red-winged Blackbird (37,880) were the most common species present year-round, followed by the American Coot (33,569), European Starling (31,021), Fish Crow (28,129), Snowy Egret (22,559), White Ibis (17,362), and the Boat-tailed Grackle (17,320) (Appendix A). During the survey period, the bird community was highest and most diverse during the winter season. Eighty-seven wintering species constituted over 66% of total bird detections, totaling more than 1.1 million detections. The most common wintering species include the Tree Swallow, Dunlin, Green-winged Teal, Least Sandpiper, Western Sandpiper, Northern Shoveler, Lesser Yellowlegs (37,456), Ring-necked Duck (27,568), and the Ruddy Duck (26,500) (Appendix A).

### **Rare and sensitive species**

Watson and Malloy (2008) provide detailed descriptions of bird species and habitat types necessary to conserve and protect priority species along the South Atlantic Coast. They rank birds of the Highest Priority (36 species), High Priority (90 species), and Moderate Priority (41 species). They also note 6 nuisance species and 16 game species of interest (Watson and Malloy 2008).

During the surveys on the Savannah Harbor DMCA, 22 of 36 species designated as Highest Priority along the South Atlantic Coast were observed; 70 of 90 High Priority species were observed; and 40 of

41 Moderate Priority species were observed (Table 3). The Savannah Harbor DMCAs also support 14 of 16 game species of local or state interest and 6 of 6 nuisance species listed by Watson and Malloy (2008).

**Table 3. Total counts of the SAMBI Highest Priority, High Priority, Moderate Priority, Game Species of local or state Interest, and Nuisance Species (from Watson and Malloy 2008) detected on the Savannah Harbor DMCAs, 1994 to 2012.**

Species	Count	Species	Count
<b>Highest Priority Species</b>			
Henslow's Sparrow <sup>1,2</sup>	1	Piping Plover <sup>1, 2, e</sup>	1
Saltmarsh Sharp-tailed Sparrow <sup>2</sup>	1	Buff-breasted Sandpiper <sup>3</sup>	151
Common Ground Dove <sup>1</sup>	279	Whimbrel <sup>2</sup>	258
Painted Bunting <sup>2</sup>	517	Redhead <sup>2</sup>	179
Black-throated Green Warbler <sup>1</sup>	3	Red Knot <sup>2</sup>	47
Wood Stork <sup>1, 2</sup>	2,450	American Black Duck <sup>1, 2</sup>	89
Sandhill Crane <sup>1</sup>	1	Northern Pintail <sup>2</sup>	2,094
Purple Gallinule <sup>1</sup>	7	Lesser Scaup <sup>2</sup>	5,403
Common Tern <sup>1, 3</sup>	12	Snow Goose <sup>2</sup>	124
American Coot <sup>2</sup>	33,569	Canvasback <sup>2</sup>	155
American Woodcock <sup>1, 2</sup>	3	Black Scoter <sup>2</sup>	2
<b>High Priority Species</b>			
Bachman's Sparrow <sup>1, 2</sup>	1	Prairie Warbler <sup>2</sup>	502
Le Conte's Sparrow <sup>2</sup>	63	Northern Bobwhite <sup>1</sup>	149
Swallow-tailed Kite <sup>1</sup>	3	Chuck-will's-widow <sup>1</sup>	25
Eastern Towhee <sup>1, 2</sup>	319	Short-eared Owl <sup>2</sup>	14
Wood Thrush <sup>1</sup>	4	Yellow-billed Cuckoo <sup>1</sup>	69
Chimney Swift <sup>1</sup>	4,239	Northern Flicker <sup>1, 2</sup>	159
Field Sparrow <sup>2</sup>	37	Eastern Kingbird <sup>1</sup>	414
Brown Thrasher <sup>1</sup>	307	Grasshopper Sparrow <sup>2</sup>	14
Northern Harrier <sup>2</sup>	230	American Kestrel <sup>1</sup>	97
Eastern Wood-Pewee <sup>1, 2</sup>	32	Vesper Sparrow <sup>2</sup>	131
White-throated Sparrow <sup>2</sup>	430	Eastern Meadowlark <sup>1, 2</sup>	688
Red-headed Woodpecker <sup>1, 2</sup>	6	Prothonotary Warbler <sup>2</sup>	39
Kentucky Warbler <sup>1</sup>	1	Seaside Sparrow <sup>1, 2</sup>	2
Worm-eating Warbler <sup>1</sup>	10	Black Rail <sup>1, 2</sup>	2
Black Skimmer	3,406	Least Tern	7,947
Red-throated Loon <sup>2</sup>	1	King Rail <sup>2</sup>	18
Gull-billed Tern <sup>1</sup>	2,509	American Bittern <sup>2</sup>	28



Species	Count	Species	Count
Tricolored Heron <sup>1, 2</sup>	5,771	Sandwich Tern <sup>1</sup>	15
Black Tern <sup>3</sup>	3,580	White Ibis <sup>1, 2</sup>	17,362
Common Loon <sup>2</sup>	3	Little Blue Heron <sup>1, 2</sup>	2,477
Black-crowned Night Heron <sup>1, 2</sup>	687	Pied-billed Grebe <sup>1</sup>	3,707
Least Bittern <sup>1</sup>	62	Snowy Egret <sup>1, 2</sup>	22,559
Yellow-crowned Night Heron <sup>1, 2</sup>	235	Glossy Ibis <sup>1, 2</sup>	1,898
Common Moorhen <sup>1, 2</sup>	2,476	Brown Pelican <sup>1</sup>	55
American White Pelican <sup>2</sup>	1,949	American Golden Plover <sup>3</sup>	25
Semipalmated Sandpiper <sup>3</sup>	163,145	Wilson's Plover <sup>1</sup>	479
Short-billed Dowitcher <sup>2</sup>	7,595	Solitary Sandpiper <sup>2</sup>	178
Upland Sandpiper <sup>3</sup>	7	Marbled Godwit <sup>2, 3</sup>	39
Least Sandpiper <sup>2</sup>	65,330	Stilt Sandpiper <sup>3</sup>	10,441
Wilson's Phalarope <sup>3</sup>	261	American Avocet <sup>2</sup>	14,153
Lesser Yellowlegs <sup>2</sup>	37,456	Sanderling <sup>2</sup>	174
Willet <sup>1, 2</sup>	1,303	Western Sandpiper <sup>2</sup>	62,131
Ruddy Turnstone <sup>2</sup>	220	Dunlin <sup>2</sup>	78,528
Wilson's Snipe <sup>2</sup>	903	American Wigeon <sup>2</sup>	763
Blue-winged Teal <sup>2, 3</sup>	23,781	Common Goldeneye <sup>2</sup>	13
<b>Moderate Priority Species</b>			
Red-shouldered Hawk <sup>1, 2</sup>	50	Swamp Sparrow <sup>2</sup>	1,231
Acadian Flycatcher <sup>1</sup>	6	White-eyed Vireo <sup>1</sup>	232
Yellow-throated Vireo <sup>1</sup>	5	Marsh Wren <sup>1, 2</sup>	160
Sedge Wren <sup>2</sup>	173	Yellow-throated Warbler <sup>1</sup>	20
Cape May Warbler <sup>3</sup>	16	Northern Parula <sup>1</sup>	101
Pine Warbler <sup>1, 2</sup>	1	Blackpoll Warbler <sup>3</sup>	88
Black-throated Blue Warbler <sup>3</sup>	55	Hooded Warbler <sup>1</sup>	19
Summer Tanager <sup>1</sup>	13	Connecticut Warbler <sup>3</sup>	1
Bobolink <sup>3</sup>	4,447	Orchard Oriole <sup>1</sup>	293
Indigo Bunting <sup>1</sup>	800	Bald Eagle <sup>1, 2</sup>	89
Black Vulture <sup>1, 2</sup>	355	Northern Harrier <sup>1</sup>	203
Cooper's Hawk <sup>1</sup>	74	Mississippi Kite <sup>1</sup>	25
Barn Owl <sup>1, 2</sup>	12	Peregrine Falcon <sup>2, 3</sup>	46
Louisiana Waterthrush <sup>2</sup>	1	Clapper Rail <sup>1, 2</sup>	47
Bonaparte's Gull <sup>2</sup>	4,926	Royal Tern <sup>1, 2</sup>	1,635
Forster's Tern <sup>1, 2</sup>	3,065	Great Egret <sup>2</sup>	5,092
Reddish Egret <sup>2</sup>	38	Sandhill Crane <sup>2</sup>	1

Species	Count	Species	Count
Black-bellied Plover <sup>2</sup>	5,370	Semipalmated Plover <sup>2</sup>	11,229
Greater Yellowlegs <sup>2</sup>	2,482	Spotted Sandpiper <sup>2</sup>	479
Pectoral Sandpiper <sup>3</sup>	1,477	Mottled Duck <sup>1, 2</sup>	5,686
<b>Game Species of Local or State Interest</b>			
Mourning Dove	3,959	Virginia Rail	19
Sora	93	American Coot	33,596
Snow Goose	124	Gadwall	4,394
American Wigeon	763	Mallard	1,765
Blue-winged Teal	23,781	Ring-necked Duck	27,568
Greater Scaup	108	Common Goldeneye	13
Bufflehead	1,426	Wood Duck	63
<b>Nuisance Species</b>			
Canada Goose	24	Cattle Egret	1,774
Double-crested Cormorant	3,076	Laughing Gull	11,151
Great Black-backed Gull	2	Herring Gull	700

<sup>1</sup>Breeding population is designated or ranked for protection/conservation.

<sup>2</sup>Nonbreeding or wintering population is ranked for protection/conservation.

<sup>3</sup> Migratory population is ranked for protection/conservation.

<sup>4</sup>Species is listed as Federally endangered.

## Examples of Priority Species

### Highest Priority Species

Figures 2–4 present examples of Highest Priority Species.

Figure 2. The Painted Bunting is a species nesting within the Savannah Harbor DMCAs that has been ranked as a Highest Priority species for the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 3. The Common Ground Dove is a species resident in the Savannah Harbor DMCAs that has been ranked as a Highest Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 4. The Wood Stork is a federally listed threatened species that feeds in the Savannah Harbor DMCA's outside the breeding season and has been listed as a Highest Priority Species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



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### High Priority Species

Figures 5–9 present examples of High Priority Species.

Figure 5. The Least Tern is a nesting species in the Savannah Harbor DMCA's that has been ranked as a Highest Priority species in the region by SAMBI (Watson and Malloy 2008). (Photo by Stevan Calver).



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Figure 6. The American Golden Plover is a species detected on the Savannah Harbor DMCAs that has been ranked as a High Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 7. The American White Pelican is a species detected on the Savannah Harbor DMCAs that has been ranked as a High Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 8. The American Avocet is a species feeding in the Savannah Harbor DMCAs that has been ranked as a High Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by Stevan Calver).



Figure 9. The Sanderling is a species detected on the Savannah Harbor DMCAs that has been ranked as a High Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).





### Moderate Priority Species

Figures 10–13 present examples of Moderate Priority Species.

Figure 10. The Pectoral Sandpiper is a species detected on the Savannah Harbor DMCA that has been ranked as a Moderate Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 11. The Sedge Wren is a species wintering in the Savannah Harbor DMCA that has been ranked as a Moderate Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by Stevan Calver).



Figure 12. The Black-bellied Plover is a species primarily wintering in the Savannah Harbor DMCAs that has been ranked as a Moderate Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



Figure 13. The Peregrine Falcon is a species detected on the Savannah Harbor DMCAs that has been ranked as a Moderate Priority species in the region by SAMBI (Watson and Malloy 2008) (Photo by J. Stevan Calver).



### Annual trends for species groups

Monitoring of avian populations is an essential tool in determining population trends and the overall health of specific bird populations. Currently, the data collected on the Savannah Harbor DMCAs will need to be analyzed more thoroughly to identify specific statistical trends for any species' groups or individual species. It is beyond the scope of this report to present such an analysis; however, there is presented a cursory view of trends for some groups of species to provide some idea of the variation



among years that are present in the dataset. In future analyses, trends should be correlated with annual habitat availability, especially in the context of DMCA management as required by the environmental impact statement (EIS) for the SHNP, to determine if habitat quantity and/or quality provide any explanatory insights into why such trends may be occurring. In addition, trends should be analyzed seasonally to separate pulses of migrants from breeding birds in the area.

