

Avian Inventory and Monitoring Needs for Fire Island National Seashore: A Review of Available Literature and Data

Final Report

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EXECUTIVE SUMMARY

In 1999, the National Park Service (NPS) announced the "Natural Resource Challenge" for preserving natural resources in parks. As part of the challenge, the National Park Service implemented a strategy designed to institutionalize natural resource inventory and monitoring on a programmatic basis throughout the agency. As a result the NPS developed the Inventory and Monitoring (I&M) Program.

This program ensures that the 270 park units (NPS 2004) with significant natural resources possess the resource information needed for effective, science-based, managerial decision-making and for resource protection required as part of the Natural Resource Challenge. One of the many goals of the I&M Program is to gather all of the existing natural resource information for each of the I&M parks and compile it electronically in order to make it easily accessible and available for park management purposes.

Compilation of natural resource information, however, is just the first step. Information evaluation and interpretation is paramount to developing effective resource management strategies. With the preponderance of species that must be considered by park managers, there is a need for expert evaluation of existing taxa-specific information. When information is lacking, park managers may need advice regarding how best to fill gaps in knowledge, and where or how to allocate management resources to benefit species of greatest concern.

For park managers to develop effective strategies to maintain the viability of avian populations they must know which populations occur in their parks, their status, and potential threats. New Jersey Audubon Society (NJAS), under a cooperative agreement with the National Park Service (NPS), conducted a comprehensive review of existing avian information for Gateway National Recreation Area (GATE) and Fire Island National Seashore (FIIS), two parks within NPS's Northeast Coastal and Barrier Network.

In an earlier report (Mizrahi 2004), we discussed how we constructed an NPSpecies-compatible database for each unit of GATE and FIIS. We also developed a systematic method to classify the residency status of species that occur during more than one distinct period of the annual cycle, and a standardized way to present additional residency status and abundance information in the database. The systematic method for classifying the residency status of birds coincided with the National NPS NPSpecies Data Dictionary (<https://science1.nature.nps.gov/npspecies/web/main/start>). After careful review of current documents and data sets, and with a working knowledge of avian abundance and distribution patterns in the region immediate to the park, we completed all fields in the FIIS

database and corrected inaccuracies.

We used NatureBib and other bibliographic databases to identify information source and data sets to use in evaluating existing knowledge gaps regarding FIIS's avian resources. Given the number of species that must be considered by park managers, and limits on resources available to conduct active species management, the need to prioritize among species is important. Our assessment of avian resource management needs was made within the context of regional and national conservation objectives.

To identify information sources, our review mainly focused on comprehensive, multi-year reports and databases, and published, peer-reviewed manuscripts. Additionally, we reviewed recent scientific permit applications for research and monitoring efforts at FIIS. We also interviewed several natural resource staff from FIIS to augment our perspective regarding inventory and monitoring needs throughout the park.

We found that several conservation priority species, across all avian groups, lack sufficient data to make informed resource management decisions. Seaside and Salt Marsh Sharp-tailed Sparrow and Prairie Warbler (passerines), Northern Harrier, American Kestrel, Short-eared and Barn Owl (raptors), American Oystercatcher, Willet and American Woodcock (shorebirds), American Black and Wood Duck (waterfowl), and Black Rail and Little Blue Heron (waterbirds), are examples of the species that may require additional inventory and monitoring to support informed management actions. We also found that information about avian species during migration was lacking for some taxa. Additionally, we noted that studies examining the effects of human activity on avian behavior and population health have not been implemented within the park, despite the potential for direct human disturbance in this popular recreation area.

For those species, species groups, or guilds identified as requiring additional abundance and distribution data, we outlined several methods (e.g., point counts, MAPS) that could be used to accomplish inventory and monitoring needs.

Overall, we found that FIIS is an important barrier island ecosystem that provides habitat for a diversity of avian species. Although the park is not critical to the viability of any avian population, it contains essential habitats used by a wide variety of species throughout the annual cycle.

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I. BACKGROUND

The National Park Service (NPS) recently embarked on an ambitious venture called the "Natural Resource Challenge." This program was designed to preserve natural resources in 270 park units that have significant natural resources (NPS 2004). To address the goals of its new program, the NPS created the Inventory and Monitoring (I&M) Program to ensure that parks had the resource information needed for effective, science-based managerial decision-making and resource protection.

One of the first objectives of the I&M Program was to gather and compile existing natural resource information for each of the I&M parks into a format that was easy to use and available for park management purposes. NPSpecies, a relational database that resource managers can use to retrieve information on living resources across all parks, or for just a single park, is a major component of this information delivery system (<http://science.nature.nps.gov/im/apps/npspp/>). Another useful resource is NatureBib, a searchable database of bibliographic citations that can provide a mechanism to find more detailed information about a particular resource in a park, or system-wide (<http://www.nature.nps.gov/nrbib/>).

Compilation of natural resource information, however, is just the first step. Databases are only as good as the information they contain, so evaluating the validity and completeness of information in NPSpecies and NatureBib is paramount to developing effective resource management strategies. When data are lacking, their interpretation can be difficult or misleading, which can lead to uncertainty regarding the allocation of management resources, or the misappropriation of these resources.

These problems form the basis of this project's goals. New Jersey Audubon Society (NJAS), under cooperative agreement with the National Park Service (NPS), was charged with evaluating the completeness and accuracy of avian species information contained in NPSpecies for two parks in the Northeast Coastal and Barrier Island Network, Gateway National Recreation Area (GATE) and Fire Island National Seashore (FIIS). These databases were provided to NJAS from the NPS I&M Program for each GATE unit and FIIS. NJAS populated the database with data not previously entered and reviewed the database for accuracy. NJAS was also asked to identify knowledge gaps for avian resources at GATE and FIIS, and to make recommendations on how to fill those gaps with new inventory and monitoring programs.

NJAS and its staff are recognized as one of the leading non-government conservation organizations in the region that includes the two parks of interest. The products that result from this effort will provide park resource managers the necessary tools to develop strategies that can help ensure the long-term persistence of avian populations. This report covers activities, findings, and recommendations related to avian databases and resources for FIIS. Findings and recommendations for GATE were presented in an earlier report (Mizrahi 2004).

II. GOALS AND OBJECTIVES

The goal of this project is to compile and evaluate existing avian inventory and monitoring data for Fire Island National Seashore (FIIS). The park includes a variety of habitats that support numerous bird species comprising several taxonomic guilds.

Specifically, our objectives are to (1) compile and review existing avian occurrence, status, and abundance, (2) update and where necessary, make corrections to existing NPS databases, (3) compile and review existing inventory and monitoring information pertinent to the parks (4) determine completeness and quality of existing inventory and monitoring data, (5) develop a historical perspective of inventory and monitoring activities and evaluate the spatial and temporal applicability of the available information, and (6) identify gaps in knowledge and make recommendations for future inventory and monitoring efforts.

III. APPROACHES

IIIA. NPSpecies Database

To meet Objectives 1 and 2, we reviewed available documents (See Appendix 1) that provided information on the occurrence, status, and abundance of avian species at FIIS. Several of these were already acknowledged as source material in the NPSpecies database. Note that all species names in the NPSpecies database and in this review coincide with current AOU standards (<http://www.aou.org/checklist/index.php3>)

Before updating the NPSpecies database, we systematically classified the residency status of species that occurred during more than one distinct period of the annual cycle. The systematic method for classifying the residency status of birds coincided with the National NPS NPSpecies Data Dictionary <https://science1.nature.nps.gov/npspecies/web/main/start>). The order of status priority was established as breeder, migrant, resident, and transient for species that could be classified in more than one residency category (see Appendix 2 for details and justification). For example, although Canada Goose (*Branta canadensis*) occurs in the park as a "breeder," a "migrant," and a "resident," according to NPSpecies definitions of these categories, we classified it as a "breeder." Abundance data relevant to the breeding season then appears in the "Abundance" field.

This meant, however, that information about the status and abundance during the other part of the annual cycle needed to be incorporated into the database to provide a comprehensive perspective of the species' occurrence in the park. To address this need, we developed a standardized way to present additional residency status and abundance information in the "Residency" and "Abundance" Details fields of the database for species classified in multiple residency status categories (see Appendix 2 for examples).

We used New York Breeding Bird Atlas (NYBBA, Andrle and Carroll 1988) and its associated website, <http://www.dec.ny.gov/animals/7312.html> (2000-2005), as the foundation of breeding confirmations for this park (see Appendix 3 and Figure A-3 for relevant Atlas blocks reviewed). The NYBBA served as the primary source of information because it represented the most comprehensive treatment of the seasonal occurrence and status of birds on FIIS. We determined seasonal abundance using several resources including Birds of Fire Island National Seashore (Mitra and Putnam 1999) and findings from the Long Island Colonial Waterbird and Piping Plover Survey (NYDEC, <http://www.pwrc.usgs.gov/cwb/database/>, 1972-1996). We also used Bull's Birds of New York State (Levine et al. 1998) for information on migratory and residency information. Christmas Bird Count data (CBC, <http://www.audubon.org/bird/cbc>) were not used as a major source for winter residency information, because each CBC circle included significant area beyond the park boundaries (see Appendix 4 for details and relevant count circles reviewed).

Data for every field, for each species known to occur, were compiled and entered into our unit-specific databases by Jeannine Parvin, NJAS's Database Manager. Final review to validate information and to detect discrepancies was conducted by David Mizrahi, Ph.D., Vice-president for Research and Monitoring for New Jersey Audubon Society.

IIIB. Literature and Data Review

To address Objectives 3-5, we used a variety of keywords (see Table 1) to search and extract bibliographic information on avian inventory and monitoring activities from NatureBib, the NPS's citation database. When available, we also extracted abstracts of relevant papers and reports. We found a total of 174 avian-related citations for FIIS (Table 1). To facilitate our review, we sorted these citations based on the general taxonomic categories used in NPS document titled "Review of Monitoring Programs for Vertebrates of the Northeast Coastal and Barrier Network" (Fabre 2003). A breakdown of citation numbers by taxonomic group is provided in Table 2. A similar approach was taken to identify citations in other bibliographic databases, such as BIOSIS (Thompson Scientific, <http://scientific.thomson.com/>), Current Contents (Thompson Scientific), and Rutgers and Clemson University Libraries.

Our review of available literature focused primarily on comprehensive, multi-year reports (e.g., New York State Department of Environmental Conservation [NYSDEC] Colonial Waterbird and Piping Plover Survey, New York State Ornithological Association [NYSOA] Winter Waterfowl Count) and published, peer-reviewed manuscripts.

Sources more than 20 years old generally were not reviewed because their relevance to current inventory and monitoring needs is limited. Casual reports, reports with "anonymous" authors, or those appearing as lists (with the exception of lists provided by the Fire Island Lighthouse banding project, Buckley et al. 2002) generally were not reviewed. Information from these sources, if credible, has likely been incorporated into the various checklists that are currently available for the park.

In our review, we considered the overall spatial and temporal scope of the information with respect to the park. We also evaluated whether the information was sufficient to meet current inventory and monitoring needs.

Table 1. The following are the keywords used to search the National Park Service's NatureBib online citation database for Fire Island National Seashore in 2004 and 2006. The keyword "Birds" produced the greatest number of bird-related citations. Subsequent searches using other keywords yielded bird-related citations, but only a portion of these represented unique citations not found in the original search using the search term "Birds."

Keyword	Fire Island National Seashore -2004		Fire Island National Seashore -2006	
	# Citations	# Unique avian citations	# Citations	# Unique avian citations
Birds	117	117	142	142
Bird	18	0	143	1
Avian	0	0	1	1
Aves	1	0	18	0
Ecology	189	4	246	20
Ecological	3	0	8	0
Hawk	0	0	6	0
Hawks	1	0	6	0
Inventory	42	14	62	7
Marshbird	0	0	0	0
Marshbirds	0	0	0	0
Passerine	0	0	1	0
Passerines	1	0	1	0
Raptor	0	0	4	0
Raptors	0	0	4	0
Falcons	0	0	0	0
Eagles	0	0	0	0
Owls	0	0	0	0
Shorebird	0	0	5	0
Shorebirds	3	2	5	0
Waterbird	0	0	21	0
Waterbirds	14	2	20	0
Waterfowl	14	2	16	3
Totals	403	141	709	174

We used state and federal "endangered," "threatened," and "special concern" species lists to identify gaps in knowledge and recommend focused inventory and monitoring efforts by the

park. New York state listings in this report are current to 2007 (<http://www.dec.ny.gov/animals/7494>)

We also reviewed and compiled information from national bird conservation plans pertinent to the park, such as the Partners in Flight (PIF) Southern New England Plan (SONE, Dettmers and Rosenberg 2000, see Figure 1 for map of plan coverage area), Bird Conservation Region 30 Plan (BCR 30, a synthesis of PIF MACP and SONE plans; Rosenberg et al. 2002), the U.S. Shorebird Conservation Plan/North Atlantic Region (USSCP, Clark and Niles 2000), North American Waterfowl Management Plan (NAWMP), and North American Waterbird Conservation Plan (NAWCP, Kushlan et al. 2002), to evaluate inventory and monitoring needs for species identified as national and regional conservation priorities (see Appendices 9 and 10 for conservation concern categories).