## **Species whose counts are thought to generally reflect the number of individuals within the DMCA**

### **Small and large shorebirds**

Small shorebirds showed relatively stable counts over the survey period, except for migrant Semipalmated Sandpipers that showed significant variation; wintering Western Sandpipers were also variable, but not as much (Figure 14). Of the large shorebirds, the wintering Lesser Yellowlegs varied greatly over the survey periods; both Long-billed and Short-billed Dowitchers tended to increase since 2004 but then decreased in 2012 (Figure 15).

### **Waterfowl**

Waterfowl counts showed repeated peaks and dips over the survey period, with several species showing similar patterns including Blue- and Green-wing Teal, Northern Shoveler, and American Coot; all other waterfowl species showed less variation (Figure 16).

### **Hérons, egrets, and cormorants**

Counts for heron, egrets, and cormorant species were relatively stable and fluctuated less than most other species groups, except counts of the Snowy Egret, which showed periods of gradually increasing counts followed by sharp declines (Figure 17).

### **Gulls and terns**

Gulls and terns were relatively stable but began to show increased annual counts beginning in 2004; counts were dominated by variable numbers of wintering Ring-billed Gulls and resident Laughing Gulls; Caspian Terns also increased during the later portion of the survey period (Figure 18).

Figure 14. Annual daily maximum counts for small shorebirds on the Savannah Harbor DMCAs, 1994–2012.

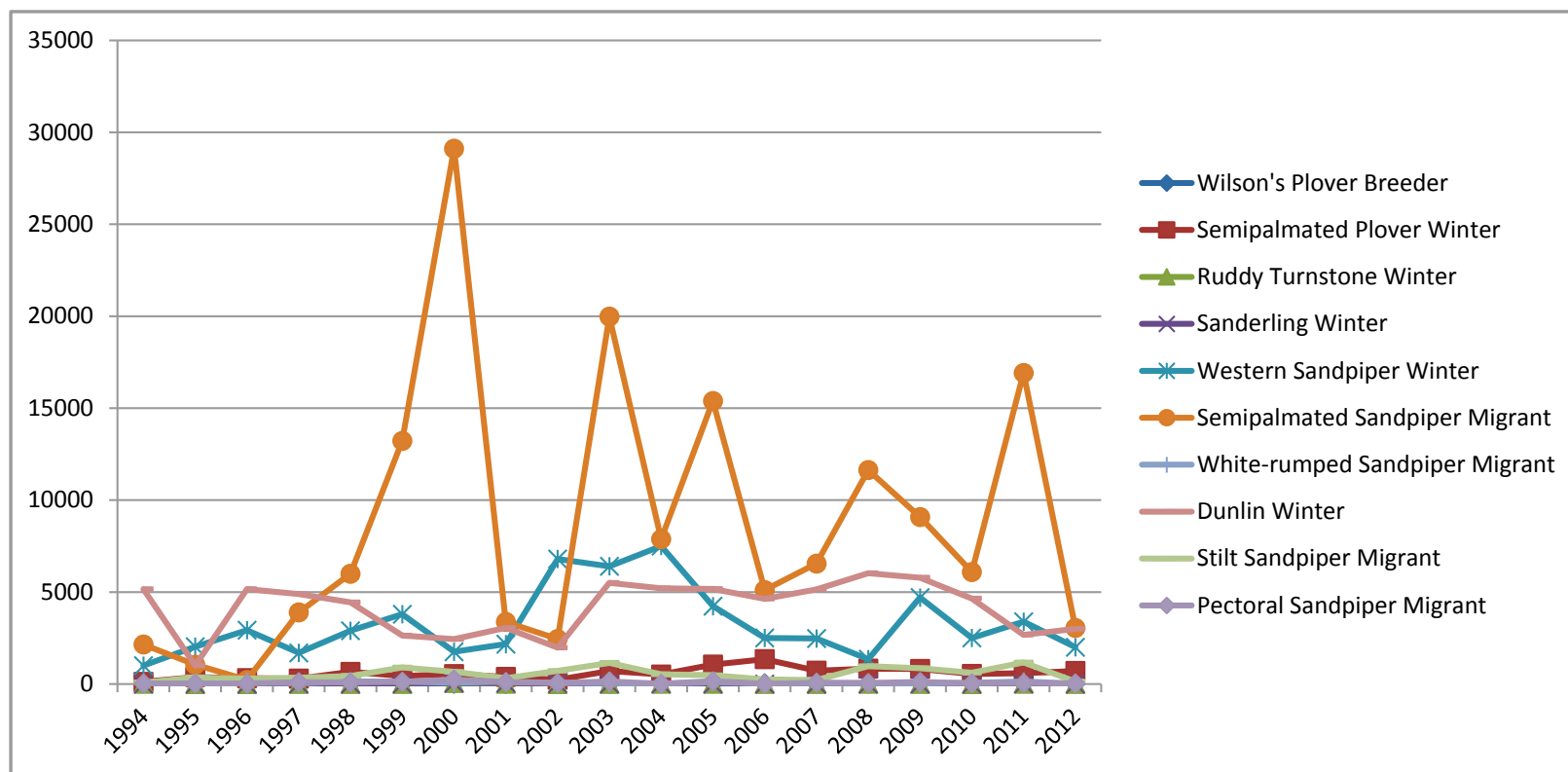


Figure 15. Annual daily maximum counts for large shorebirds on the Savannah Harbor DMCAs, 1994–2012.

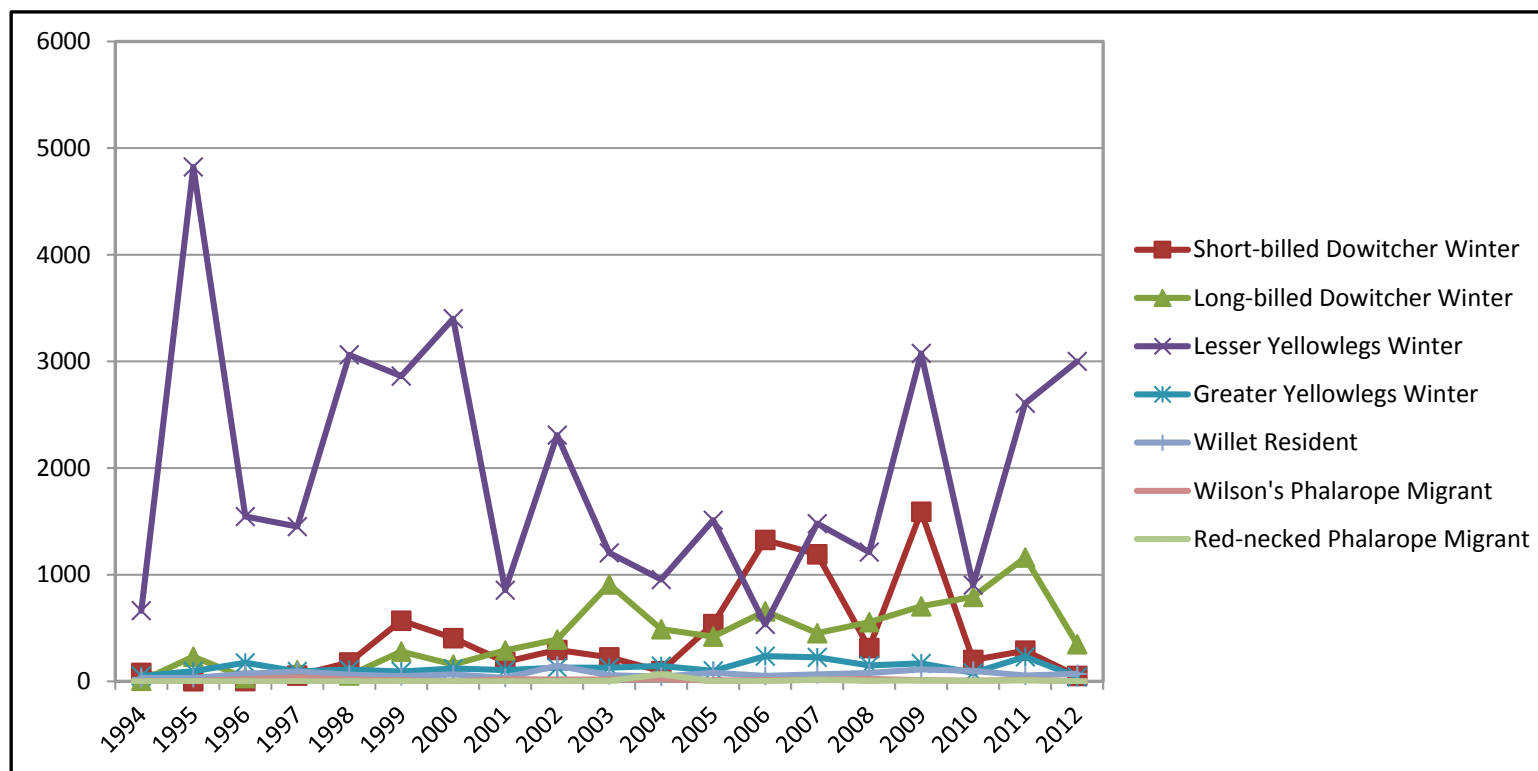


Figure 16. Annual daily maximum counts for waterfowl species on the Savannah Harbor DMCA, 1994–2012.

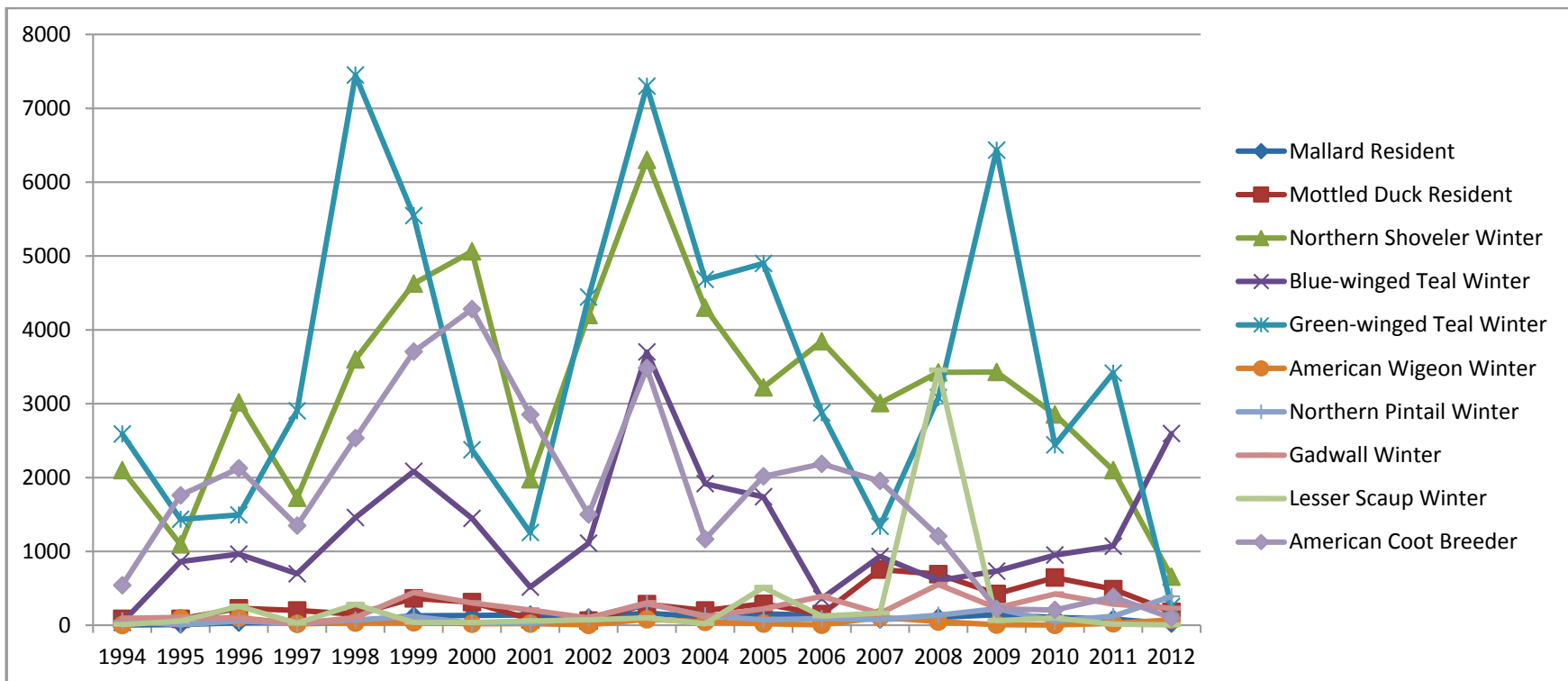


Figure 17. Annual daily maximum counts for herons, egrets, and cormorants on the Savannah Harbor DMCAs, 1994–2012.

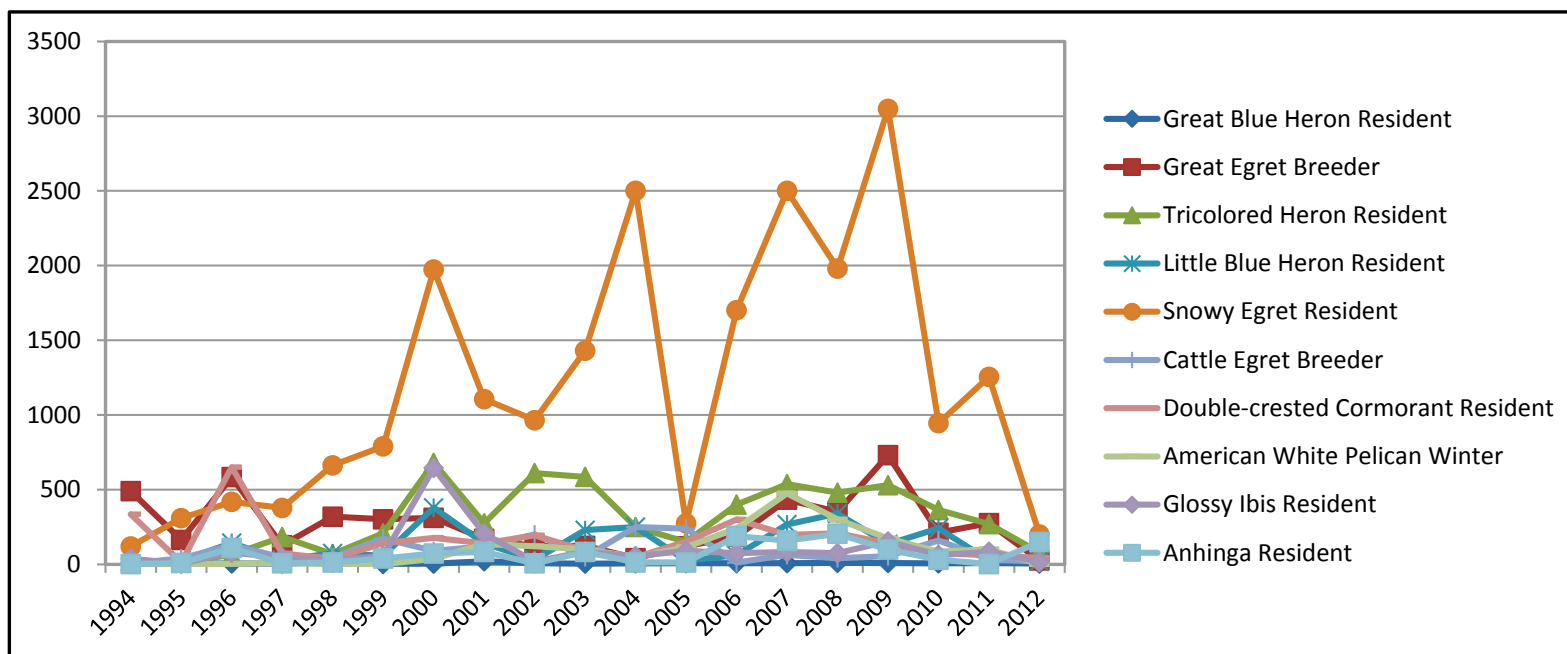


Figure 18. Annual daily maximum counts for gulls and terns on the Savannah Harbor DMCAs, 1994–2012.

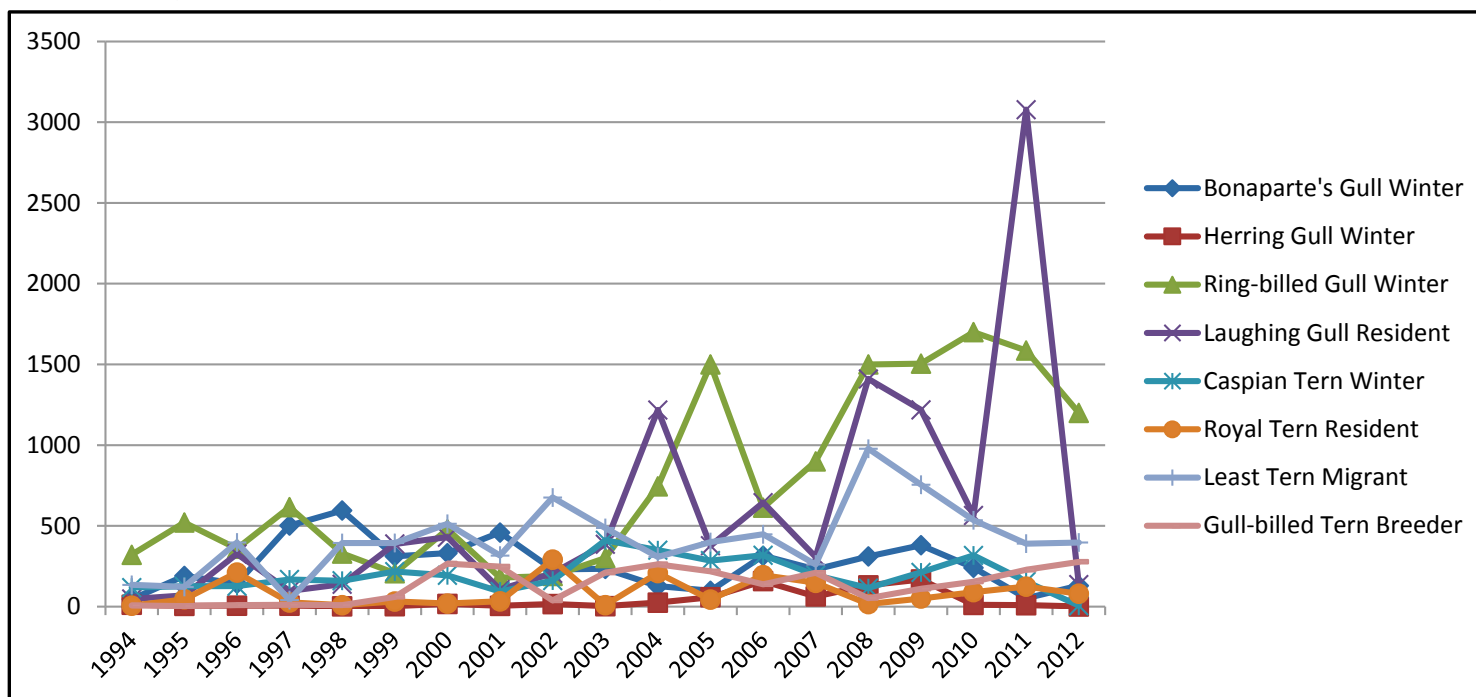
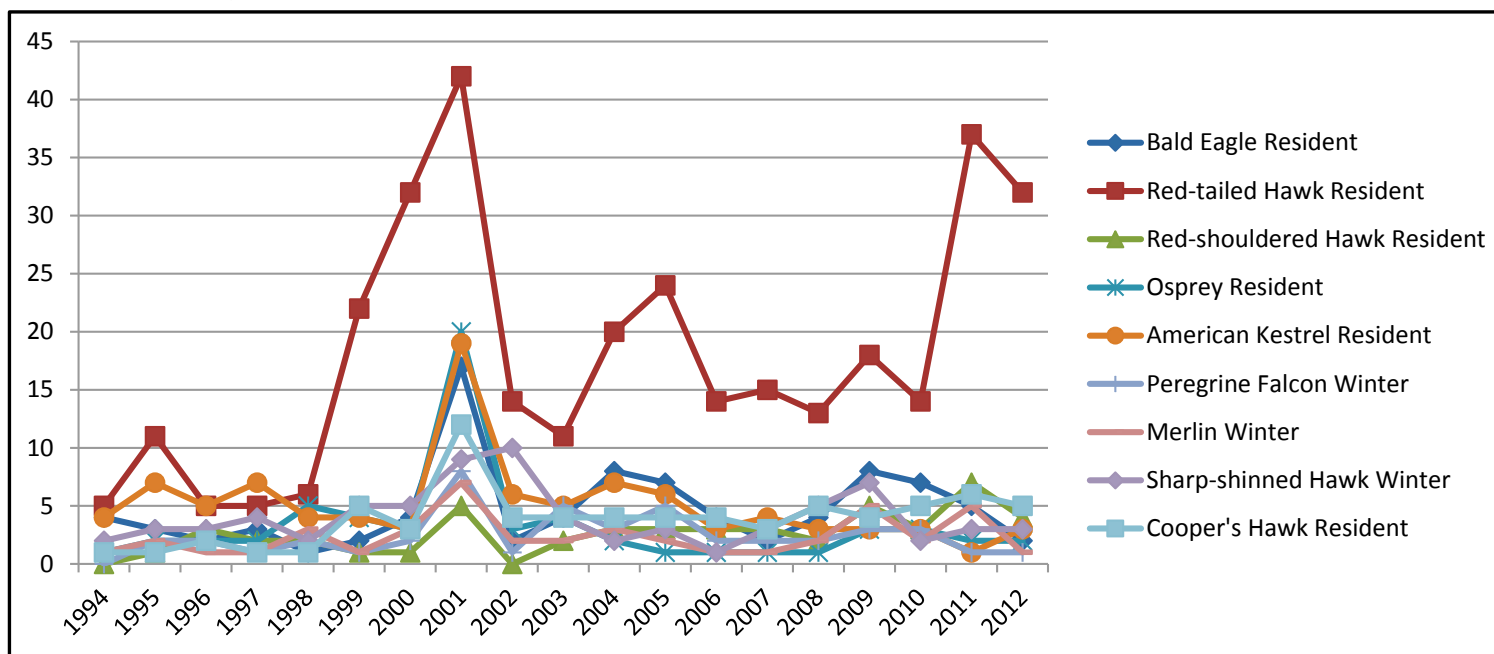


Figure 19. Annual daily maximum counts for raptors on the Savannah Harbor DMCA, 1994–2012.



## **Raptors**

Raptor counts were dominated by the abundance of Red-tailed Hawks; these birds showed increased counts from 1998 to 2001, followed by a sharp decline in 2002 and variable counts thereafter, with increasing counts until a decline in 2012 (Figure 19). The other raptor species were relatively stable, but most all species showed a peak in counts from 2000 to 2001, followed by a decline in 2002—this pattern appears to mirror the counts of the Red-tailed Hawk. Counts of the other raptors were stable for the rest of the survey period (Figure 19).

## **Species whose counts were greatly affected by the time during a count available to be applied to them<sup>1</sup>**

### **Blackbirds, grackles, crows, meadowlarks, and orioles**

After 1998, these birds showed wide fluctuations in counts, particularly counts of resident Common Grackles, Red-winged Blackbirds, and Fish Crows that varied between alternating large increases and sharp declines over the survey period (Figure 20).

### **Flycatchers and vireos**

Eastern Kingbirds showed sharp fluctuations during the survey period, with gradual declines after 2006 (Figure 21). Wintering Eastern Phoebe and White-eyed Vireos also showed significant variation in counts, particularly between the 2000 and 2004 counts; other species appear relatively stable over the survey period (Figure 21).

### **Wood-warblers**

Counts for wood-warblers were dominated by increasing counts of wintering Yellow-rumped Warblers over the survey period (Figure 22). Other than some variation in counts of resident Common Yellowthroats, counts for other species appear relatively stable during the survey period (Figure 22).

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<sup>1</sup> Since these counts have not been analyzed on a per-hour basis, apparent trends based on total counts should be viewed with caution.



**Sparrows and finches**

Counts for sparrows and finches tended to show the most variable annual counts of all species groups (Figure 23). In particular, sharp increases and declines were observed for migrant Bobolinks, with additional variation in counts of wintering Savannah Sparrows, Swamp Sparrows, and Song Sparrows (Figure 23).

Figure 20. Annual daily maximum counts for blackbirds, grackles, meadowlarks, and orioles on the Savannah Harbor DMCA, 1994–2012.