Table 2. Number of citations by avian group for Fire Island National Seashore (FIIS) found by searching the National Park Service's NatureBib literature database.

<u>Category</u>	2004	2006
	<u>Citations</u>	<u>Citations</u>
Passerines/Landbirds	12	12
Diurnal/Nocturnal Raptors	1	4
Shorebirds*	3	2
Waterbirds	36	41
Waterfowl	16	19
General Inventory**	16	30
Miscellaneous	57	66
Totals	141	174

* Does not include 9 citations from the Long Island Colonial Waterbird and Piping Plover Survey, and 1 citation from the Long Island Least Tern and Piping Plover Survey. These 10 citations are included in the "Waterbirds" category.

** Includes 1 annual report from the William Floyd Salt Marsh Bird Monitoring project (2001).

We also interviewed park staff from FIIS, and individuals familiar with the park, to explore what gaps in information might exist that a literature and data review would not reveal. Scott Barnes (NJAS) conducted a standardized interview at each unit (see Appendix 5 for a list of interviewees and questions) and also conducted several phone interviews. Notes from these interviews and conversations (see Appendix 6) were incorporated into our assessment of avian inventory and monitoring needs for the park.

Because we were unable to obtain some reports and manuscripts for review, we also took a meta-analysis approach to developing an historic perspective of inventory and monitoring in the park and identifying gaps in knowledge. We considered the total of taxa-specific inventory and monitoring information available for the park, the time frame of these data, and their overall ability to address current inventory and monitoring information needs with respect to endangered, threatened, special concern, and priority species. In this report, species groups are treated separately, with groupings generally following those used by Fabre (2003).

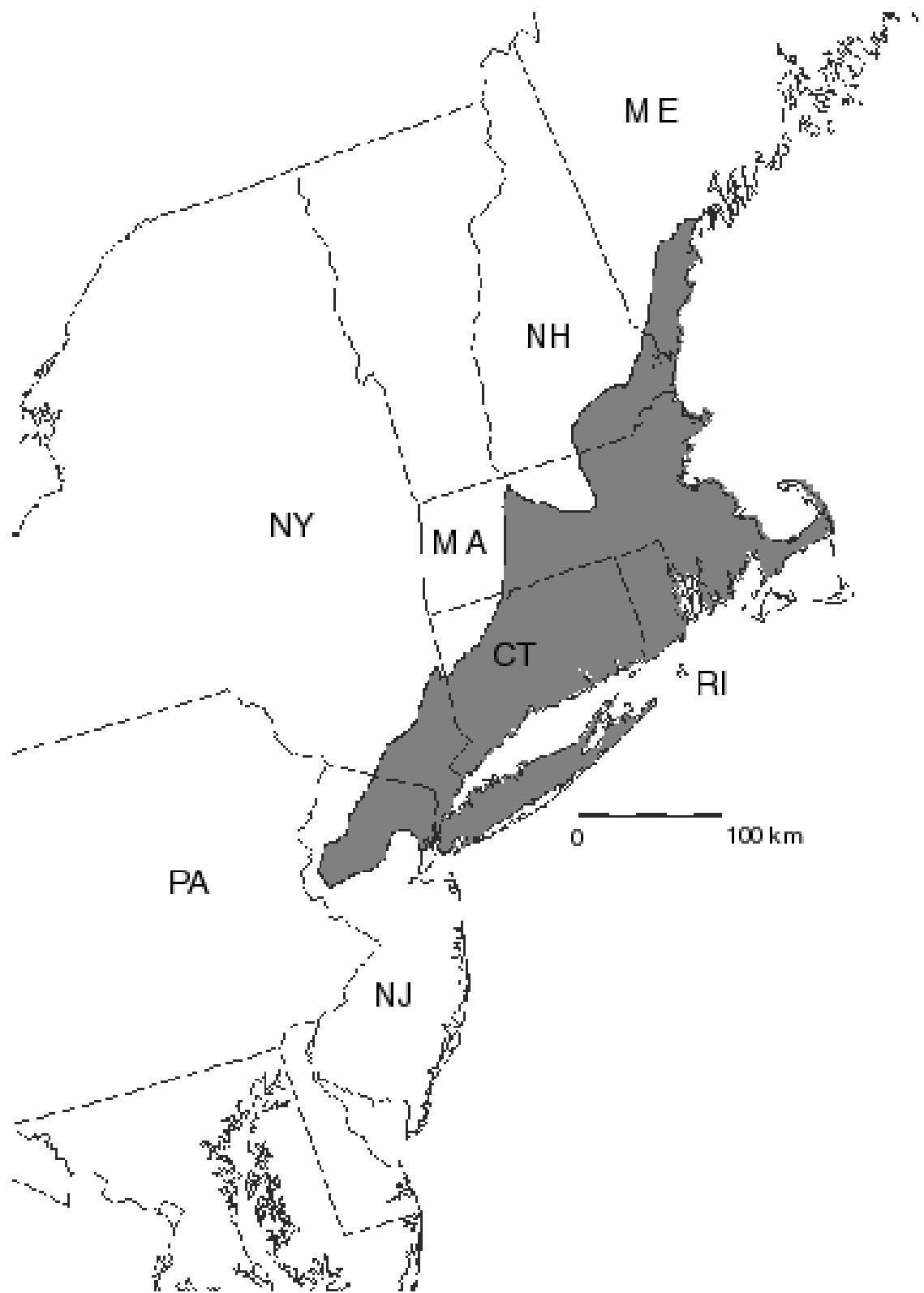


Figure 1. Partners-in-Flight Southern New England (SONE) physiographic region (#9) covering 4,425,100 hectares (10,934,422 acres) across New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine.

They differ in that (1) grassland/shrubland passerine species are covered with other landbirds and passerines, and (2) non-passerine marsh birds (e.g., rails) are covered with colonial waterbirds in a single section. We employed these changes for general convenience and because this system was used in the GATE assessment (Mizrahi 2004). The grassland/shrubland bird guild is not an important one within FIIS habitats and therefore did not merit a full section for review. Few data were available on non-passerine waterbirds using FIIS, which were subsequently presented in their own subcategories within the colonial waterbirds section.

The primary purpose of our pertinent literature and data review was to identify gaps in knowledge about avian species at FIIS, and recommend actions that would begin to resolve them (i.e., Objective 6). Throughout the document we point out what we believe are obvious needs for information regarding the abundance, distribution, and ecology of particular avian species, species groups, or guilds. A synopsis of our recommendations is presented in Appendix 7.

IV. RESULTS OF REVIEW

IVA. NPSpecies Database

Compared to GATE (Mizrahi 2004), we found the avian database for FIIS to be in relatively good condition with respect to how much information was previously entered. Many of the abundance and nativity fields were completed for species records, and most had the residency status field completed. Additionally, citations referencing the information sources for particular fields were included in most cases.

After thorough review of available official checklists, state atlases, and multi-year, systematic seasonal counts and studies, we generated a draft database for the park. This draft had all fields completed with appropriate citations, except for "residency" and "abundance" details information. These fields were completed as part of a comprehensive review of the draft conducted by Scott Barnes. Information in the "details" sections included data on residency for species that occur during more than one distinct period of the annual cycle and their corresponding abundance data.

The final draft of the database was submitted to NPS's Northeast Coastal and Barrier Network Inventory and Monitoring staff for review in 2005. From this we derived species lists for Fire Island National Seashore (see Appendix 8 for list). However, note that this list includes historic species, unconfirmed species as well as synonyms for species. The NPSpecies database should be consulted to obtain information on the current status of all species listed.

Our review of the NPSpecies database and the information necessary to complete all fields indicated that FIIS generally lacks specific avian data across the annual cycle. Three of the 13 NYBBA blocks pertinent to the park also include large areas of possible breeding habitat

outside of the park limits, making it difficult to draw inference about breeding occurrences for some regions of the park. Similarly, although three Christmas Bird Count circles include FIIS, only a small percentage of these circles is park habitat and each includes significant birding habitat outside of park boundaries. Therefore, specific data on winter occurrences cannot be attributed specifically to the park. Systematic migration monitoring, however, is taking place for raptors (Fire Island Hawk Watch) and in the recent past for passerines (Buckley and Mitra 1998, Buckley et al. 1994, 1998, 2002; as part of a study of North American birds as hosts for the Lyme disease spirochete).

IVB. Literature and Data Review

1. *Land Birds/Passerines*

Results

A review of NatureBib resources revealed 12 references specifically related to passerines or near-passerines on FIIS (e.g., hummingbirds, woodpeckers; Table 2). More than half (n=7) of the references were associated with studies of birds as vectors for ticks carrying Lyme disease (Buckley and Mitra 1998, Buckley et al. 1994, 1998, 2002, Dillon 1997, Ginsberg et al. 1994), with two containing summaries of banding activity conducted at Fire Island Lighthouse (Buckley 1972, Buckley et al. 2002). The more current banding report (Buckley et al. 2002) consisted of an unpublished list of species caught 1995-2002, but did not provide temporal (i.e., date) or abundance data.

Two additional studies dealt with passerine behavior on FIIS. One was species-specific and detailed the social behavior of seaside sparrow (Post 1972), while the other provided information regarding habitat use and foraging behavior of several passerine species during spring and fall migration (Smith et al. 1983). Three references were old accounts of individual species (Smith's longspur, Davis 1976; gray catbird; Smith 1962) or hybrids ("purple" grackle, Huntington 1952),

A search of the published literature uncovered five additional sources of passerine work conducted on or near FIIS that were not listed in the NatureBib database (Baird et al. 1959, Buckley 1959, 1974, Ginsberg et al. 2004, 2005). Buckley (1974) and Baird et al. (1959) are dated and report landbirds caught in mistnets at the Fire Island Lighthouse and Tiana Beach, respectively, during fall migration. Buckley (1974) reported only "rare" migrants, whereas Baird et al. (1959) reported both rare and "principal" species. Ginsberg et al. (2005) report on birds caught during a recent study (August-July, 1997-1998) to test for "reservoir competence" for Lyme disease in six species of passerines, including American robin (*Turdus migratorius*), gray catbird (*Dumetella carolinensis*), brown thrasher (*Toxostoma rufum*), eastern towhee (*Pipilo erythrophthalmus*), song sparrow (*Melospiza melodia*), and northern cardinal (*Cardinalis cardinalis*).

Several general inventories of various intensity (e.g., checklists and systematic surveys) that would be expected to include passerine species were also listed in the NatureBib database. Summary reports from the Central Suffolk County Christmas Bird Count (CBC) were cited in NatureBib for 1958-1966, 1971, 1985, 1987-1991, 1993, 1995, and 2000, and from the Captree Christmas Bird Count for 1967 and 1971. June Bird Counts were also conducted by the Fire Island National Seashore park staff in several years, and reports are available and listed in NatureBib for 1985, 1988-1990, 1992, 1993, and 1995. Updated data for the three sites (ending with survey 71 for the LI Fire Island Unit, and survey 103 for the LI Captree and LI Central Suffolk County Units) are available at <http://www.audubon.org/bird/cbc/> but are not referenced in NatureBib.

The CBC surveys are useful for obtaining general information regarding the presence of avian overwintering species, but do not provide reliable data concerning relative abundance due to sampling issues such as annual differences in observer effort (Dunn et al. 2005). Suggestions have been offered to improve future CBC data, such as having participants separate data obtained during different types of survey efforts (e.g., feeder-watching vs. area searches), or encouraging the establishment of standardized sample components within CBC circles (e.g., standardized survey routes) (Dunn et al. 2005). If such measures are taken in the FIIS region, future CBC data could prove more useful for estimating species relative abundance during winter. These data, however, will not be useful for determining species distributions within the park unless more refined survey site information is also obtained, as only a small percentage of each of the three CBC count circles that overlap FIIS actually fell within park boundaries.

Finally, standardized point counts were conducted at several georeferenced sites within the Long Island National Wildlife Refuge Complex in forest (39 points, 2001-2006, excluding 2005), grassland (10 points, 2001) and saltmarsh (17 points, 2004-2005) habitats by Tom Penn (USFWS). Most of the points were located in the Wertheim National Wildlife Refuge, and may be useful for inferring what species occur in similar habitats on FIIS. These data are publicly available in the USGS Point Count Database (<http://www.pwrc.usgs.gov/point>) and could provide useful regional information, but are not referenced in the NatureBib database.

Additional resources for landbird monitoring data are limited with respect to FIIS. For instance, there has not been a MAPS (Monitoring Avian Productivity and Survival) study conducted within FIIS. MAPS is a program developed and administered by the Institute of Bird Population Studies (IBPS) (<http://www.birdpop.org/maps.htm>) to assess and monitor vital rates and population dynamics of approximately 120 species of North American landbirds using constant-effort mist netting and banding at a continent-wide network of monitoring stations. There are also no Breeding Bird Survey (BBS) routes on FIIS, although there was a route established at neighboring Jones Beach (route #61004) in 2005. The BBS is a cooperative effort between the U.S. Geological Survey's Patuxent Wildlife Research Center and the Canadian Wildlife Service's National Wildlife Research Centre to monitor the status and trends of North American bird populations. Following a rigorous protocol, BBS data are collected by thousands of dedicated participants along thousands of randomly established

roadside routes throughout the continent. Data obtained from the Jones Beach route would be expected to continue in subsequent breeding seasons and are available at the Migratory Bird Data Center website (<http://mbdcapps.fws.gov/>).

Another important resource not listed in NatureBib refers to an extensive avian survey conducted on Fire Island between May and June 2002, and October and May 2002/2003 in support of the Shore Protection and Storm Damage Reduction Project (U.S. Army Corps of Engineers 2003). This survey consisted of 20 standardized strip-transect samples spread across approximately 52 miles of the island, and yielded over 17,000 observations of 162 avian species. Documented species included several landbirds, waterbirds and raptors, including 16 listed as federally endangered, threatened, or special-concern. Information from this report should be integrated into current species lists for the park, and the report should be added to the NatureBib database.

Several site-specific (e.g., within FIIS) monitoring efforts were documented and listed in the NatureBib database, with a particular emphasis on the William Floyd Estate (WFE). The WFE consists of 247 ha, of which 65% are forested and likely to be an important area for breeding passerines. Forested areas on the estate consist mainly of xeric black oak (*Quercus vlutina*) – white oak (*Q. alba*) dominated habitats (Klopfer et al. 2002). Furthermore, from June 1999 through September 2000, restoration efforts were conducted on WFE in support of the Long Island Wetland Restoration Initiative, which is part of a Long Island-wide marsh restoration program developed by the U.S. Fish and Wildlife Service, Ducks Unlimited, Suffolk County (New York) Vector Control Commission, and the New York Department of Environmental Conservation. The goal of the project was to recover, at least in part, tidal wetland habitat on the estate that was conducive to use by waterfowl, wading birds, shorebirds, fish, and other wildlife. Activities designed to restore the natural hydrology of the 60+ ha of wetland, including open marsh hydrology management (e.g., ditching), were implemented at several sites within the estate. Although post-restoration monitoring efforts were limited, they provide some insight into avian species present on the WFE (Taylor 2001a)

Lynch (1986) conducted an avian inventory of the WFE but his report provided only a common name list of the species observed and did not provide information regarding species-specific abundance, residency, or nativity. Similarly, an inventory conducted within the WFE by Jack McCormick & Associates (McCormick 1975) listed species occurring in the park, and their associated habitats within the park, without offering information on species abundance or residency. The McCormick (1975) report is the only source that documents the historical presence of Henslow's sparrow (*Ammodramus henslowii*), a PIF watchlist species with high continental priority, in the park.

Taylor (2001a) provided an annual report summarizing the results of a more formalized salt marsh bird survey conducted on the WFE from May 2000 – April 2001. These surveys were conducted systematically on a monthly basis using line-transect (120-230m) sampling methods at two restored and one unrestored spartina-dominated marsh sites. Birds were recorded as either $\leq 50\text{m}$ or $> 50\text{m}$ from the transect line. Unfortunately, this unpublished

report contains only total observations by species or species groups for the entire survey period, without relative abundance estimates or annual phenologies which could have been inferred from the raw data.

One breeding bird survey from the Otis Pike Wilderness was also documented by Taylor (2002). The report includes a species list based on point counts conducted at 10 points located between the Smith Point visitor's center and Bellport Beach, along with numbers of observations. Only 20 landbird species were recorded and the list was meant to serve as a baseline for future studies. However, we were unable to locate any record of subsequent surveys conducted at the site.

Recommendations

As with the GATE complex (Mizrahi 2004), the need to conduct systematic, spatially comprehensive abundance and distribution monitoring programs exists throughout FIIS. Information on several state-listed species and high priority species listed in BCR 30 and PIF SONE plans (Table 3) could be obtained through such efforts. Efforts could include establishing permanent point count survey routes throughout the park (Ralph et al. 1995) and instituting MAPS stations within the park. Incorporating methods that allow for the estimation of detection probability such as distance sampling (Buckland et al. 2001, Diefenbach et al. 2003), time-depletion removal (Farnsworth et al. 2002) or occupancy modeling (MacKenzie et al. 2005) would also improve estimates by removing the bias associated with observers' imperfect ability to detect birds present at a site.

Natural resource staff expressed the opinion that more focused monitoring of seaside sparrow (*Ammodramus maritimus*) and saltmarsh sharp-tailed sparrow (*Ammodramus caudacutus*) was needed at the park. These two species are identified by the SONE and BCR 30 plans as "high continental concern," "high regional responsibility" (i.e., 1A; Table 3). They are both confirmed breeders in FIIS (Mitra and Putnam 1999). Seaside and Saltmarsh Sharp-tailed Sparrow nest in emergent herbaceous marsh habitats, although the latter is more likely to be found in the higher, drier portions of the marsh (Greenlaw and Rising 1994, Post and Greenlaw 1994). Both species are susceptible to the effects of sea level rise and mosquito control practices that bring higher tide water levels to nesting areas in the marsh (e.g., open marsh water management, Greenlaw and Rising 1994, Post and Greenlaw 1994).

Monitoring efforts for seaside and saltmarsh sharp-tailed sparrow on FIIS have been limited. In the Taylor (2001a) William Floyd Estate marsh bird surveys, seaside and saltmarsh sharp-tailed sparrows were unfortunately lumped into a single category labeled "marsh sparrows". However, nearly all (40 of 42) of these individuals were located at one restored site, offering opportunity for further, intensive monitoring efforts for these two species at that site. It is also noteworthy that Dr. Chris Elphick and Dr. Margaret Rubega, (University of Connecticut) are currently conducting research to develop a method to estimate the numbers of saltmarsh sharptailed sparrows (above) and seaside sparrows living in Long Island Sound salt marshes. Their goal is (1) to study population health and habitat relationships to determine if potential

habitats within Long Island Sound can sustain viable breeding populations, and (2) to assess which sites need to be restored and protected (http://hydrodictyon.eeb.uconn.edu/people/elphick/sparrows/saltmarsh_sparrows.htm). The progress and spatial domain of this study is not currently publicly available, but could provide insight into the ecology of seaside and saltmarsh sharp-tailed sparrows breeding on FIIS.

Table 3. State, Partners-in-Flight (PIF), and Bird Conservation Region (BCR) plan rankings for priority near-passerine and passerine landbirds that likely breed on Fire Island National Seashore.

Common Name	Scientific Name	State Status ^a	PIF SONE ^b		BCR 30 ^c	
			Priority Tier*	Action Level**	Priority Tier*	Action Level**
Whip-poor-will	<i>Caprimulgus vociferus</i>	NY (SC)	5	4	2A	3,5
Chimney Swift	<i>Chaetura pelagica</i>		2	3	2A	3
Northern Flicker	<i>Dryocopus pileatus</i>		--	--	2A	3
Eastern Wood-peewee	<i>Contopus virens</i>		2A	3	2A	3
Great-crested Flycatcher	<i>Myiarchus crinitus</i>		--	--	2A	3
Eastern Kingbird	<i>Tyrannus tyrannus</i>		--	--	2A	NA
White-eyed Vireo	<i>Vireo griseus</i>		--	--	--	--
Horned Lark	<i>Eremophila alpestris</i>	NY(SC)	--	--	5	4
Marsh Wren	<i>Cistothorus palustris</i>		--	--	2A	NA
Wood Thrush	<i>Hylocichla mustelina</i>		1A	3	1A	3
Gray Catbird	<i>Dumetella carolinensis</i>		--	--	--	--
Brown Thrasher	<i>Toxostoma rufum</i>		--	--	2A	3
Prairie Warbler	<i>Dendroica discolor</i>		1A	3	1A	3
Blue-winged Warbler	<i>Vermvora pinus</i>		1A	3	1A	3
Black-and-white Warbler	<i>Mniotilta varia</i>		2A	3	2A	3
Yellow-breasted Chat	<i>Icteria virens</i>	NY(SC)	5	4	--	3
Eastern Towhee	<i>Pipilo erythrophthalmus</i>		2A	3	2A	3
Field Sparrow	<i>Spizella pusilla</i>		--	--	2A	3
Seaside Sparrow	<i>Ammodramus maritimus</i>	NY (SC)	1A	2	1A	4,5
Saltmarsh Sharp-tailed Sparrow	<i>A. caudacutus</i>		1A	4	1A	2,5
Grasshopper Sparrow	<i>A. savannarum</i>	NY (SC)	--	--	2C	3
Savannah Sparrow	<i>Passerculus sandwichensis</i>		--	--	5	3
Eastern Meadowlark	<i>Sturnella magna</i>		--	--	5	3

^a T=Threatened, SC=Special Concern

^b Southern New England physiographic region (#9)

^c Bird Conservation Region 30 encompasses areas covered by SONE PIF plan

* PIF Priority Tiers (see Appendix 11 for detailed descriptions or priority categories): 1A-High continental priority/high regional responsibility; 1B High overall priority/low regional responsibility; 2A-High regional concern; 2B-High regional responsibility, 2C-High regional threats, 3-Additional Watch list species; 4-Additional federally listed species, 5-Additional state listed species

** PIF Action Levels (see Appendix 11 for detailed descriptions or priority categories): 1-Crisis recovery needed, 2-immediate management, 3-management to reverse or stabilize populations, 4-long term planning is needed, 5-investigations are needed to better define threats, 6-monitor population changes only

The need for a standardized, comprehensive marsh bird monitoring program prompted two recent workshops that were held at the Patuxent Wildlife Research Center (1998 Marsh Bird Monitoring Workshop, 2006 Marsh Bird Monitoring Technical Workshop). Although the marsh bird monitoring program focuses primarily on secretive marsh birds such as rails (*Rallus* sp.), seaside and saltmarsh sharp-tailed sparrows are also identified as target species. This work could also provide similar information for Marsh Wren (*Cistothorus palustris*),

another species that inhabits emergent herbaceous marshes in FIIS and identified as a "high priority" species (2A, Table 3) by the BCR 30 plan. Proceedings and documentation presented at these workshops are available online at <http://www.fws.gov/birds/waterbirds/monitoring/marshmonitoring.html>. Standardized monitoring protocols have been developed and are available to natural resource managers wishing to implement a marsh bird monitoring plan (Conway and Nadeau 2006).

Prairie Warbler (*Dendroica discolor*) is another passerine species identified as "high continental concern" in all relevant land bird conservation plans that likely breeds in FIIS. This species is typically associated with open scrub-shrub habitats (Nolan et al. 1999) and is reported as a breeder in the Great South Bay area (Mittra and Putnam 1999). Prairie Warbler is a "probable" breeder in BBA Blocks containing sections of Smith County Park and the William Floyd Estate (Blocks 6751D, 6851A, Appendix 3). They are usually conspicuous vocally, and population viability indicators like reproductive success, survival and recruitment can be monitored using the standard survey techniques (e.g., nest monitoring, distance or removal sampling, spot-mapping, mark-recapture, occupancy modeling).