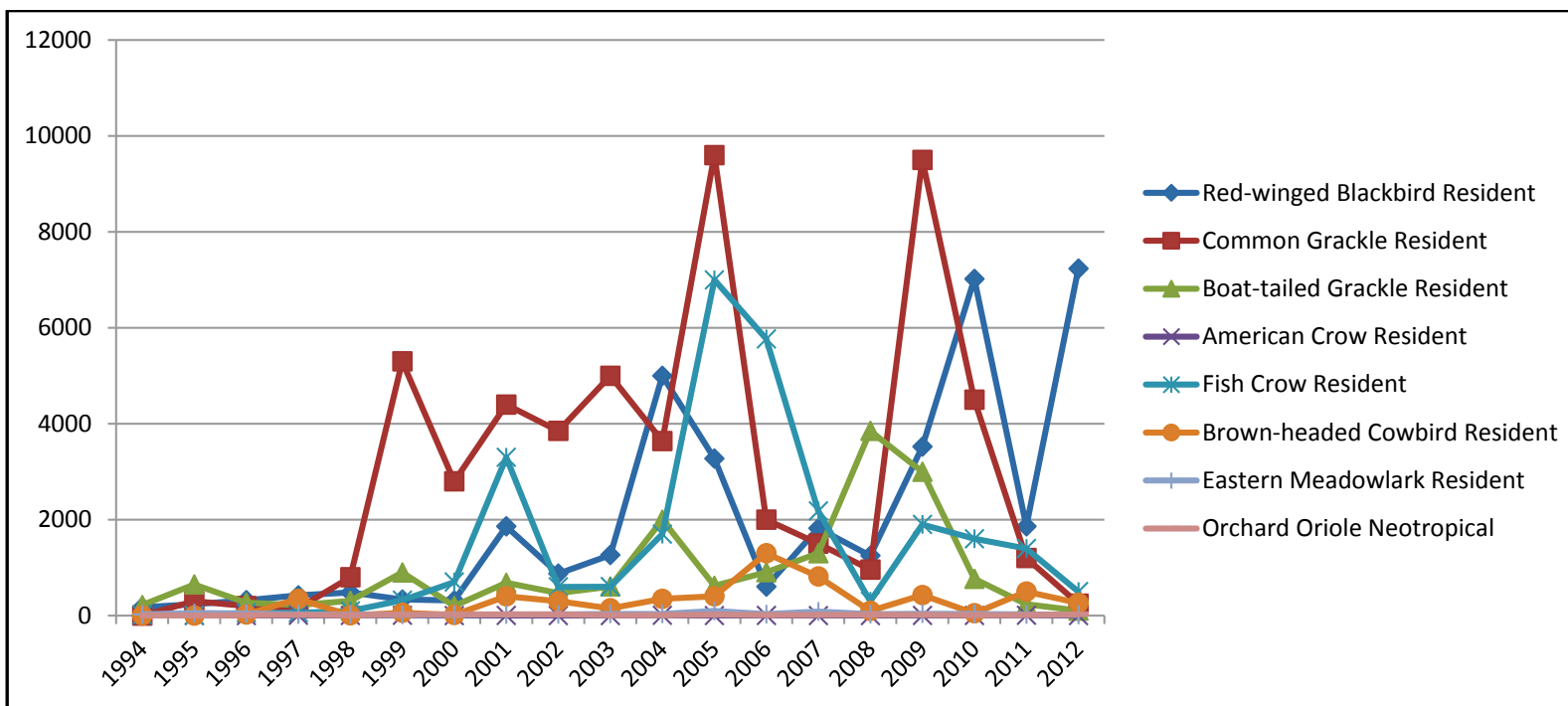


Figure 21. Annual daily maximum counts for flycatchers and vireos on the Savannah Harbor DMCA, 1994–2012.

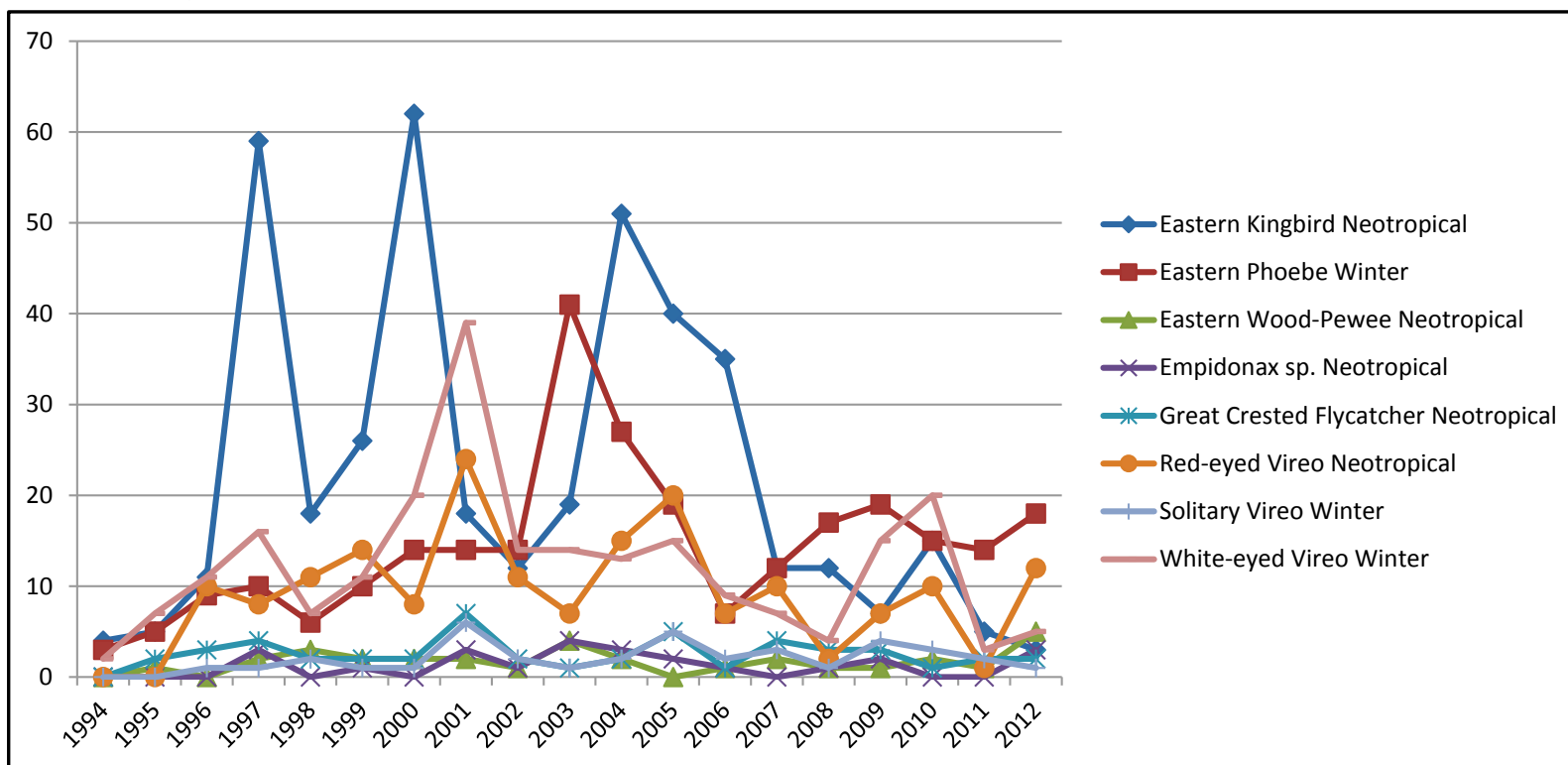


Figure 22. Annual daily maximum counts for wood-warblers on the Savannah Harbor DMCAs, 1994–2012.

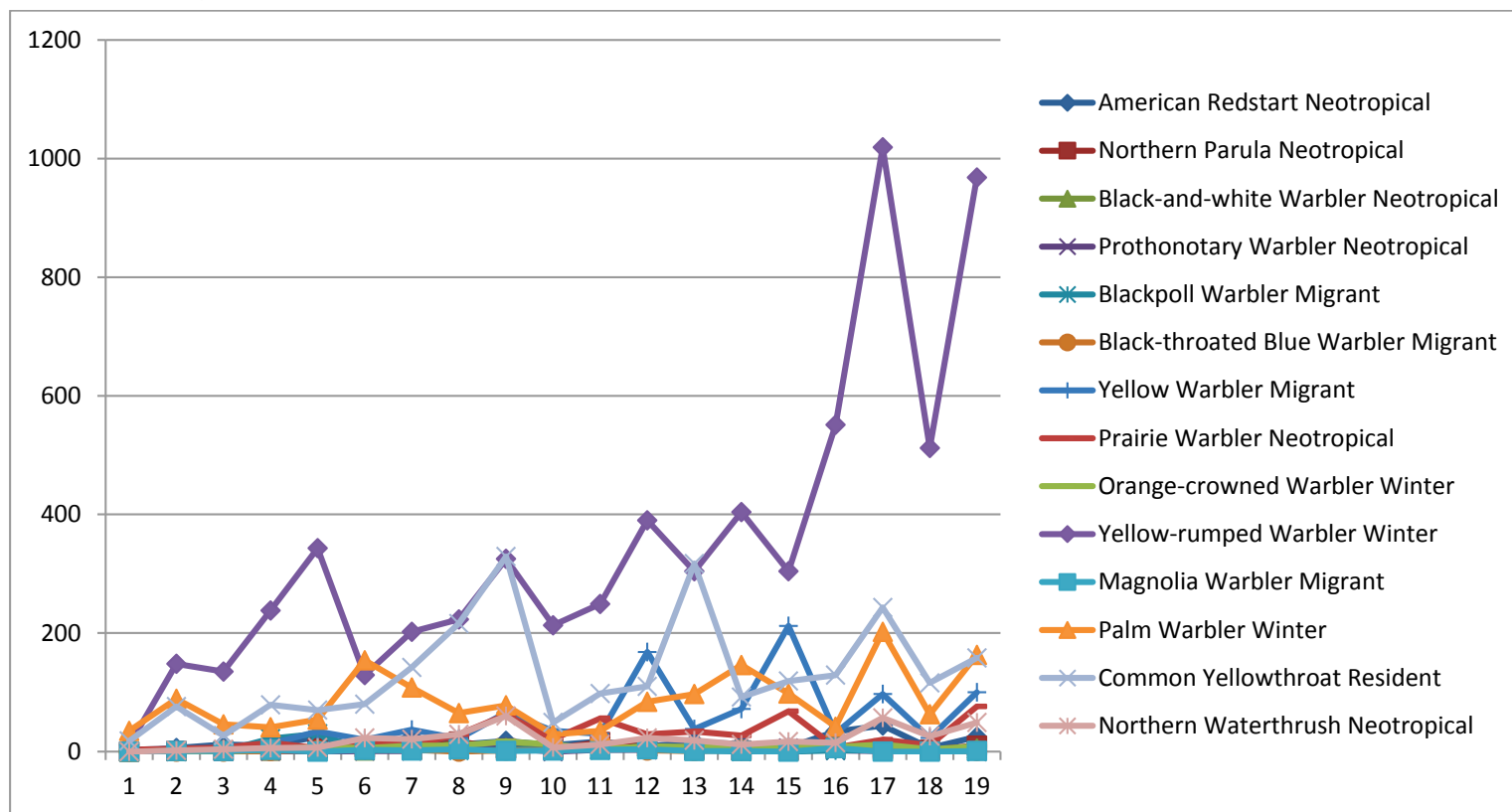
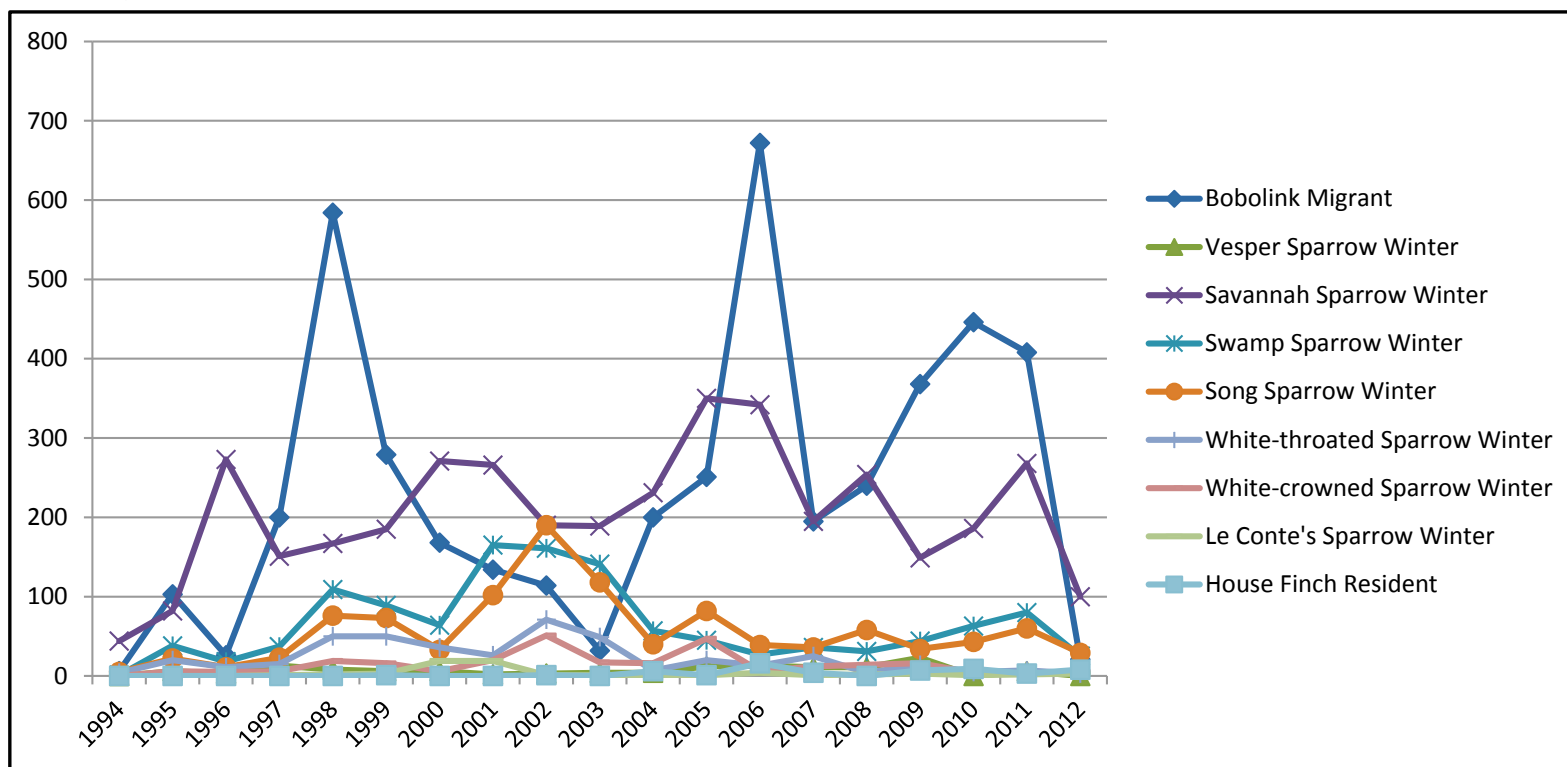