Blue-winged Warbler (*Vermvora pinus*), another early-successional species of high continental and high regional priority, also could be monitored within this context. Blue-winged warbler is recognized as a confirmed or probable breeder in BBA blocks containing sections of Smith County Park and the William Floyd Estate.

Similar techniques could be used to monitor passerine species breeding in forested habitats on FIIS. One Tier I species (PIF SONE, High Continental Priority - High Regional Responsibility, see Appendix 9 for full ranking scheme) and several Tier II species (PIF SONE, High Regional Concern) are either confirmed or probable breeders in the park. Wood Thrush (*Hylocichla mustelina*, Tier I) is the highest ranked species and is a confirmed breeder in FIIS. Wood Thrush nest in mature, deciduous forest, and are generally considered area-sensitive; i.e., breed more successfully in patches with a large core area (Roth and Johnson 1996). Eastern Wood-Pee-wee (*Contopus virens*, Tier II) is a generalist forest breeder, but is typically associated with forest edges and clearings (McCarty 1996). It is listed as a probable breeder in three BBA Blocks that include small portions of FIIS (6751C, 6751B, 6851A, Appendix 3). Eastern Towhee prefers a dense understory, with or without a developed overstory (Greenlaw 1996), and will likely be found using both forested and unforested patches within the park. This species has been recorded as a "probable" breeder in several (n=6) BBA Blocks throughout FIIS. Finally, Black-and-White Warbler (*Mniotilta varia*) is a Tier II species of concern that is recognized as a probable breeder in BBA Blocks containing the William Floyd Estate and Smith County Park (Blocks 6751D and 6851A). Black-and-White Warbler nests in mature and second-growth deciduous and mixed deciduous-coniferous forests (Kricher 1995).

We suggest that FIIS implement a long-term breeding landbird monitoring system in pertinent areas within the park. The William Floyd Estate and Smith County Park clearly emerged as potentially important areas for breeding passerines. As noted above, well-established

monitoring techniques can be used including point-counts, spot-mapping, and nest searching and monitoring. By including both early-successional and mature habitats in the sampling scheme, several species of high and moderate conservation concern can be monitored simultaneously.

FIIS is also used by migrant land birds during north and southbound migrations. Because of a trend for migration patterns to be more concentrated along coastal areas (Dettmers and Rosenberg 2000), the heavily urbanized coastal sections of the SONE region are located in extremely important migration stopover areas. For instance, a recent USACE study (USACE 2003) documented 55 species of birds during spring migration (March and April).

The energy required to complete the northbound or southbound phase of migration is considerable, and small migrating songbirds generally cannot store enough energy to fly nonstop between wintering and breeding destinations. Consequently, they must stop frequently along the migration route to rest and replenish energy stores. The availability of suitable "stopover" habitats that can provide the food resources necessary for birds to accumulate energy quickly and safely is critical to their ability to complete migration successfully. Recently, the importance of high quality habitats for migrating passerines, especially "Neotropical" migrants, has been recognized (Moore 2000). Neotropical songbirds are not only susceptible to alterations in breeding and wintering habitats, but to habitats used during en route stopovers between seasonal destinations.

The U.S. Army Corps of Engineers (2003) report cited above was conducted throughout the migratory periods and offers good baseline information pertaining to species moving through the park. Additional monitoring efforts that include mist-netting and transect surveys could provide valuable information regarding the importance of FIIS to migrating land birds, and the habitats they use during migration.

One region of FIIS that did not appear to receive adequate monitoring attention for avifauna was the Sunken Forest, a maritime holly forest of approximately 16 ha. The Sunken Forest is one of only a few mature maritime forests in the New York area and the northernmost holly-dominated maritime forest on the Atlantic barrier island chain. The Nature Conservancy lists this community type as globally imperiled (G2). Avian species typically associated with breeding in maritime forest habitat include Prairie Warbler and Northern Parula (*Parula americana*). Maritime forest also provides critical habitat for migrating landbirds. The relatively small area of the Sunken Forest would allow an extensive, comprehensive avian inventory to be conducted during the breeding season. This could be achieved through standard breeding survey methods (e.g., point-counts, spot-mapping, nest monitoring).

Park employees expressed a need for obtaining more current data from inventory projects that have been, or are being conducted on FIIS. They stated that Ernie Taylor (former FIIS Natural Resource Manager) did inventory work on birds within the park, and that more detailed data than were provided in his (2002) report may be available, specifically with regard to neotropical migrants. They also commented that Richard Stavdal (former manager

of the William Floyd Estate) was involved in a marsh restoration program at WFE. His colleagues there may have access to his avian inventory data associated with the program. FIIS employees also expressed that they would like access to Paul Buckley's most recent data, to be incorporated into their General Management Plan.

2. Diurnal/Nocturnal Raptors

Results

A search of NatureBib returned only 4 unique citations related to raptors (Table 2). These were primarily comprised of the Fire Island Raptor Enumerator Newsletters from 1985, 1994 and 1995, which provide summaries of raptors observed during fall migration at the Fire Island Hawk Watch, located at the eastern end of Moses State Park. The database does not reference the publicly available Fire Island Raptor Enumerator database (Panko 2007, <http://www.battaly.com/fire/>), which provides annual summaries of Hawk Watch data from 1982-2006, and daily summaries of data from 2003-2006. FIIS is along a major raptor migration route and is likely an important stopover for several species during both north and southbound movements. Since 1982, the Fire Island Hawk Watch has been conducted annually and is currently coordinated by Drew Panko (Southeastern New York State compiler for the Hawk Migration Association of North America). NPS should obtain recent data for this project to evaluate changes in diurnal raptors populations migrating through the park. Another resource that is not listed in the NPS database is the Master of Science thesis completed by Marilyn England through Long Island University (England 1989). The thesis focuses on the breeding biology of northern harriers on Long Island, and should be available through the Post Campus library.

Recommendations

FIIS is considered important for migrating and overwintering Northern Harrier (*Circus cyaneus*, also a possible breeder), Short-eared Owl (*Asio flammeus*) and Snowy Owl (*Bubo scandiacus*), all of which forage over swales and the extensive salt marshes fringing the barrier island on its northern edge (USFWS 1991). Northern Harrier, a species listed as "threatened" in New York, has received little, if any, focused attention at FIIS. In addition to its state listed status, Northern Harrier is identified as a focal species for maritime marsh habitats in the PIF SONE and BCR 30 plans (Table 4). No citations exist within NatureBib that refer to any inventory or monitoring efforts on FIIS for this species, although at least one intensive breeding study has been conducted in the region (England 1989). Clearly, this is a gap in information that should be addressed.

Although Northern Harrier is not listed as a "confirmed" breeder on FIIS, it is classified as a breeder in NPSpecies based on knowledge of breeding activity within Great South Bay and Moriches Bay (USFWS 1997a), and on behavioral observations in several blocks covering Smith County Park and the southern half of the William Floyd Estate (NYDEC 2006). They

most likely nest in the emergent herbaceous marsh habitats that make up a large part of the park and possibly in the grassland habitats at the William Floyd Estate. Given their status, determining the abundance and distribution of nesting pairs, and where possible, monitoring productivity is important. Regardless of their breeding status on FIIS, it is likely that Northern Harriers use marsh habitats in the park for foraging during the breeding and overwintering periods. Given this, maintaining habitats at FIIS that support foraging, and monitoring their use by Northern Harriers, is important.

The park is also likely to be an important wintering area for Northern Harrier. They are recorded regularly during CBCs that include portions of the park, and autumn Hawk Watch counts are up 33% over the average recorded for the last 18 years (Panko 2007). Monitoring winter populations, and their use of habitats within the park, can provide important information to direct resource management strategies that might enhance winter survival.

Table 4. State, Partners-in-Flight (PIF), and Bird Conservation Region (BCR) plan rankings for priority diurnal and nocturnal raptors that likely breed on Fire Island National Seashore.

Common Name	Scientific Name	Status ^a	PIF SONE ^b		BCR 30 ^c	
			Priority Tier*	Action Level**	Priority Tier*	Action Level**
Osprey	<i>Pandion haliaetus</i>	NY (SC)	5	5	4	4
Northern Harrier	<i>Circus cyaneus</i>	NY (T)	5	4	4	4
American Kestrel	<i>Falco sparverius</i>		--	--	5	3
Cooper's Hawk	<i>Accipiter cooperii</i>	NY (SC)	5	4	5	4
Short-eared Owl	<i>Asio flammeus</i>	NY (E)	2C	5	1B	3,5
Barn Owl	<i>Tyto alba</i>		2	3	4	3,5

^a T=Threatened, SC=Special Concern

^b Southern New England physiographic region (#9)

^c Bird Conservation Region 30 encompasses areas covered by SONE PIF plan

* PIF Priority Tiers (see Appendix 9 for detailed descriptions or priority categories): 1A-High continental priority/high regional responsibility; 1B High overall priority/low regional responsibility; 2A-High regional concern; 2B-High regional responsibility; 2C-High regional threats, 3-Additional Watch list species; 4-Additional federally listed species, 5-Additional state listed species

** PIF Action Levels (see Appendix 9 for detailed descriptions or priority categories): 1-Crisis recovery needed, 2-immediate management, 3-management to reverse or stabilize populations, 4-long term planning is needed, 5-investigations are needed to better define threats, 6-monitor population changes only

Among nocturnal/crepuscular raptors, two species, Short-eared Owl (*Asio flammeus*) and Barn Owl (*Tyto alba*) may require specific inventory and monitoring attention at FIIS. Short-eared Owls are listed as "endangered" in New York. FIIS may be an important wintering area for the species, as it is known to inhabit coastal marshes throughout the region during the non-

breeding periods. Monitoring winter populations, and their use of habitats within the park, can provide important information to direct resource management strategies.

Barn Owl is a "special concern" species in New York. It is a cavity nester that frequently uses nest boxes (Marti 1992). Typically, it nests in areas adjacent to open habitat types (Marti 1992) similar to American Kestrel (*Falco sparverius*). Barn Owl is a "probable" breeder in FIIS. Although it is not listed as a priority species in the PIF SONE or the BCR 30 plans, it is identified as a focal species in early successional and grassland/agricultural habitats (Table 4). There is no record of a Barn Owl nest box study ever being conducted on FIIS. Long-term research projects like the ongoing nest box study on Gateway National Recreation Area are uncommon (Mizrahi 2004), but are extremely important for tracking Barn Owl populations due their dependency upon a cyclic prey base such as microtine mammals (Taylor et al. 1988). Other nest-box monitoring programs are in effect in Massachusetts, Connecticut, Pennsylvania, New Jersey, Maryland, and Virginia (e.g., Katzner et al. 2005, http://www.urwa.org/news/kestrelProjectOverview_12-06.pdf).

Long Island also supports one of two major breeding osprey (*Pandion haliaetus*) populations in New York (the second is in the Adirondack Mountains; New York State Department of Environmental Conservation, NYSDEC). The species is known to breed in FIIS, with two confirmed nests at the William Floyd Estate. Osprey continues to be listed as a species of "special concern" in New York, and recent analyses of New Jersey Osprey data suggest a stable population, but an overall decline in breeding productivity (Mizrahi 2004). The most recent Hawk Watch summary (i.e. 2006, Panko 2007) indicates that Osprey counts at FIIS during migration are down nearly 50% as compared to average counts from the last 18 years. The NYSDEC and NYCDEP are involved in the Long Island Sound Study (LISS), a collaborative effort initiated in 1985 to analyze and address pressing environmental issues regarding the sound. The LISS provides a graphic summary of the number of Osprey nests located in New York between 1984 and 2002 (http://www.longislandsoundstudy.net/indicators/section3_4.pdf), which indicates that Osprey nesting activity in the state has steadily increased over the last two decades.

Osprey breeding activity on FIIS appears to have either, (1) received little focused attention, or (2) received attention but not been reported. In 1993, the NPS and New York City Department of Environmental Protection (NYCDEP) developed a collaborative raptor management program (Nadareski and Riepe 1997) to monitor breeding Osprey. This work appears to be current and ongoing (Mizrahi 2004), although we have not been able to locate documentation of numbers of nests, hatched young, or young banded in support of this project. We also have not been able to determine if a concentrated effort to monitor Osprey nesting activity has been in effect on FIIS, or how to access these data. A concerted effort should be made to access available data, and to use these data to assess trends in Osprey population metrics on FIIS (e.g., number of nesting pairs, hatching success).

American Kestrel (*Falco sparverius*) is another raptor species that may require a focused inventory and monitoring effort at FIIS. Kestrels are cavity nesters and are well known for

their ability to use nest boxes (Smallwood and Bird 2002). They typically breed in complex open habitat types that are often a mix of grasslands, early successional shrublands, and forest edge and are generally tolerant of low levels of human development (Smallwood and Bird 2002). Some areas of FIIS, especially the William Floyd Estate, provide suitable nesting habitat for this species. According to the New York Breeding Bird Atlas (BBA), they are "probable" breeders in a block that contains the northern half of the William Floyd Estate, and "possible" breeders in the eastern half of Smith County Park (NYSDEC 2006). Although American Kestrel is not listed in New York, the BCR 30 plan classifies the species as a species of local management concern that requires management to reverse or stabilize populations, while the SONE plan does not classify American Kestrel at any priority level (Table 4).

According to the Breeding Bird Survey (Sauer et al. 2003), American Kestrel is experiencing significant declines in New York and across the entire northeast region over the last 20 years. Additionally, over the last 25-30 years, this species has shown declines at coastal hawk watch migration sites in general (Farmer et al. 2007) and a 50% decline at the Fire Island Hawk Watch site when compared to historic counts (i.e., the last 18 years of data collection, Panko 2007). Furthermore, dramatic declines in winter populations have been documented over the last 30 years in New York, including areas that may be pertinent to the park (<http://www.audubon.org/bird/cbc/>). Because of their propensity to use nest boxes, a program to provide artificial cavities throughout appropriate habitats in FIIS could be beneficial for American Kestrels and should be explored as a management strategy to recover the species locally.

Cooper's Hawk (*Accipiter cooperii*) is also a confirmed breeder in the 6851A BBA block, which includes a small section of Smith County Park (Appendix 4), and listed as a "possible" breeder in adjacent blocks containing large proportions of Smith County Park, the William Floyd Estate and the Otis Pike Wilderness Area (BBA). Cooper's hawk is recognized as a species of Special Concern in the state of New York, and a Priority Tier 5 species in the PIF SONE plan (Table 4). In general, the ability of this hawk to use altered environments has been a conservation success story for the species (Curtis et al. 2006). However, the impacts that Cooper's Hawk may have on other species, including both potential prey and competitors, are not understood. For example, there is evidence that Cooper's Hawks regularly take American Kestrels, and that they may be playing a role in the current declines in this species in certain parts of its range (Sullivan and Wood 2005). Therefore, monitoring of Cooper's Hawk may be a priority conservation goal, and several monitoring techniques for the species have been proposed. In breeding season, broadcast of tape-recorded conspecific calls is useful in eliciting vocal and behavioral responses, increasing detection rates, and locating nests (Mosher et al. 1990). Also, broadcasts of tape-recordings of Great Horned Owl vocalizations have proved to be a very reliable means of surveying for breeding pairs of Cooper's Hawks (Mosher and Fuller 1996).

A recent report was submitted to Kingbird (Schiff and Farina, 2005) regarding the occurrence of Peregrine Falcon (*Falco peregrinus*) nesting on Long Island. Although not specific to Fire

Island, this report suggests that Peregrine Falcon breeding activity may also be occurring in the limited nesting habitat (e.g., cliffs, ledges, special trees, towers, buildings; White et al. 2002) available on FIIS (e.g., Fire Island Lighthouse, Robert Moses State Park). The species is currently listed in the NPSpecies Database as a spring and fall migrant that is occasionally recorded on FIIS as a non-breeding summer resident. Peregrine falcon populations are increasing throughout its breeding range in the United States, and the northeast region provides abundant man-made nesting sites (e.g., water towers, buildings) where high breeding success has been observed (Green et al. 2006).

3. Shorebirds

Results

Inventory and monitoring efforts for shorebirds at FIIS are limited and dominated by work on the federally threatened Atlantic Coast population of Piping Plover (*Charadrius melodus*), which is a confirmed breeder in the park. The two NatureBib citations that were uniquely related to shorebird research or monitoring were (1) a technical shorebird report drafted by the USFWS for the New York Bight Coastal Ecosystems Program (1997b), and (2) a management plan for the Piping Plover in the Breezy Point District of Gateway National Recreation Area (Riepe 1989). An additional 10 citations provide summaries of the Long Island Colonial Waterbird and Piping Plover surveys (n=9), and the Long Island Least Tern and Piping Plover survey (n=1). The most recent of the NatureBib listed reports was printed in 2000 (NYSDEC, Colonial Waterbird and Piping Plover Survey).

The Long Island Colonial Waterbird and Piping Plover Survey is conducted annually by NYSDEC (NYSDEC 1999). Survey reports by various authors covering the period between 1984-2000 are listed in NatureBib. However, more current information on the status of breeding populations should be included in NatureBib, and be made available to FIIS resource managers. The most recent USFWS report for the Atlantic coast population was distributed in 2004 (USFWS 2004), and statewide estimates of breeding pair numbers and demographic parameters associated with breeding success are available for 1998-2007, through the USFWS at <http://www.fws.gov/northeast/pipingplover/status/index.html>. Raw data from the Long Island Colonial Waterbird and Piping Plover survey are also available through USGS (<http://www.pwrc.usgs.gov/cwb/database/>). In 2005, there were an estimated 374 nesting pairs of Piping Plovers on the Long Island coast, and the number of pairs specifically located on FIIS should be available through M. Gibbons of NYSDEC, who provided the data for this assessment. National Park Service staff are also responsible for managing and monitoring Piping Plovers on Fire Island, and information from their monitoring efforts are provided to NYSDEC for inclusion with the Long Island data. Currently, NPS have data from 10 years of monitoring, and internal annual reports are available for the last 8 years. These internal NPS reports are not listed in NatureBib. Intense monitoring of the Atlantic Coast population of Piping Plovers will continue, as the current population remains more than 300 pairs below the recovery goal of 2000 pairs (USFWS 2004, Cohen et al. 2006).

Several focal studies on the Atlantic Coast population of Piping Plovers, though not necessarily specific to the park, also provide important insight into factors that affect nest site selection (Burger 1987), foraging behavior (Burger 1991), habitat use (Burger 1994), and how human disturbance affects these aspects of their ecology (Burger 1991, 1994). Cohen et al. (2006) examined site fidelity and survival of Piping Plovers breeding on Westhampton Island, off the south shore of Long Island, 2001-2005. They found that annual adult survival was high (0.70) and similar to that of other breeding populations in the U.S. Mean breeding site fidelity was also high (0.83), as is typical for the species, emphasizing a need for maintaining habitat quality at historically used breeding areas (Cohen et al. 2006). Cohen et al. (2006) provided additional information on reproductive success, helping to confirm a trend (10-15 year) of decreasing success on the bay side of Westhampton Island (Houghton 2005). They reported a reproductive output for the population that was below replacement rate, which may be responsible for population declines recorded on Westhampton Island (Cohen et al. 2006). Elias-Gerken et al. (2000) also focused on several aspects of brood foraging ecology (e.g., food types, habitat use, behavior) and examined the importance of interdune habitats for Piping Plovers breeding on the central barrier islands of Long Island. A report on reducing gull breeding in close proximity to nesting Piping Plovers at Breezy Point (Olijnyk and Brown 1999) is also pertinent and worthy of review by resource managers. The latter two of these papers were recommended for incorporation into the NatureBib database in an earlier report (Mizrahi 2004), and we recommend adding the others cited above as well.

Recent large-scale studies of overall Piping Plover breeding population viability have also incorporated survey data from the Atlantic Coast (Plissner and Haig 2000, Haig et al. 2005). The studies are based on data obtained during the International Piping Plover Census, a collaborative effort designed to estimate breeding and wintering distributions and abundance, and to acquire breeding population estimates for viability modeling (Plissner and Haig 1999, 2000; Haig et al. 2005). Comprehensive censuses were conducted in 1991, 1993, and 2001. The 2001 census resulted from the efforts of over 1364 biologists and volunteers, and raw data and maps from the census are available in Ferland and Haig (2002). These data should be accessed for park managers and cited in the NatureBib database.

Recommendations

Several other "high priority" breeding shorebird species, such as American Oystercatcher (*Haematopus palliatus*), American Woodcock (*Scolopax minor*), and Willet (*Catoptrophorus semipalmatus*), also may need comprehensive inventory and monitoring efforts at FIIS (Table 5). Our search of NatureBib revealed no specific information on these species.

The SONE PIF plan and the BCR 30 plan identify American Oystercatcher as a "high continental concern/high regional responsibility" species (Table 5). Additionally, the USSCP, North Atlantic Region lists this species in the "very high priority" (i.e., 5 out of a possible 5 score) category (Clark and Niles 2000). The first record of American Oystercatcher breeding on Long Island was in 1957 (Bull 1974), and the species has continued to expand its breeding

range northward. They are now considered “common” breeders within the South Shore Estuary Reserve, which includes FIIS (New York Department of State [NYDOS] and USFWS 1998). Additionally, the USFWS has recently developed a “focal species” strategy to provide explicit, strategic, and adaptive sets of conservation actions required to return a species to healthy and sustainable levels. American Oystercatcher is being considered for inclusion on the list of focal species and may be targeted for conservation action (S. Brown, Manomet Center for Conservation Sciences, *personal communication*). A fact sheet on the topic is available through a link at <http://www.fws.gov/migratorybirds/>.

At FIIS, American Oystercatcher likely nests in many of the same open beach, barrier island habitats used by Piping Plover. Given this, oystercatchers are subject to many of the same threats and perturbations that endanger plovers. Current winter population estimates across its entire range (i.e., mid-Atlantic - Gulf of Mexico, Nol and Humphrey 1994) are slightly over 10,000 individuals (Brown et al. 2005). The species is a confirmed breeder in BBA blocks containing Smith County Park (6751 C and D, 6851 A and C).

Table 5. State, Partners-in-Flight (PIF), Bird Conservation Region (BCR), and U.S. Shorebird Conservation (USSCP) plan rankings for priority shorebirds that likely breed in, or migrate through, Fire Island National Seashore.

Common Name	Scientific Name	State Status ^a	PIF SONE ^b		BCR 30 ^d		USSCP ^e
			Priority Tier*	Action Level**	Priority Tier*	Action Level**	
Piping Plover ^f	<i>Charadrius melodus</i>	NY(E)	1A	2	1A	2	5
Upland Sandpiper	<i>Bartramia longicauda</i>	NY(T)	1B	3	2C	3	4
American Oystercatcher	<i>Haematopus palliatus</i>		1A	3	1A	3	5
Willet	<i>Catoptrophorus semipalmatus</i>		--	--	2B	4	4
American Woodcock	<i>Scolopax minor</i>	NY(SC)	1A	3	2A	3	5
Red Knot ⁺	<i>Calidris canutus rufa</i>		--	--	--	--	5
Whimbrel ⁺	<i>Numenius phaeopus</i>		--	--	--	--	5
Hudsonian Godwit ⁺	<i>Limosa haemastica</i>		--	--	--	--	5
Semipalmated Sandpiper ⁺	<i>Calidris pusilla</i>		--	--	--	--	4
Killdeer	<i>Charadrius vociferus</i>		--	--	--	--	3

^a T=Threatened, SC=Special Concern

^b Southern New England physiographic region (#9)

^c Mid-Atlantic Coastal Plain physiographic region (#44)

^d Bird Conservation Region 30 encompasses areas covered by SONE and MACP PIF plans

^e Continental scores (i.e., do not reflect regional concerns, scoring scheme similar to PIF)

^f Federally threatened

* PIF Priority Tiers (see Appendix 11 for detailed descriptions or priority categories): 1A-High continental priority/high regional responsibility; 1B High overall priority/low regional responsibility; 2A-High regional concern; 2B-High regional responsibility, 2C-High regional threats, 3-Additional Watch list species; 4-Additional federally listed species, 5-Additional state listed species

** PIF Action Levels (see Appendix 11 for detailed descriptions or priority categories): 1-Crisis recovery needed, 2-immediate management, 3-management to reverse or stabilize populations, 4-long term planning is needed, 5-investigations are needed to better define threats, 6-monitor population changes only

⁺ Migrant. Not typically covered in PIF or BCR plans

Because it nests at many of the same sites as Piping Plovers, inventory and monitoring of American Oystercatchers can be coupled with plover monitoring programs. Breeding individuals are conspicuous which facilitates survey efforts, at least in open beach habitats. However, surveying this species can be difficult in the more inaccessible and isolated marsh breeding sites, which may be increasing in importance as habitat alteration and human disturbance on outer beaches make traditional sites less suitable for nesting (McGowan et al. 2005, T. Virzi, *personal comm.*). Surveys for American Oystercatcher have been conducted within the South Shore Estuary Reserve as part of the LI Colonial Waterbird and Piping Plover Survey by NYSDEC (Mike Wasilco, NYSDEC, cited in Chan 2003). Sites that appear to have oystercatchers nesting are West Fire Island, FIIS Wilderness Watch Hill, John Boyle Island, Carter's Island, FIIS East Smith Point, and West Inlet Island. In addition to identifying areas with high nesting densities, future efforts should also focus on productivity, survivorship, and site fidelity, similar to efforts afforded to Piping Plovers.