Figure 23. Annual daily maximum counts for Bobolink, sparrows, and finches on the Savannah Harbor DMCAs, 1994–2012.



## 4 Discussions and Recommendations

The SHNP DMCAs support a tremendous number and diversity of birds year round. This report summarizes long-term, monthly monitoring of the DMCAs for the 19-year period from 1994 to 2012. These data support prior research that shows habitats created from dredged material are often important for coastal bird species, and in some cases, such habitats may support a disproportionate proportion of a species' continental or regional population (Guilfoyle et al. 2006, 2007). In such cases, habitats created with dredged material may not just be beneficial but may be essential in the long-term persistence of a species. Currently, the USACE Savannah District continues to perform dredged material deposition in the DMCAs according to the LTMS, and personnel are continuing the monthly and seasonal monitoring efforts.

Results of this effort continue to show the importance of the DMCAs for regional bird populations, including many species ranked at Highest Priority and High Priority by SAMBI (Watson and Malloy 2008). During the monitoring period documented in this report, several species ranked as Highest Priority were observed on the DMCAs in large numbers, including the American Coot, Wood Stork, and Lesser Scaup. During the winter, the DMCAs may occasionally be used by the Endangered Piping Plover (Calver 2006). The DMCAs also support large numbers of High Priority species, including the Least Tern, Semipalmated Sandpiper, and Stilt Sandpiper. Virtually all species (40 of 41 species) ranked as Moderate Priority species in the South Atlantic Coast physiographic region have been detected on the DMCAs, with counts of 12 such species numbering in the thousands. Not only are such areas important for many regional priority species, but by supporting moderately rare and/or sensitive species, areas such as the DMCAs may act as critical links that serve to buffer populations from becoming critically rare in the future.

In addition, nesting islands created in the DMCAs are contributing important breeding areas for many priority species listed by Watson and Mallory (2008). Verified breeding efforts have been documented by 22 species designated as High Priority species (Eastern Towhee, Black Skimmer, Least Tern, Tricolored Heron, White Ibis, Little Blue Heron, Black-crowned Night-Heron, Snowy Egret, Common Moorhen, Glossy Ibis, Wilson's Plover, American Avocet, Willet, Brown Thrasher, Gull-

billed Tern, Least Bittern, Yellow-crowned Night-Heron, Blue-winged Teal, Pied-billed Grebe, Yellow-billed Cuckoo, Chuck-Wills-Widow, and Sandwich Tern [Tomkins Island]); 5 species designated as Moderate Priority (Indigo Bunting, White-eyed Vireo, Marsh Wren [probable], Mottled Duck and Great Egret); 1 Game species (Mourning Dove); and 1 Nuisance species (Cattle Egret). Some rare or state-listed species documented as breeding on the SHNP nesting islands include the American Oystercatcher, Sandwich Tern, Gull-billed Tern, and Royal Tern (Calver 2006). The DMCA's also support the largest breeding population of Black-necked Stilts in the state (Calver 2006).

Included in this report is a simple analysis that provides a visual assessment of the variation of maximum counts for species groups observed annually from 1994 to 2012 (Figures 14 to 23). These figures show great variability of many species groups monitored over the years, but the data are not presented as trends and reveal no statistical patterns. A more detailed analytic approach is needed to assess these data and to test whether individual species or specific groups of birds have experienced statistical population increases, decreases, or have remained stable. Such an analysis that incorporates information on habitat availability, and is specifically tied to specific management practices (e.g., DMCA rotation schedules in the LTMS for receiving dredged material), would provide a means to test whether specific approaches detailed in the LTMS (e.g., maintaining at least 204 ha (504 acres) of open water habitat and 266 ha (657 acres) of wetland/mudflat habitat) are having significant impacts on annual or seasonal bird populations, particularly birds categorized as Highest or High Priority in the South Atlantic Coast region. Results of such an analysis would be useful in assessing the value of the mitigation approach developed by the Savannah District and may provide important guidelines in the management of existing or proposed confined disposal facilities (CDF) nationally.

#### Specific recommendations:

1. It is recommended the monitoring continue for as long as time and funding are available. In addition to continued monitoring of the bird community, efforts should also include continued procurement of satellite imagery that could be used to quantitatively assess habitat availability on the DMCA's seasonally and annually.
2. In order to facilitate future efforts, and to promote standardized approaches, long-term bird conservation, and technical transfer of the

- survey data, it is recommended that future efforts link with the Department of Defense (DoD) Coordinated Bird Monitoring (CBM) approach (Guilfoyle and Fischer 2007; Bart et al. 2012). The CBM approach details numerous surveys methods, including area searches that are compatible with current efforts on the Savannah Harbor DMCAs. Moreover, the CBM approach promotes data sharing by uploading data into centralized data repositories such as the Coordinated Bird Monitoring Database (CBMD) maintained by the U.S. Geological Survey (USGS), and that will be made available to the public online through the Avian Knowledge Network (AKN) (<http://www.avianknowledge.net/>) and/or eBird (<http://ebird.org>). By providing public access to the data, the data may be used in regional or continental trend analyses by universities or other researchers, which could yield significant progress in conservation efforts for the most imperiled species.
3. The monitoring data should be analyzed as described in this report to test hypotheses concerning the value of the LTMS as a mitigation tool to provide habitat for waterfowl and shorebirds both seasonally and annually. Results of this analysis could test trends for individual species and groups of species to determine if populations are increasing, decreasing, or stable. The results of this approach could also inform management at existing or future CDFs nationally.



## 5 Summary

This report represents an introduction to long-term monitoring of the bird community on the U.S. Army Corps of Engineers (USACE) Savannah Harbor Navigation Project (SHNP). The surveys were incorporated into the SHNP monitoring of its dredged material containment areas (DMCAs) as part of a mitigation effort to offset loss of wetland habitat due to continued maintenance dredging operations in the Savannah Harbor and efforts to expand and deepen the harbor for national and international commerce. The Savannah District established a long-term management strategy (LTMS) approach to benefit waterfowl and shorebirds by initiating 3-year rotations where some DMCAs received dredged material and other DMCAs were allowed to dry. The LTMS also created habitat islands in the DMCAs that would provide isolated nesting habitat for many important regional shorebirds and other species. The Savannah District is in charge of maintaining the DMCAs and established long-term monitoring of the DMCAs to ensure that the mitigation efforts were successful. The bird community was surveyed approximately twice monthly on a regular basis from 1994 to the present. This report summarizes the results of these surveys by focusing on maximum counts from 1994 to 2012. During this period, over 6.9 million birds of 298 species were detected. The results of these surveys are discussed in relation to the North American Bird Conservation Initiative and specifically to the South Atlantic Migratory Bird Initiative. In the South Atlantic Region, various bird species have been ranked according to their need of conservation effort. Based on the results of monitoring effort, the SHNP DMCAs have been found to support 22 of 36 designated Highest Priority species, 70 of 90 High Priority species, and 40 of 41 species of Moderate Priority. These data support the conclusion that the SHNP DMCAs provide important habitat for many regional species and may provide a critical link to buffer some priority species from becoming rarer. The report recommends that the Savannah District continues monitoring efforts but should link the effort with ongoing DoD Coordinated Bird Monitoring efforts. This would entail that the data be uploaded onto a national repository of bird data that could be accessed by independent researchers. It also recommends that the data on the DMCAs be subjected to a statistical analysis to test for significant increases or decreases in bird community trends (e.g., measures of abundance and species richness) and to test specific hypotheses concerning the value of habitat availability from specific approaches in the LTMS in providing important habitat for regionally important species. Such an analysis may

provide important insights into the success of current mitigation efforts and may help provide guidelines for management of current and future confined disposal facilities nationally.

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## **Appendix A: Table of Counts of Birds Detected During Surveys on Six DMCA's on the Savannah Harbor Navigation Project, 1994–2012**

This table provides a list of all species detected and maximum counts by year (1994–2012) accumulated through monthly surveys on the Savannah Harbor Navigation Project DMCA's.