Currently, the American Oystercatcher working group helps to coordinate coast-wide inventory and monitoring efforts (<http://www.ncsu.edu/project/grsmgis/AMOY/Research.htm>). The working group has recently completed the American Oystercatcher Conservation Plan (Schulte et al. 2006), which outlines the conservation threats, strategies and actions for managing American Oystercatcher populations, and identifies important breeding and wintering sites for the species. In New York, only two sites were identified as important for breeding or overwintering American Oystercatchers; Jones Beach State Park and Fire Island National Seashore. Abundance estimates for both breeding and non-breeding oystercatchers on FIIS are listed as "unknown" in the plan, further emphasizing the need for focal monitoring of this species within the park (Shulte et al. 2006).

American Woodcock is a game species that nests in upland areas at the interface of open fields and woodlands. It is a "probable" breeder in parts of Smith Point County Park and the William Floyd Estate (BBS blocks 6751C and D, and 6851A). The PIF SONE plan lists American Woodcock as a "high continental/high regional responsibility species" that requires management to reverse or stabilize populations, while the BCR 30 plan considers it a species of "high regional concern" and one that requires management to reverse or stabilize populations (Table 5). The USSCP considers this species a "very high priority" for the North Atlantic Region (Clark and Niles 2000). Although previous estimates of American Woodcock were approximately 5,000,000 (Morrison et al. 2001), current estimates place the population at approximately 3,500,000 (Morrison et al. 2006). Courtship behaviors of male American Woodcocks at dawn and dusk are conspicuous and can be used to assess whether the species is a breeder on FIIS, and to estimate potential nesting densities and habitat use during the courtship phase.

Willetts commonly nest in tidal salt marshes throughout the mid-Atlantic region. It is a "confirmed" breeder throughout several areas of FIIS. Before the 1960s, it was not known to breed anywhere on Long Island (Bull 1964), but during the last 40 years this species has expanded its breeding range and become widespread. Willet is not included as a priority

species under any category in the PIF SONE plan, although the BCR 30 plan identifies this species as a "high regional responsibility" that requires long-term management planning. Similarly, the USSCP/North Atlantic Region considers Willet a "high priority" species (i.e., 4 out of a possible 5 score; Clark and Niles 2000). Because of its use of tidal marsh habitats for nesting, Willet is generally a difficult species to inventory and monitor. However, this species is particularly vocal and conspicuous in defending breeding territories, so presence/absence data similar to what is collected during breeding bird atlases are readily attainable. Nesting density, productivity, and survival data are far more difficult to collect.

FIIS may also be a regionally important stopover area for shorebirds as they migrate between wintering and breeding grounds. Shorebirds may be especially vulnerable at staging sites because they tend to concentrate in bottlenecks, where a large proportion of a population can be affected simultaneously by a local event (Myers et al. 1987). Jones Beach State Park is recognized as an important area for shorebirds during spring and fall migration (NYDOS and USFWS 1998, Harrington and Brown 2002), and Moriches Bay is also considered one of the best concentration areas for shorebirds in the region during spring (marshes, spoil islands, flats near Moriches Inlet) and fall (salt marshes and flats east of Moriches Inlet) migrations (Chan 2003). Great South Bay is the largest shallow estuarine bay in New York State and provides critical feeding habitat for migrating shorebirds, particularly within back-barrier marshes and flats such as the Fire Island Wilderness Area (NYDOS and USFWS 1998).

Jones Beach, Cedar Beach, and Oak Beach are International Shorebird Survey (ISS) sites, and data from these sites can be obtained from Manomet Center for Conservation Sciences (MCCS), which manages the survey. Although these sites are not on Fire Island, a synthesis of this long-term data set can provide much needed insight into population fluctuations in the region. Information on specific shorebird use of Fire Island is lacking, however, and no ISS survey sites fall within the FIIS. The USFWS held a workshop in 1997 to identify shorebird concentration areas on Long Island (NYDOS and USFWS 1998) and the results of this workshop helped generate a draft plan for monitoring shorebirds in the region (Chan 2003). Once implemented, this monitoring effort will provide valuable data regarding shorebird use of FIIS.

During the last decade, an increase in the harvest of horseshoe crabs (*Limulus polyphemus*) during their spawning season has likely affected shorebirds migrating through FIIS. Several migrant shorebird species, such as Red Knot (*Calidris canutus*), Ruddy Turnstone (*Arenaria interpres*), Sanderling (*C. alba*), and Semipalmated Sandpiper (*C. pusilla*) rely on horseshoe crab eggs to build up the energy reserves needed to complete their northbound migration to Arctic breeding grounds. Rates of crude mass gain in shorebirds during spring migration have declined in Delaware Bay as a result. Sites on Long Island may alternatively be more important to shorebirds during fall migration, when trilobite stage horseshoe crab hatchlings are still buried in nests. The horseshoe crab harvest quota for New York waters has ranged from 100,000 – 180,000 individuals/year between 2001 and 2005 (ASMFC Fishery Management Plan for Horseshoe Crab Addendum IV, 2006), many of which were taken from the Long Island region. Recently the state voluntarily agreed to reduce their harvest to

150,000 individuals per year, and catch for bait purposes in 2005 was approximately 155,000 (ASMFC Fishery Management Plan for Horseshoe Crab Addendum IV, 2006).

Over 50 sites, including 28 in the South Shore Estuary Reserve (SSER), have been surveyed by the Long Island Horseshoe Crab Network (LIHCN) at Dowling College at least once in the last three years. Horseshoe crab numbers around Long Island appear to have decreased compared to historical accounts, according to the LIHCN, and are currently estimated at 25,000 (<http://www.dowling.edu/school-arts-science/earthmarine/horseshoe.shtm>); a Powerpoint presentation of horseshoe crab monitoring results through 2004 is available at <http://el.erdc.usace.army.mil/workshops/05oct-dots/s8-Tanacredi.pdf>. In a separate study conducted by Cornell Cooperative Extension and the NYSDEC, five sites on Long Island, including two in the SSER, were also monitored. If possible, these data should be accessed and made available to FIIS management staff, as they will provide insight into shorebird populations in the park that may rely on horseshoe crabs as a food resource, such as Red Knot and Ruddy Turnstone.

Red Knot and Semipalmated Sandpiper are identified by the USSCP/North Atlantic Region plan as species of "very high" and "high" priority, respectively (Table 5; Clark and Niles 2000). Red Knot, in particular, has shown dramatic declines (Morrison et al. 2006) that may be related in part to the decline of horseshoe crab eggs available during spring migration stopovers in the region (USFWS 2003, Karpanty et al. 2007). Efforts should be made to monitor these and other species during spring migration to better understand their distribution throughout the park in relation to distributions of spawning horseshoe crabs. Additionally, weight gain in migrant shorebirds stopping in the park should be monitored to establish whether birds are accumulating sufficient reserves to complete their migration. Similar studies have been conducted in Delaware Bay since 1995.

Another factor that likely affects shorebird use of FIIS, a popular recreation area in a highly populated region, is human disturbance. Human disturbance is defined as the temporary loss of habitat due to human activities (Nisbet 2000), and can affect birds by increasing energetic costs, limiting access to profitable areas, and enhancing predation risk (review in Frid and Dill 2002). Threats to shorebirds by direct human disturbance are specified as management concerns in the U.S. Shorebird Conservation Plan (Brown et al. 2001), the American Oystercatcher Conservation Plan (Schulte et al. 2006), and the Piping Plover Recovery Plan (U.S. Fish and Wildlife Service 1996). Pressures from recreational activity are particularly relevant to the North Atlantic region, where growing human populations and limited space increase the frequency of interactions between humans and shorebirds.

Human disturbance, particularly on beaches heavily used by humans, has been associated with a reduction in habitat use by shorebirds (review in Burger et al. 1995). Although most direct disturbance studies have tended to focus on breeding colonies (e.g., Rodgers and Smith 1991), evidence exists to indicate that disturbance affects shorebirds at their migration staging and wintering sites as well (Burger 1981, 1986; Pfister et al. 1992; Peters and Otis 2005, 2007). Studies have shown human disturbance of roosting shorebirds to be related to

population declines (Pfister et al. 1992, Tubbs et al. 1992), lowered body condition (Durell et al. 2005), regional habitat shifts (Burton et al. 1996), and local avoidance behavior (Kirby et al. 1993). Recreational disturbance has been shown to decrease Piping Plover breeding success (Flemming et al. 1988), and disturbance to nesting Piping Plovers on FIIS is noted as a probable cause for the low nesting success observed in the park (U.S. Fish and Wildlife Service. 1997b). Furthermore, although the effects of human disturbance on nesting success of American Oystercatcher are not well understood, several studies have documented lower nest survival and higher chick mortality in high-disturbance sites (review in Schulte et al. 2006).

Despite the likelihood that human disturbance factors are in effect on FIIS, there is a shortage of empirical data concerning the potential effects of human activity on shorebird habitat use or productivity within the park. This data gap should receive future attention and offers wide opportunity for more intensive study on FIIS. Examples of questions that should be addressed include (1) how are birds and humans distributed throughout the park? (2) is human activity related to habitat use by shorebirds during the breeding, migratory, or overwintering periods? (3) does human activity affect shorebird behavior or productivity? and (4) do shorebirds habituate to human activity? Several methods can be employed to address such questions, including standard abundance and distribution sampling (e.g., transects, flock counts), mark-resight, or behavioral observation (e.g., focal animal sampling, see Peters and Otis 2005).

4. Waterfowl

Results

FIIS is located within one of the most important areas for waterfowl in the region. The Long Island South Shore Complex has been designated an important focus area by the Atlantic Coast Joint Venture for waterfowl (ACJV 2005). Specifically, the complex appears to support significant concentrations of Greater (*Aythya marila*) and Lesser (*A. affinis*) Scaup, American Black Duck (*Anas rubripes*), Atlantic Brant (*Branta bernicla hrota*), and Canada Goose (*Branta canadensis*) (USFWS 1997a). The USFWS has also identified Great South Bay, Moriches Bay, and Shinnecock Bay as important sub-focus areas (Figure 2). The highly productive estuarine habitats within the Long Island South Shore Complex represent important waterfowl wintering areas, as large numbers of waterfowl use the marshes between November and March, except when prohibited by ice cover (ACJV 2005). The bays are also used for stopover during spring and fall migration (ACJV 2005). The Otis Pike Wilderness Area in FIIS is known for harboring high concentrations of wintering waterfowl such as scaup, pied-billed grebe (*Podilymbus podiceps*), American black duck and red-breasted merganser (*Mergus serrator*).

Several species occurring at FIIS during winter are considered priority conservation targets by the North American Waterfowl Management Plan for Waterfowl Conservation Region (WCR) 30, the region relevant to the park (Table 6; ACJV 2005). The geographic extent of

WCR 30 is similar to that of BCR 30 (Figure 3). Species of concern that breed on FIIS include American Black Duck, Mallard (*Anas platyrhynchos*), and Wood Duck (*Aix sponsa*).