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Acadian Flycatcher <sup>N</sup>	0	0	0	0	0	1	0	0	0	1	1	0	0	1	0	0	0	1	1
American Avocet <sup>YR</sup>	690	380	925	830	971	825	564	254	1110	465	676	790	979	700	1120	1014	969	701	353
American Bittern <sup>W</sup>	0	0	0	1	1	2	1	2	3	2	1	2	8	0	1	1	1	2	0
American Black Duck <sup>W</sup>	0	50	0	2	2	0	2	14	0	2	0	2	0	0	0	5	4	6	0
American Coot <sup>WRB</sup>	542	1760	2125	1349	2534	3704	4280	2852	1500	3482	1166	2016	2185	1954	1206	222	207	385	100
American Crow <sup>YR</sup>	0	0	0	6	4	8	0	4	1	0	7	1	4	1	0	3	4	8	1
American Golden Plover <sup>M</sup>	0	2	1	1	1	2	1	4	0	1	1	1	0	1	1	1	1	1	3
American Goldfinch <sup>W</sup>	0	1	1	17	1	2	1	6	15	11	108	3	4	2	12	5	0	85	0
American Kestrel <sup>WR</sup>	4	7	5	7	4	4	3	6	6	5	7	6	3	4	3	3	3	1	4
American Pipit <sup>W</sup>	23	31	38	478	106	89	50	88	203	125	35	150	160	500	100	71	45	394	110
American Redstart <sup>N</sup>	0	6	12	10	25	8	25	12	18	11	17	9	16	13	7	34	44	6	25
American Robin <sup>YR</sup>	0	50	6	46	1	10	2	122	55	20	1077	46	61	47	839	1	89	120	42
American White Pelican <sup>YR</sup>	0	0	3	10	0	1	37	136	121	101	49	115	240	475	301	174	85	101	15
American Wigeon <sup>W</sup>	3	92	103	19	35	40	21	23	5	81	46	22	6	107	50	8	4	26	72
American Woodcock <sup>W</sup>	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Anhinga <sup>R</sup>	2	9	110	7	13	39	73	83	7	83	13	13	189	159	205	99	31	2	150
Ash-throated Flycatcher <sup>RW</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Bachman's Sparrow <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Baird's Sandpiper <sup>T</sup>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1
Bald Eagle <sup>YR</sup>	4	3	2	3	1	2	4	3	2	4	8	7	4	2	4	8	7	5	5
Baltimore Oriole <sup>W</sup>	0	1	7	0	1	1	1	1	4	2	1	6	0	1	0	0	0	0	0
Bank Swallow <sup>M</sup>	10	4	16	22	4	43	12	21	15	625	876	226	4	83	13	22	110	5	7
Barn Owl <sup>YR</sup>	0	0	1	0	0	0	0	0	0	0	1	1	3	1	0	1	1	2	1
Barn Swallow <sup>S</sup>	300	104	138	236	180	333	720	102	233	361	113	877	138	129	242	465	255	195	737
Barred Owl <sup>YR</sup>	0	0	0	0	0	0	0	1	1	0	0	0	2	0	0	0	1	1	1
Bay-breasted Warbler <sup>M</sup>	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0
Belted Kingfisher <sup>YR</sup>	1	3	5	3	3	5	4	3	4	4	3	3	6	4	3	7	4	5	4
Black Rail <sup>RS</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Black Scoter <sup>W</sup>	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0
Black Skimmer <sup>SB</sup>	19	36	29	10	3	103	210	258	44	200	73	149	174	241	132	312	300	639	474
Black Tern <sup>M</sup>	8	41	94	29	6	144	75	36	66	153	245	163	48	34	477	906	355	612	88
Black Vulture <sup>YR</sup>	1	6	3	4	6	15	11	23	23	9	12	10	50	41	16	21	37	46	19
Black-and-white Warbler <sup>W</sup>	0	1	3	2	5	2	4	3	6	4	4	9	2	2	3	8	3	2	5

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Black-bellied Plover <sup>W</sup>	25	71	103	318	72	74	46	120	367	237	365	273	459	859	456	572	324	315	314
Black-bellied Whistling Duck <sup>R</sup>	0	0	0	0	0	0	0	1	0	9	28	47	20	22	55	22	21	18	51
Blackburnian Warbler <sup>M</sup>	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0
Black-crowned Night-Heron <sup>R</sup>	2	0	10	12	2	15	18	11	13	37	59	39	83	89	136	80	46	15	13
Black-headed Gull <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0
Black-necked Stilt <sup>B</sup>	264	898	447	677	401	434	908	363	297	831	753	906	418	776	541	558	756	820	208
Blackpoll Warbler <sup>M</sup>	0	0	1	22	30	2	2	2	3	6	3	9	3	0	0	2	2	1	0
Black-throated Blue Warbler <sup>M</sup>	0	0	0	1	2	4	3	0	2	3	12	2	1	3	4	7	7	1	1
Black-throated Green Warbler <sup>M</sup>	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0
Blue Grosbeak <sup>N</sup>	1	1	2	7	5	3	4	11	2	4	8	14	4	7	11	9	2	9	4
Blue Jay <sup>YR</sup>	1	0	1	1	0	6	3	0	1	0	1	1	0	0	0	0	0	0	0
Blue-gray Gnatcatcher <sup>R</sup>	0	8	3	9	9	14	19	29	30	33	25	16	9	14	10	18	8	4	5
Blue-headed Vireo <sup>W</sup>	0	0	1	1	2	1	1	2	2	1	2	5	2	3	1	4	3	2	1
Blue-winged Teal <sup>WR</sup>	38	863	963	698	1458	2084	1447	516	1111	3700	1917	1739	360	932	604	733	951	1071	2596
Blue-winged Warbler <sup>M</sup>	0	0	0	0	0	1	0	0	1	1	0	1	2	1	0	0	0	0	0



Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Boat-tailed Grackle <sup>R</sup>	220	650	272	221	308	900	202	684	469	607	2000	621	905	1760	3850	3000	768	237	104
Bobolink <sup>M</sup>	6	103	26	200	584	279	168	134	114	32	200	251	672	195	240	368	446	408	21
Bonaparte's Gull <sup>W</sup>	46	190	143	502	595	312	331	459	230	234	127	98	315	270	311	380	241	52	130
Broad-winged Hawk <sup>M</sup>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0
Brown Noddy <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Brown Pelican <sup>R</sup>	0	0	6	2	3	5	13	2	4	1	1	1	1	4	1	1	2	2	0
Brown Thrasher <sup>R</sup>	5	7	7	14	14	16	21	21	18	12	14	22	24	16	20	20	15	8	17
Brown-headed Cowbird <sup>R</sup>	0	2	25	350	6	60	14	403	300	152	350	403	1300	816	100	430	50	500	266
Buff-breasted Sandpiper <sup>T</sup>	0	11	2	2	20	0	0	11	17	2	4	1	0	42	1	0	2	35	1
Bufflehead <sup>W</sup>	2	84	33	51	48	23	24	55	48	36	15	105	120	173	308	153	192	21	10
Canada Goose <sup>R</sup>	0	0	0	0	0	0	0	5	2	0	0	2	0	1	3	3	0	5	0
Canada Warbler <sup>M</sup>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Canvasback <sup>W</sup>	0	1	17	29	54	7	1	0	0	3	0	8	6	8	5	3	12	1	0
Cape May Warbler <sup>M</sup>	0	1	0	0	1	1	1	0	1	2	2	1	0	1	0	2	2	0	4
Carolina Chickadee <sup>R</sup>	0	7	5	5	4	4	8	5	11	6	6	7	2	3	4	5	4	3	3
Carolina Wren <sup>R</sup>	1	5	6	12	10	12	12	23	17	12	22	19	10	16	9	18	8	14	16
Caspian Tern <sup>YR</sup>	118	126	127	168	160	217	194	94	161	411	350	285	318	195	115	212	317	155	6
Cattle Egret <sup>B</sup>	7	40	129	46	46	173	90	121	200	49	250	239	12	63	41	55	160	33	20

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Cave Swallow <sup>T</sup>	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	05	0	0	0
Cedar Waxwing <sup>W</sup>	0	82	30	218	661	25	240	576	169	11	726	145	150	267	130	387	121	1700	466
Chestnut-sided Warbler <sup>M</sup>	0	0	0	0	0	0	1	1	0	1	2	2	1	0	0	1	1	0	0
Chimney Swift <sup>S</sup>	15	58	62	116	153	70	24	202	50	363	900	63	57	1820	65	62	50	16	93
Chipping Sparrow <sup>T</sup>	0	0	1	2	0	0	1	6	2	0	1	1	0	1	6	0	0	2	0
Chuck-will's-widow <sup>N</sup>	0	0	1	0	2	1	3	4	1	1	1	2	1	4	1	1	2	0	0
Cinnamon Teal <sup>T</sup>	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Clapper Rail <sup>YR</sup>	0	1	1	0	1	0	9	0	1	1	0	1	1	5	8	2	3	16	0
Clay-colored Sparrow <sup>T</sup>	0	0	0	0	0	0	1	0	0	1	3	1	0	0	0	1	0	0	1
Cliff Swallow <sup>M</sup>	1	1	0	0	0	1	0	3	0	1	1	0	0	0	0	1	3	1	0
Common Goldeneye <sup>W</sup>	0	1	1	1	2	0	1	1	0	0	0	0	1	2	2	0	1	0	0
Common Grackle <sup>R</sup>	0	300	200	150	800	5300	2800	4400	3850	5000	3640	9600	2000	1500	960	9500	4500	1200	250
Common Ground-Dove <sup>R</sup>	6	5	5	7	10	9	13	23	13	19	20	26	14	13	34	8	8	13	26
Common Loon <sup>W</sup>	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
Common Moorhen <sup>R</sup>	2	13	35	10	10	78	246	78	26	475	257	384	311	112	53	89	144	129	27
Common Nighthawk <sup>N</sup>	6	9	9	16	7	9	10	4	7	10	26	12	8	8	12	23	17	57	32

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Common Tern <sup>M</sup>	0	0	0	0	0	1	0	1	0	4	1	1	0	0	1	0	0	0	0
Common Yellowthroat <sup>N</sup>	18	76	27	79	70	80	142	216	329	49	98	110	317	92	119	129	243	116	158
Connecticut Warbler <sup>M</sup>	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Cooper's Hawk <sup>S</sup>	1	1	2	1	1	5	3	2	4	4	4	4	4	3	5	4	5	6	5
Curlew Sandpiper <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
Dark-eyed Junco <sup>W</sup>	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Dickcissel <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Double-crested Cormorant <sup>R</sup>	335	12	650	73	37	142	177	140	194	93	47	152	300	197	208	140	74	61	44
Downy Woodpecker <sup>YR</sup>	1	3	9	5	3	6	4	6	4	4	5	5	2	2	5	4	4	3	5
Dunlin <sup>W</sup>	5160	1005	5160	4890	4440	2637	2442	3050	1975	5500	5200	5166	4630	5147	6022	5784	4648	2672	3000
Eared Grebe <sup>RW</sup>	1	1	2	3	12	17	8	4	7	7	10	9	11	12	7	10	13	3	0
Eastern Bluebird <sup>YR</sup>	0	0	0	0	1	0	0	0	4	0	3	8	8	6	0	7	4	0	0
Eastern Kingbird <sup>N</sup>	4	5	11	59	18	26	62	10	12	19	51	40	35	12	12	7	15	5	3
Eastern Meadowlark <sup>W</sup>	25	54	47	24	19	17	17	20	27	37	36	98	31	86	31	39	36	25	23
Eastern Phoebe <sup>W</sup>	3	5	9	10	6	10	14	13	14	41	27	19	7	12	17	19	15	14	18
Eastern Screech-Owl <sup>YR</sup>	0	0	1	2	2	1	1	2	2	2	1	1	1	0	0	0	1	0	0

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Eastern Towhee <sup>R</sup>	4	6	10	17	11	14	13	18	42	21	16	25	18	13	9	18	16	7	18
Eastern Wood-Pewee <sup>T</sup>	0	1	0	2	3	2	2	1	1	4	2	0	1	2	1	1	2	1	5
Empidonax sp. <sup>T</sup>	0	0	0	3	0	1	0	3	1	4	3	2	1	0	1	2	0	0	3
Eurasian Collared-Dove <sup>YR</sup>	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	21	0	0
Eurasian Wigeon <sup>T</sup>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
European Starling <sup>YR</sup>	61	25	50	186	300	130	351	469	226	100	1600	8975	700	100	2000	8500	6000	928	320
Field Sparrow <sup>W</sup>	0	0	1	1	0	2	1	4	2	0	1	2	3	1	1	2	5	11	0
Fish Crow <sup>R</sup>	20	8	60	59	100	321	700	3300	600	604	1700	7000	5770	2183	300	1900	1604	1400	500
Forster's Tern <sup>W</sup>	8	7	50	25	28	121	70	142	168	325	273	139	234	417	542	330	53	108	94
Fox Sparrow <sup>W</sup>	0	0	0	0	0	0	0	0	0	1	2	0	1	0	0	0	0	0	0
Franklin's Gull <sup>T</sup>	0	0	0	0	1	0	0	0	2	9	2	0	0	0	0	0	0	1	0
Fulvous Whistling-Duck <sup>T</sup>	0	0	0	0	0	1	0	0	0	1	0	2	0	0	0	0	0	0	0
Gadwall <sup>W</sup>	94	107	94	21	105	442	303	207	99	305	116	223	392	161	552	234	423	287	229
Glossy Ibis <sup>R</sup>	38	6	78	44	29	56	645	205	18	86	55	90	75	83	75	153	62	84	16
Golden-crowned Kinglet <sup>W</sup>	0	0	0	0	0	0	1	0	4	7	0	0	1	1	0	0	1	0	0
Golden-winged Warbler <sup>M</sup>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Grasshopper Sparrow <sup>W</sup>	0	0	1	0	1	0	1	0	1	0	1	0	1	0	0	0	4	1	3
Gray Catbird <sup>R</sup>	53	53	16	38	46	152	67	75	227	721	67	86	70	39	47	180	36	58	902