Our search of NatureBib revealed 19 inventory and monitoring citations for waterfowl. Eight of these citations appeared to be summaries of waterfowl counts conducted by park staff at the William Floyd Estate (1982-1986, 1989, 1991, and 1993). It is unclear but likely that these surveys were associated with the Winter Waterfowl Survey (FWC) conducted by the NYSOA and NYSDEC (NYSOA 2004). This annual, midwinter survey has continued through 2007, and data from 1973-2004 and summary reports from 2000-2004 are available at the following website: <http://www.nybirds.org/ProjWaterfowl.htm>. The relevant region for FIIS, Region 10, covers the entire coast and inland waters of Long Island and the New York City metropolitan area; Ronald & Jean Bourque are currently responsible for compiling all count data from the region (contact information available on Project Waterfowl website). The survey is ground-based, so is susceptible to bias related to the inability to access all locations used by waterfowl. Overall, however, the data are collected systematically and over a long period (i.e., 1955-2007), making them invaluable for assessing population trends in target species.

Table 6. Waterfowl species identified as priority conservation targets by the North American Waterfowl Management Plan for Waterfowl Conservation Region (WCR) 30.

Common name	Scientific name	Priority Status (WCR 30)	
		Breeding	Non Breeding
Canada Goose (migratory Atlantic race)	<i>Branta canadensis</i>		high
Wood Duck	<i>Aix sponsa</i>	high	high
Atlantic Brant	<i>Branta bernicla</i>		high
Mallard	<i>Anas platyrhynchos</i>	moderate	high
American Black Duck	<i>Anas rubripes</i>	high	highest
Canvasback	<i>Aythya valisineria</i>		high
Greater Scaup	<i>Aythya marila</i>		high
Lesser Scaup	<i>Aythya affinis</i>		high
King Eider	<i>Somateria spectabilis</i>		moderate high
Common Eider	<i>Somateria mollissima</i>		highest
Harlequin Duck	<i>Histrionicus histrionicus</i>		high
Black Scoter	<i>Melanitta nigra</i>		high
White-winged Scoter	<i>Melanitta fusca</i>		high
Surf Scoter	<i>Melanitta perspicillata</i>		high
Long-tailed Duck	<i>Clangula hyemalis</i>		high
Bufflehead	<i>Bucephala albeola</i>		high
Common Goldeneye	<i>Bucephala clangula</i>		moderate high

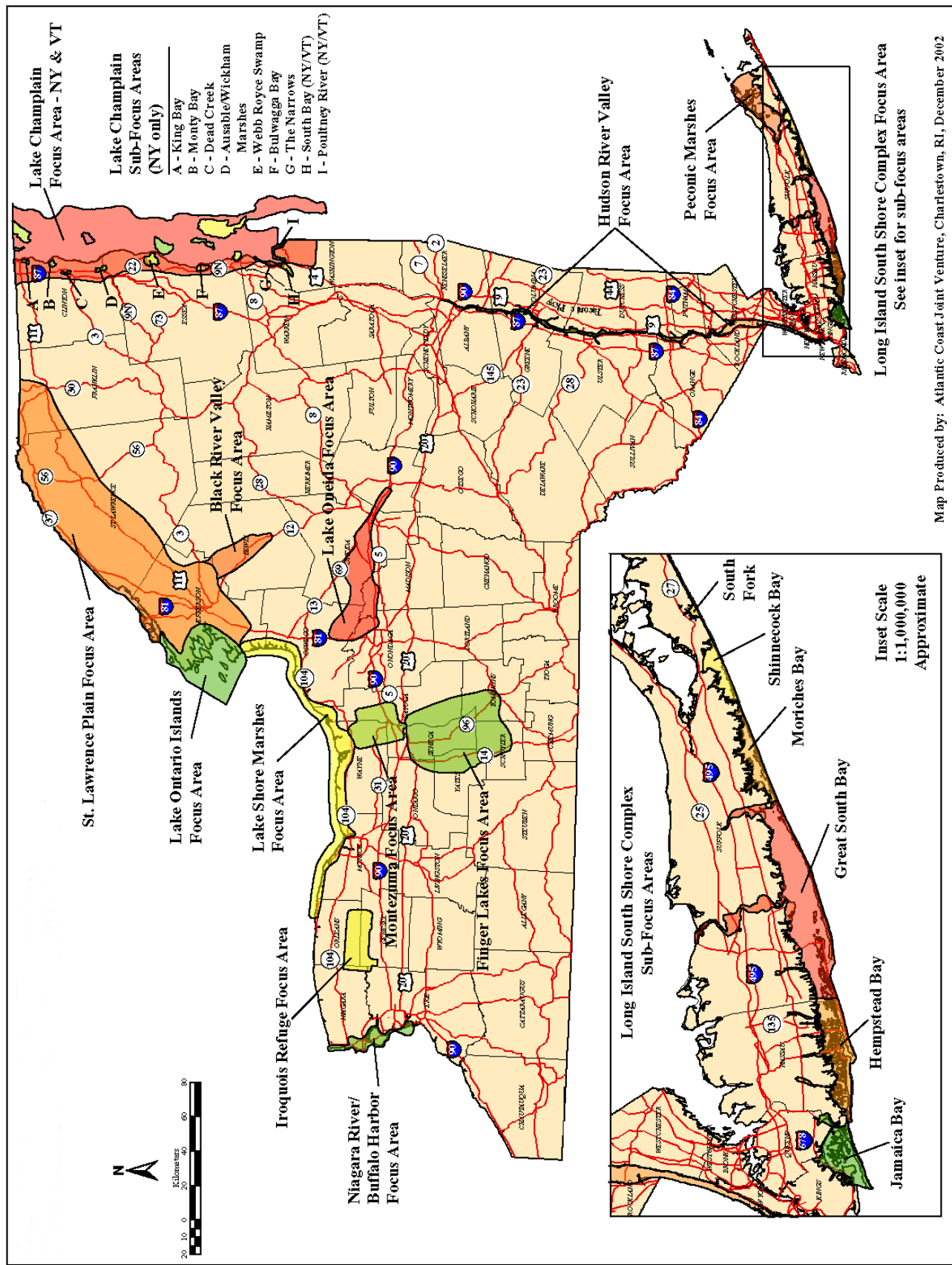


Figure 2. New York waterfowl focus areas designated by USFWS/Atlantic Coast Joint Venture.

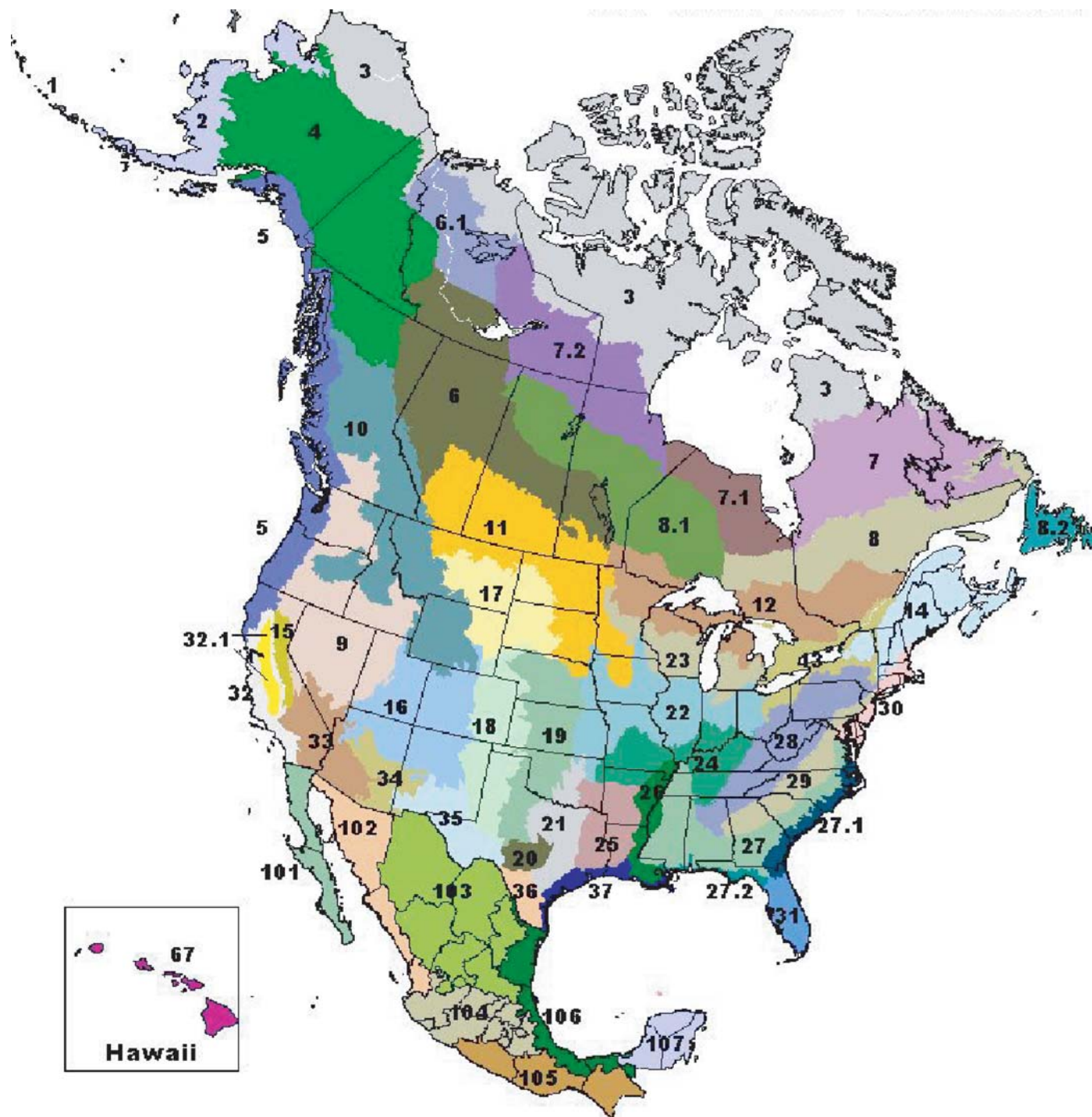


Figure 3. North American waterfowl conservation planning regions (from the North American Waterfowl Conservation Plan). Fire Island National Seashore is within Waterfowl Conservation Region 30, which encompasses the mid-Atlantic/Southern New England coastal plain.

Of the remaining 11 waterfowl-related citations listed in NatureBib, six were papers or reports written prior to 1980, and all were written prior to 1988. One citation refers to a map generated by NPS FIIS staff in 1985 that describes waterfowl distributions from Fire Island Inlet to Moriches Inlet. This information, however, needs to be updated using available survey data. The only relatively current peer-reviewed study of waterfowl on FIIS refers to an outbreak of schistosomiasis in Atlantic Brant (*Branta bernicla hrota*) in the 1980s (Wojcinski et al. 1987).

Data are also available from the Atlantic Flyway Mid-winter Waterfowl Survey. This aerial survey is subject to several limitations due to changes in sampling protocols and lack of statistical sampling design (Eggeman and Johnson 1989). The midwinter aerial surveys indicate an average population for all species of over 42,000 birds and peak counts of over 82,000 birds within the South Shore Estuary Reserve (South Shore Estuary Reserve Council, 2001). A count database for the survey is available online through the FWS/USGS Migratory Bird Data Center (<http://mbdcapps.fws.gov/>). The database contains raw count data for survey zones, segments, and sub-segments for each state. New York data are only available for 2001, after which surveys were cancelled when NYDEC concluded that the FWC provided comparable or better data for monitoring long-term population trends (Swift and Hess 1999). The January 2001 data demonstrate large discrepancies between aerial counts and those conducted on the ground.

Recommendations

For breeding waterfowl species, there is consensus that American Black Duck is the "species of greatest concern" among bird conservation plans relevant to the park. However, PIF, BCR, and WCR plans differ somewhat in their priority categorization for this species. The SONE PIF plan considers the species to be regionally threatened. The BCR 30 plan and the WCR plans, maybe the most regionally relevant plans, classify American Black Duck in their highest priority categories.

Although American Black Ducks are known to nest in a variety of habitats, they reach their highest densities in emergent marsh habitats (e.g., saltmarsh, brackish, freshwater) associated with coastal zones (Longcore et al. 2000). It is likely that American Black Ducks breed in salt marshes throughout FIIS. The park and surrounding appropriate habitats may be important strongholds for species in the NPS Northeast Coastal and Barrier Network. It may also serve as an important overwintering area for the species, as counts within relevant CBC circles commonly range from 2000-3000 individuals. Ducks Unlimited conducted a study in winter 2004-2005 on Long Island, during which 30 Black Duck hens were fitted with radio-transmitters (<http://glaromaps.ducks.org/conservation/blackduck/li/>). Findings from this study should be acquisitioned, as it focused on determining habitat use and food availability for Black Ducks in the region.