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Gray-cheeked Thrush <sup>M</sup>	0	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	0	0
Great Black-backed Gull <sup>W</sup>	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Great Blue Heron <sup>R</sup>	6	7	6	6	12	3	5	5	8	5	7	8	8	8	10	9	7	9	6
Great Crested Flycatcher <sup>N</sup>	0	2	3	4	2	2	2	7	2	1	2	5	1	4	3	3	1	2	2
Great Egret <sup>R</sup>	490	164	584	128	319	302	311	171	121	124	41	121	186	433	351	731	212	276	27
Great Horned Owl <sup>R</sup>	0	0	0	0	1	1	1	2	1	1	2	3	1	1	1	1	1	0	1
Greater Scaup <sup>W</sup>	0	1	0	4	1	3	3	2	5	8	1	3	7	50	50	8	2	0	1
Greater White-fronted Goose <sup>RW</sup>	0	0	0	0	0	0	0	0	0	1	22	0	0	0	0	0	0	13	0
Greater Yellowlegs <sup>YR</sup>	51	95	175	94	110	93	121	106	129	129	145	99	237	226	150	169	80	230	43
Green Heron <sup>B</sup>	1	7	12	6	9	27	32	9	37	24	25	19	17	10	20	13	9	12	15
Green-winged Teal <sup>W</sup>	2590	1435	1494	2902	7450	5548	2375	1255	4445	7300	4682	4900	2875	3108	3082	6434	2443	3415	254
Gull-billed Tern <sup>B</sup>	7	3	9	11	9	60	266	248	38	210	262	218	138	209	52	110	154	228	277
Henslow's Sparrow <sup>RW</sup>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hermit Thrush <sup>W</sup>	0	1	5	3	3	3	4	7	11	10	6	14	6	5	3	1	7	2	2
Herring Gull <sup>W</sup>	12	5	6	6	2	3	17	5	16	3	25	58	158	63	132	168	11	9	1
Hooded Merganser <sup>W</sup>	722	6	1304	668	45	155	579	168	242	106	140	897	1500	1367	2495	539	1500	17	42

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Hooded Warbler <sup>N</sup>	0	0	1	1	0	3	0	1	2	1	1	2	0	0	1	2	1	1	2
Horned Grebe <sup>W</sup>	10	3	22	41	45	59	9	2	21	5	10	14	52	17	16	19	10	4	1
Horned Lark <sup>RW</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3	0	0	0	0
House Finch <sup>YR</sup>	0	0	0	0	0	1	0	0	1	0	6	1	16	4	0	7	9	3	8
House Wren <sup>W</sup>	1	2	7	13	17	15	19	13	31	15	28	24	10	17	8	12	18	8	17
Hudsonian Godwit <sup>M</sup>	0	2	0	0	1	1	0	0	0	1	0	0	0	2	0	0	0	0	0
Iceland Gull <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Indigo Bunting <sup>N</sup>	38	38	48	18	23	181	19	28	75	49	50	37	6	8	6	138	5	15	18
Kentucky Warbler <sup>T</sup>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Killdeer <sup>R</sup>	105	80	355	332	76	167	51	85	158	121	118	196	105	213	226	234	254	171	103
King Rail <sup>YR</sup>	0	0	0	0	0	1	1	0	0	0	1	1	1	1	5	1	3	2	1
Lark Sparrow <sup>T</sup>	0	0	0	0	1	0	2	1	0	2	1	0	0	0	0	0	0	0	1
Laughing Gull <sup>R</sup>	47	70	326	97	139	388	430	106	206	386	1218	377	644	308	1410	1219	565	3078	137
Le Conte's Sparrow <sup>W</sup>	0	0	0	1	2	3	19	19	1	1	0	1	4	1	2	3	1	2	3
Least Bittern <sup>B</sup>	0	1	1	1	2	2	3	4	2	6	1	4	6	3	5	8	5	7	1
Least Flycatcher <sup>M</sup>	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Least Sandpiper <sup>W</sup>	915	3966	3241	2252	3000	4450	9730	2952	5262	2402	5454	2114	1830	8087	2857	1436	861	3215	1306
Least Tern <sup>N</sup>	135	122	397	41	394	394	513	316	676	487	308	400	448	261	978	755	535	390	397
Lesser Black-backed Gull <sup>W</sup>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Lesser Scaup <sup>W</sup>	10	56	258	28	282	39	38	58	74	100	22	511	125	277	3455	62	100	16	5

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Lesser Yellowlegs <sup>W</sup>	663	4823	1546	1451	3062	2862	3401	856	2309	1205	955	1511	534	1480	1212	3075	904	2607	3000
Lincoln's Sparrow <sup>W</sup>	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	0	0	0
Little Blue Heron <sup>R</sup>	3	26	143	30	74	58	379	141	30	229	250	25	61	267	340	135	241	25	20
Little Gull <sup>T</sup>	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Loggerhead Shrike <sup>YR</sup>	0	0	1	1	1	1	0	4	1	1	1	1	1	2	3	1	2	3	2
Long-billed Dowitcher <sup>W</sup>	6	232	32	105	56	280	158	290	392	910	490	420	658	452	555	704	793	1161	349
Long-tailed Duck <sup>T</sup>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Louisiana Waterthrush <sup>M</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Magnolia Warbler <sup>M</sup>	0	1	1	3	0	3	2	1	1	2	3	4	1	1	0	6	0	0	1
Mallard <sup>R</sup>	4	10	35	44	60	129	132	141	105	165	110	154	137	79	106	142	106	84	22
Marbled Godwit <sup>W</sup>	0	0	0	0	2	1	1	2	0	1	0	14	13	0	0	1	2	2	0
Marsh Wren <sup>R</sup>	4	2	6	7	12	13	12	5	10	7	8	8	6	12	12	10	8	5	7
Merlin <sup>W</sup>	1	2	1	1	3	1	3	2	2	2	3	2	1	1	2	5	2	5	1
Mew gull <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mississippi Kite <sup>S</sup>	0	0	2	2	0	2	2	1	1	1	2	1	1	1	0	4	1	3	1
Mottled Duck <sup>R</sup>	87	86	229	200	149	364	312	81	64	285	200	290	150	754	692	425	646	489	183
Mourning Dove <sup>R</sup>	25	54	155	97	50	242	157	182	125	170	129	362	203	361	182	254	703	293	215
Mute Swan <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	3	0	0	0

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Nashville Warbler <sup>M</sup>	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	0	1	0	0
Nelson's Sharp-tailed Sparrow <sup>W</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Northern Bobwhite <sup>R</sup>	4	2	14	12	13	19	28	22	15	9	4	3	1	1	1	1	0	0	0
Northern Cardinal <sup>R</sup>	5	19	31	45	43	44	52	61	79	91	73	69	58	48	36	70	38	42	51
Northern Flicker <sup>YR</sup>	4	5	17	4	11	8	7	11	7	6	13	9	6	7	7	21	4	3	6
Northern Harrier <sup>W</sup>	4	6	6	9	7	10	12	10	13	16	22	12	10	8	10	12	10	24	13
Northern Mockingbird <sup>R</sup>	3	11	9	25	28	24	33	30	38	26	27	32	32	33	26	28	14	24	44
Northern Parula <sup>YR</sup>	0	1	1	2	5	7	3	17	5	5	16	8	4	2	1	6	5	3	10
Northern Pintail <sup>W</sup>	59	8	59	25	72	118	28	28	103	291	130	74	91	77	137	225	57	122	390
Northern Rough-winged Swallow <sup>N</sup>	1	1	0	7	2	3	8	4	4	4	3	2	1	2	3	3	6	5	3
Northern Shoveler <sup>W</sup>	2100	1095	3018	1726	3600	4626	5063	1976	4200	6300	4300	3221	3845	3008	3424	3429	2854	2100	659
Northern Waterthrush <sup>WM</sup>	0	2	4	6	7	23	21	29	60	7	12	23	19	12	17	15	57	26	49
Orange-crowned Warbler <sup>W</sup>	0	1	1	3	8	6	10	8	17	12	4	9	8	8	8	8	12	4	9
Orchard Oriole <sup>N</sup>	3	3	9	17	9	21	27	27	26	10	10	22	11	16	20	15	9	12	26
Osprey <sup>R</sup>	1	2	2	2	5	4	3	3	3	4	2	1	1	1	1	3	3	2	2



Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ovenbird <sup>M</sup>	0	0	0	0	3	1	0	0	2	1	1	2	1	1	1	2	0	0	1
Pacific Golden Plover <sup>T</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Painted Bunting <sup>N</sup>	2	8	15	33	30	36	30	28	42	27	46	34	23	20	11	41	16	38	37
Palm Warbler <sup>W</sup>	35	89	46	41	54	154	108	65	78	29	35	84	97	146	98	42	202	63	163
Pectoral Sandpiper <sup>M</sup>	32	31	25	97	92	124	244	105	50	140	14	154	11	73	53	113	40	50	29
Peregrine Falcon <sup>W</sup>	0	2	2	1	2	1	2	6	1	5	3	5	2	2	2	3	3	1	1
Pied-billed Grebe <sup>R</sup>	5	33	871	283	222	321	185	49	93	85	10	192	235	226	124	239	352	137	153
Pileated Woodpecker <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Pine Siskin <sup>W</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Pine Warbler <sup>T</sup>	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Piping Plover <sup>W</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Prairie Warbler <sup>M</sup>	3	5	7	15	6	15	11	29	62	21	56	29	34	27	68	7	20	11	76
Prothonotary Warbler <sup>M</sup>	0	0	1	1	0	1	1	10	6	0	3	3	2	2	6	2	1	0	0
Purple Gallinule <sup>B</sup>	0	0	0	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0
Purple Martin <sup>N</sup>	0	0	5	3	2	1	1	4	3	5	3	3	2	3	2	1	1	0	6
Red Knot <sup>W</sup>	0	20	0	0	1	0	0	0	0	0	17	1	0	1	3	4	0	0	0
Red-bellied Woodpecker <sup>R</sup>	1	3	7	2	4	3	5	7	7	7	12	8	3	6	6	4	4	4	3
Red-breasted Merganser <sup>W</sup>	0	0	2	6	33	7	17	1	2	6	7	8	6	4	6	3	3	0	5
Reddish Egret <sup>T</sup>	0	0	0	0	1	1	7	0	4	0	2	3	1	3	6	7	0	3	0

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Red-eyed Vireo <sup>T</sup>	0	0	10	8	11	14	8	24	11	7	15	20	7	10	2	7	10	1	12
Redhead <sup>W</sup>	10	4	31	35	6	6	0	2	0	9	0	6	1	16	32	8	16	8	0
Red-headed Woodpecker <sup>T</sup>	0	0	0	0	1	1	0	0	0	2	0	1	0	0	0	1	0	0	0
Red-necked Grebe <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Red-necked Phalarope <sup>M</sup>	0	1	0	0	0	1	1	0	1	5	66	1	2	16	5	8	5	10	1
Red-necked Stint <sup>T</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Red-shouldered Hawk <sup>S</sup>	0	1	3	2	2	1	1	2	0	2	3	3	3	3	2	5	3	7	4
Red-tailed Hawk <sup>R</sup>	5	11	5	5	6	22	32	16	14	11	20	24	14	15	13	18	14	37	32
Red-throated Loon <sup>W</sup>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red-winged Blackbird <sup>R</sup>	175	237	321	422	482	337	317	1861	875	1263	5000	3275	605	1823	1250	3522	7020	1862	7233
Ring-billed Gull <sup>W</sup>	321	521	359	616	329	207	479	180	190	301	745	1500	613	950	1500	1505	1700	1586	1200
Ring-necked Duck <sup>W</sup>	207	81	226	3250	960	1475	87	27	2630	3170	1335	6595	2938	174	2153	1125	1102	33	0
Rock Dove <sup>YR</sup>	30	26	33	65	62	44	70	45	10	25	48	63	30	36	102	34	18	20	32
Roseate Spoonbill <sup>S</sup>	0	1	0	0	1	0	0	0	8	15	19	25	27	46	78	372	135	116	80
Rose-breasted Grosbeak <sup>M</sup>	0	0	0	0	0	2	1	0	0	1	1	0	0	0	1	0	0	0	0
Ross's Goose <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
Royal Tern <sup>SB</sup>	6	45	211	26	9	32	19	33	291	9	208	43	195	148	16	50	90	124	80

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Ruby-crowned Kinglet <sup>W</sup>	1	2	4	6	16	15	32	33	88	73	23	29	17	24	27	21	25	12	19
Ruby-throated Hummingbird <sup>S</sup>	0	1	1	1	1	2	1	2	1	5	3	2	1	1	1	0	1	0	1
Ruddy Duck <sup>WR</sup>	12	496	1674	1778	2300	641	1936	204	1520	1441	965	1608	1350	5120	5120	1301	1128	941	8
Ruddy Turnstone <sup>W</sup>	14	1	3	10	7	4	56	13	2	9	18	16	8	6	17	10	2	15	9
Ruff <sup>T</sup>	0	1	1	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	0
Rusty Blackbird <sup>W</sup>	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sabine's Gull <sup>T</sup>	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Saltmarsh Sharp-tailed Sparrow <sup>W</sup>	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Sanderling <sup>W</sup>	3	2	1	5	2	10	52	50	22	4	8	1	1	1	3	4	1	4	0
Sandhill Crane <sup>T</sup>	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sandwich Tern <sup>B</sup>	0	0	0	0	0	3	0	6	0	1	2	0	0	0	1	1	1	0	0
Savannah Sparrow <sup>W</sup>	44	82	273	151	167	185	271	266	190	189	231	350	342	195	254	149	186	268	110
Scarlet Tanager <sup>M</sup>	0	0	0	0	0	0	1	1	1	0	1	1	0	0	0	0	2	0	0
Seaside Sparrow <sup>YR</sup>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Sedge Wren <sup>W</sup>	1	1	3	12	18	18	25	12	8	7	17	22	4	2	2	2	11	5	3
Semipalmated Plover <sup>W</sup>	120	377	319	294	662	435	542	386	236	709	517	1056	1350	725	834	819	548	591	709
Semipalmated Sandpiper <sup>M</sup>	2150	1050	220	3894	6000	13218	29115	3376	2448	19980	7879	15390	5107	6549	11636	9079	6093	16915	3046

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Sharp-shinned Hawk <sup>W</sup>	2	3	3	4	2	5	5	5	10	4	2	3	1	3	5	7	2	3	3
Shiny Cowbird <sup>T</sup>	0	0	0	0	3	4	1	0	1	3	1	0	3	0	0	0	0	0	0
Short-billed Dowitcher <sup>YR</sup>	80	2	4	55	178	569	406	183	295	226	96	538	1326	1192	313	1591	201	288	52
Short-eared Owl <sup>W</sup>	0	0	0	0	0	0	2	1	0	1	2	0	2	2	2	0	1	0	2
Snow Goose <sup>W</sup>	8	8	8	10	7	22	5	17	4	3	1	16	014	3	12	9	0	1	0
Snowy Egret <sup>R</sup>	120	309	418	378	663	790	1973	1106	965	1431	2500	275	1702	2500	1980	3049	945	1255	200
Solitary Sandpiper <sup>M</sup>	3	4	2	5	10	18	6	1.	2	5	8	4	16	3	16	60	8	2	3
Song Sparrow <sup>W</sup>	5	22	11	23	76	73	33	102	190	118	40	82	39	36	58	34	43	60	29
Sooty Tern <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Sora <sup>W</sup>	0	4	2	1	4	4	9	1	1	2	9	6	7	6	6	2	17	6	6
Spotted Sandpiper <sup>W</sup>	21	12	24	16	44	60	40	15	11	14	29	24	27	34	29	23	13	21	15
Sprague's Pipit <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Stilt Sandpiper <sup>M</sup>	81	360	287	339	437	898	661	313	713	1150	526	477	250	211	967	860	610	1169	132
Summer Tanager <sup>S</sup>	0	1	0	1	0	1	0	1	1	1	0	1	0	0	1	3	0	1	0
Surf Scoter <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Swainson's Thrush <sup>M</sup>	0	1	1	1	0	2	1	2	2	1	1	1	2	0	0	1	0	0	0
Swallow-tailed Kite <sup>S</sup>	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0
Swamp Sparrow <sup>W</sup>	1	38	18	37	109	89	64	165	161	141	57	45	27	36	31	44	63	80	25

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Tennessee Warbler <sup>M</sup>	0	0	0	0	0	0	1	0	1	0	3	2	0	0	0	2	0	0	0
Tree Swallow <sup>W</sup>	1700	8200	20150	44500	30100	5715	11300	36000	8728	10500	8000	3404	6500	20700	50000	15500	100000	144000	373
Tricolored Heron <sup>R</sup>	21	15	63	183	69	208	680	275	611	585	250	150	400	537	480	530	364	270	80
Tufted Titmouse <sup>T</sup>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tundra Swan <sup>W</sup>	0	0	0	5	1	0	0	0	0	0	2	0	0	0	1	0	4	0	0
Turkey Vulture <sup>R</sup>	32	30	26	34	32	23	82	55	60	36	52	38	117	136	50	39	28	101	29
Upland Sandpiper <sup>M</sup>	0	0	0	1	0	2	1	0	1	0	0	0	1	0	1	0	0	0	0
Veery <sup>M</sup>	0	0	5	0	1	1	0	2	1	3	0	2	0	0	0	0	0	0	0
Vermilion Flycatcher <sup>T</sup>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Vesper Sparrow <sup>W</sup>	0	6	3	13	8	6	6	2	3	4	4	12	13	11	11	23	0	6	1
Virginia Rail <sup>W</sup>	0	0	0	0	1	1	0	0	0	1	3	2	2	0	1	0	4	1	3
Warbling Vireo <sup>T</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Western Kingbird <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0
Western Sandpiper <sup>W</sup>	1000	2030	2927	1695	2900	3795	1756	2170	6800	6400	7500	4237	2506	2474	1350	4700	2503	3388	2000
Whimbrel <sup>W</sup>	0	0	0	0	20	0	0	0	0	4	0	4	193	0	27	7	3	0	0
Whip-poor-will <sup>W</sup>	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0
White Ibis <sup>R</sup>	99	170	282	404	233	936	2090	635	337	842	630	1004	610	2370	1921	1384	842	2432	141
White-crowned Sparrow <sup>W</sup>	0	6	5	6	19	16	6	20	51	17	16	47	6	12	14	16	4	3	5

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
White-eyed Vireo <sup>R</sup>	2	7	11	16	7	11	20	39	14	14	13	15	9	7	4	15	20	3	5
White-rumped Sandpiper <sup>M</sup>	21	34	115	41	147	120	69	127	64	43	11	98	36	43	48	26	66	136	24
White-throated Sparrow <sup>W</sup>	4	20	11	15	50	50	36	26	71	49	7	20	13	25	4	14	5	7	3
White-winged Scoter <sup>T</sup>	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
White-winged Tern <sup>T</sup>	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Willet <sup>R</sup>	33	32	71	93	63	49	65	33	147	58	44	81	52	66	79	112	99	55	71
Willow Flycatcher <sup>T</sup>	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Wilson's Phalarope <sup>M</sup>	2	4	21	37	17	10	1	20	17	18	22	9	11	14	23	12	6	15	2
Wilson's Plover <sup>B</sup>	16	37	12	34	24	33	13	7	19	16	39	21	38	26	20	47	25	36	16
Wilson's Snipe <sup>W</sup>	4	470	10	79	8	23	17	16	35	12	18	18	22	9	65	41	40	9	8
Wilson's Warbler <sup>T</sup>	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Winter Wren <sup>W</sup>	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0
Wood Duck <sup>WR</sup>	5	5	0	3	0	1	12	7	0	12	6	6	2	2	0	0	0	0	0
Wood Stork <sup>YR</sup>	1	57	226	43	140	101	140	137	42	72	43	68	252	200	415	414	32	19	63
Wood Thrush <sup>M</sup>	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2	0	0	0
Worm-eating Warbler <sup>M</sup>	0	0	0	1	1	0	0	0	0	0	2	1	2	1	0	1	1	0	0
Yellow Warbler <sup>M</sup>	3	5	3	13	34	20	37	22	66	35	30	168	38	72	212	31	97	23	100
Yellow-bellied Sapsucker <sup>W</sup>	0	0	0	1	2	1	2	2	3	6	6	4	2	3	2	3	3	3	5

Bird Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Yellow-billed Cuckoo <sup>N</sup>	1	2	4	7	5	6	6	7	3	4	3	3	2	2	1	2	1	3	2
Yellow-breasted Chat <sup>N</sup>	0	1	4	7	8	11	11	4	2	6	12	6	2	8	3	3	0	5	1
Yellow-crowned Night-Heron <sup>B</sup>	0	1	1	1	12	19	7	4	1	8	8	10	2	115	15	25	1	0	2
Yellow-headed Blackbird <sup>T</sup>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Yellow-rumped Warbler <sup>W</sup>	11	148	135	238	343	129	202	223	325	213	249	390	304	404	304	551	1019	512	968
Yellow-throated Vireo <sup>M</sup>	0	0	1	0	0	0	0	2	0	2	0	0	0	0	0	0	0	0	0
Yellow-throated Warbler <sup>M</sup>	0	0	0	1	0	0	1	2	3	2	2	1	0	1	0	0	1	0	2
TOTAL 22.8k 35.1k 55.7k 82.4k 81.1k 71.7k 95.8k 78.9k 62.8k 96.9k 82.9k 100.3k 66.3k 86.4k 126.8k 106.1k 164.1k 211.1k 37.2k																			
GRAND TOTAL = 1,663,922																			

<sup>B</sup> = Breeds in the areas and is likely a short-distance migrant that winters elsewhere on the continent.

<sup>N</sup> = Long-distance Neotropical migrant that breeds in the area, but winters in Central/South America.

<sup>M</sup> = Observed in the areas only during migration.

<sup>R</sup> = Occurs year-round and has nested in the areas or on one of the nesting islands.

<sup>T</sup> = Transient with no record of regular occupancy during the breeding, wintering, or migration seasons.

<sup>W</sup> = Winters in the area; likely a short-distance migrant that breeds north of the study area.

YR = Occurs year round but no confirmed successful breeding in the areas.

WR = Winters in the area and breeds in the areas occasionally.

RW = Rare, but has wintered in the areas.

S = Occurs only during the summer, but no confirmed breeding.

RS = Rare, but has occurred during the summer.

SB = Occurs in the areas during the summer and breeds; remains in the vicinity but moves out of the areas during the winter.

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14. ABSTRACT <p>The U.S. Army Corps of Engineers, Savannah District, has been responsible for monthly avian community monitoring on the dredged material containment areas (DMCAs) as part of the Savannah Harbor Navigation Project since 1994 to the present. This report summarizes the results of this monitoring effort from 1994 to 2012. During this period, over 6.9 million birds of 298 species were detected. These results are discussed in relation to the North American Bird Conservation Initiative, and specifically to the South Atlantic Region, where birds have been ranked according to their need of conservation effort. The SHNP DMCAs were found to support 22 of 36 designated Highest Priority Species, 70 of 90 High Priority Species, and 40 of 41 Moderate Priority Species. These results suggest that the SHNP DMCAs provide important habitat in the region, and may provide a critical link to buffer some priority species from becoming rarer. The report recommends that the Savannah District continues monitoring efforts, but should link the effort with Department of Defense (DoD) Coordinated Bird Monitoring efforts. In addition, data for the monitoring effort could be subjected to rigorous statistical procedures to test hypotheses concerning the success of current management efforts for the benefit of the bird community. The management approach established on the DMCAs could serve as an example for management of other Confined Disposal Facilities nationwide.</p>						
15. SUBJECT TERMS See Reverse						
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**15. SUBJECT TERMS (concluded)**

Savannah Harbor Navigation Project  
Long Term Management Strategy  
Dredged material Disposal Areas  
Monitoring surveys  
Waterfowl  
Terrestrial passerines  
Raptors  
South Atlantic Migratory Bird Initiative  
Highest Priority Species  
High priority Species  
Moderate Priority Species  
Savannah Harbor (Ga.)  
Shore birds  
Birds of prey  
Dredging -- Environmental aspects -- Savannah Harbor (Ga.)  
Dredging spoil -- Environmental aspects -- Savannah Harbor (Ga.)  
Endangered species  
Passerines