Given its status, the park should consider developing a focused inventory and monitoring program for American Black Duck. This could include efforts to determine distribution and abundance, reproductive success, survival, recruitment, and threats to habitats used by this

species throughout the park. One potential threat to American Black Duck populations is hybridization with Mallards. Because Mallard x American Black Duck hybrid fledglings have been confirmed in the vicinity of the William Floyd Estate (BBA Block 6751B), focal monitoring may be especially crucial at that site. The William Floyd Estate supports large Black Duck and Mallard populations in the spring (Taylor 2001a, n = 145 combined species), so offers opportunity for studying waterfowl breeding in the park in general.

Collaboration with agencies that have experience monitoring waterfowl populations, like NYSDEC and USFWS/Atlantic Coast Joint Venture, could provide expertise and possibly logistic support for work on American Black Ducks in the park. In addition, the Black Duck Joint Venture (BDJV) was established in 1989 to coordinate and promote monitoring and research among councils, universities, and federal, provincial, and state conservation agencies. Current projects include an aerial/ground based breeding survey along the Atlantic and Mississippi flyways, and the Atlantic Flyway Eastern Cooperative Banding Agreement, both of which are described in more detail at <http://www.blackduckjv.org/about.html>.

Wood Ducks are cavity-nesters and are listed as a confirmed breeder in BBA blocks containing Smith County Park (Blocks 6851B and 6751C), and as a possible breeder in a block including the southern half of the William Floyd Estate (Block 6751D). Wood Duck is listed as a High Priority species in the NAWMP for WCR 30 (Table 6). We did not find any information on a Wood Duck nest box monitoring program, such as the one conducted at Wertheim National Wildlife Refuge. If such a program does exist on FIIS, these data should be integrated into the NPSpecies database. If no program is currently in effect, the park should consider initiating a monitoring program to assess Wood Duck productivity, survival, cavity availability (including nest boxes and tree inserts) and foraging habitat availability.

Specific information on the abundance and distribution of waterfowl during migration periods on FIIS appears to be absent. Current information on factors responsible for determining patterns of abundance and distribution (e.g., food resources) during the migration and overwintering periods also appear to be lacking.

Finally, waterfowl exposure to contaminants may be an issue on FIIS and deserves attention. Rocque and Barclay (1999) noted that numbers of wintering greater scaup have declined throughout Long Island Sound, which has historically been an important wintering area for the species (Bellrose 1980). In 2006, the continental estimate of scaup (greater and lesser) was 48% below the North American Waterfowl Management Plan (NAWMP) goal of 6.3 million (Wilkins et al. 2006), and both species are considered species of “high” concern within WCR 30 of the NAWMP (ACJV 2005). Long Island Sound and adjacent waters are also known to be heavily polluted based on contaminant levels in sediments, shellfish, and finfish (Grieg et al. 1977a, 1977b, Grieg and Sennfelder 1985, Varekamp et al. 2005, but see Clark 2000). High levels of DDT have been identified specifically as a potential problem on the William Floyd Estate in the past (Lynch 1986). Studies of contaminant effects on scaup within the region still appear to be underway by J.S. Barclay and his students at University of Connecticut (Perkins and Barclay 1997, Cohen et al. 2000). Resulting findings could be

useful to FIIS personnel and should be accessed for the NPS database. Furthermore, issues such as the effects of contaminants on waterfowl population health in FIIS could be addressed with a combination of techniques such as satellite telemetry and banding.

Several initiatives for restoring wetlands within the Long Island South Shore Estuary Reserve (LISSER) have been put forth in the LISSER Comprehensive Management Plan, (<http://www.estuary.cog.ny.us/background-pages/cmp.htm>). If monitoring waterfowl use of restored sites is integrated into restoration plans, such data could be beneficial to park managers. There is also a Long Island Waterbird Habitat Use study in progress at Werheim and Sayville National Wildlife Refuges, both part of the Long Island National Refuge Complex (LINWRC). The project focuses on shorebird, colonial waterbird, and waterfowl use of recently restored marshes on the refuges throughout the breeding and non-breeding seasons. These data should be accessible through the USFWS.

5. Waterbirds

Results - Colonial Nesters

Many beach nesting species of conservation concern breed at FIIS or in the immediate region (Table 7). For instance, the Fire Island National Seashore Wilderness Area provides significant nesting habitat for Least Tern, and as of 1997, neighboring Cedar Beach (i.e., west of the park), harbored the second largest Common Tern nesting colony in the world and the fourth largest Roseate Tern colony in the northeastern U.S., plus approximately 200 nesting Black Skimmers (U.S. Fish and Wildlife Service. 1997a). Fire Island Inlet was recently considered the most critical foraging area for Roseate Terns on Long Island (U.S. Fish and Wildlife Service 1997a). Least Tern (*Sterna antillarum*), Common Tern (*S. hirundo*), Roseate Tern (*S. dougallii*), and Black Skimmer (*Rhynchops niger*) are all confirmed breeders on FIIS, according to the NYBBA (2005, <http://www.dec.ny.gov/animals/7312.html>). Three of these species are classified by the PIF SONE plan as of "local management interest," and the BCR 30 plan ranks them as "high regional concern" (Least Tern, Roseate Tern, Black Skimmer; Table 7). Alternatively, Common Tern is considered a "low concern" species by the NAWCP, while Least Tern and Black Skimmer are classified as "high concern." Roseate Tern, also a confirmed breeder on FIIS, has been listed as Federally Endangered since 1987.

The BCR 30 plan identifies long-legged waders such as Tricolored Heron (*Egretta tricolor*), and Little Blue Heron (*Egretta caerulea*) as "local management interest" species, while the NAWCP considers these two species a "high concern" (Table 7, see Appendix 12 for NAWCP classification definitions). Yellow-crowned Night Heron (*Nycticorax violaceus*), and Black-crowned Night Heron (*Nycticorax nycticorax*) are also identified as "local management interest" by the PIF SONE plan and by the BCR 30 plan, while the NAWCP plan considers both species as "moderate concern" (Table 7).

More avian-related inventory and monitoring work at FIIS has been conducted on waterbirds than on any other group. Nearly a quarter (41) of the 173 unique citations extracted from

NatureBib for the park deal specifically with this group (Table 2). Of these, 8 are summaries of the Long Island Colonial Waterbird and Piping Plover Survey (1989, 1991-1994, 1997-2000), and one is a summary from a Long Island Least Tern and Piping Plover Survey (1983). Those remaining are all 19 or more years old, but include important documents regarding colonial waterbird habitat selection, productivity and behavior on FIIS and in the region.

As stated earlier, NYSDEC conducts the Long Island Colonial Waterbird and Piping Plover Survey annually on 10 sites on Fire Island, including several sites within the park's boundaries (Appendix 1). These efforts provide valuable data on the abundance and distribution of colonial waterbirds at FIIS, and can be used to evaluate population trends over

Table 7. State, Partners-in-Flight (PIF), Bird Conservation Region (BCR), and North American Waterbird Conservation (NAWCP) plan rankings for priority waterbirds that likely breed on Fire Island National Seashore.

Common Name	Scientific Name	State Status ^a	PIF - SONE ^b		NAWCP ^c
			Priority Tier*	Action Level**	
Pied-billed Grebe	<i>Podilymbus podiceps</i>	NY (T)	5	5	2A
American Bittern	<i>Botaurus lentiginosus</i>	NY (SC)	5	4	2A
Least Bittern	<i>Ixobrychus exilis</i>	NY (T)	5	4	2A
Tricolored Heron	<i>Egretta tricolor</i>	--	--	--	2A
Little Blue Heron	<i>Egretta caerulea</i>	--	--	--	2A
Yellow-crowned Night Heron	<i>Nycticorax violaceus</i>	--	5	5	3
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	--	5	5	3B
Glossy Ibis	<i>Plegadis falcinellus</i>	--	--	--	4C
					3C (Light-footed, California, and Yuma subspecies only)
Clapper Rail	<i>Rallus longirostris</i>	--	--	--	
Black Rail	<i>Laterallus jamaicensis</i>	NY(E)	1B	2	1A
Common Tern	<i>Sterna hirunda</i>	NY (T)	5	4	4B
Least Tern	<i>Sterna antillarum</i>	NY (T)	5	4	2A
Roseate Tern	<i>Sterna dougallii</i>	NY (E), Federal (E)	4	2	2A
Black Skimmer	<i>Rhynchops niger</i>	NY (SC)	5	?	2A

^a T=Threatened, SC=Special Concern

^b Southern New England physiographic region (#9)

^c Continental scores (i.e., do not reflect regional concerns, scoring scheme similar to PIF)

* PIF Priority Tiers (see Appendix 11 for detailed descriptions or priority categories): 1A-High continental priority/high regional responsibility; 1B High overall priority/low regional responsibility; 2A-High regional concern; 2B-High regional responsibility, 2C-High regional threats, 3-Additional Watch list species; 4-Additional federally listed species, 5-Additional state listed species

** PIF Action Levels (see Appendix 11 for detailed descriptions or priority categories): 1-Crisis recovery needed, 2-immediate management, 3-management to reverse or stabilize populations, 4-long term planning is needed, 5-investigations are needed to better define threats, 6-monitor population changes only

time. Although these surveys have continued to the present, citations regarding surveys after 2000 were not found, and a search of NYSDEC did not reveal a source for these data. NPS should make a concerted effort to obtain these data sets or the results of trend analyses for

FIIS sites directly from NYSDEC. More current information on the status of breeding tern, gull, and Black Skimmer populations should be included in NatureBib, and made available to FIIS resource managers. Raw data are also available from USGS Waterbird monitoring partnership database for several Long Island Colonial Waterbird and Piping Plover Surveys conducted between 1982 and 1996 (<http://www.pwrc.usgs.gov/cwb/database/>). This database is in its early stages of development and should be checked periodically for more current data. The site also lists one relevant citation as a data source that is not included in Naturebib. The citation refers to a report summarizing coastal waterbird colonies from Maine to Virginia in 1984-1985 (Andrews 1990). The most current documents listed in Naturebib that provide comparative summaries are based on data from 1977 (Erwin 1979, Erwin and Korschgen 1979).

The Seabird Ecological Assessment Network (SEANET) of New Jersey, New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine may also provide important information regarding seabird populations in the FIIS region. The SEANET is comprised of beached bird surveys, which are being carried out twice annually to identify and record information about bird mortality along the northeastern U.S. coast. Data collected by SEANET volunteers are used to examine the spatial pattern of bird carcass deposition and how it varies across time. These surveys will provide baseline information about bird mortality as well as help detect mass mortality events such as oil spills. The study may also help detect longer-term effects of contaminants, diseases, and offshore development. Regular volunteer-based beached bird surveys have been ongoing for many years on the west coast of the U.S., Atlantic Canada, and in other areas around the world, but there has been a lack of regular monitoring on the coast of northeastern U.S. SEANET has been initiated in collaboration with the Tufts Center for Conservation Medicine, Wildlife Trust (Julie Ellis, Tufts University School of Veterinary Medicine, julie.ellis@tufts.edu; www.tufts.edu/vet/seanet).

A large amount of information on colonial waterbirds found in Naturebib is the result of work by Paul and Francine Buckley (nine citations), Michael Gochfeld (four citations), or both (one citation). Work by the Buckleys tends to take a broad view of waterbird ecology and conservation (e.g, F. G. Buckley 1980, P.A. Buckley 1982, Buckley and Buckley 1983). The Buckleys surveyed the entire coastline of Long Island in the first two weeks of June, from 1974-1978, and incorporated their findings into several peer-reviewed articles (e.g., Buckley 1980, Buckley et al. 1978). It is notable that a recent paper, based on these data, is not included in Naturebib (Buckley and Buckley 2000). This study examines marsh habitat nesting in Common and Roseate Terns on Long Island and suggests that Common Tern are well-adapted to marsh nesting, and have likely historically nested in these habitats, whereas Roseate Terns have failed to exploit marsh habitats. Gochfeld's work focused on the effects of contaminants on seabird colonies (Gochfeld 1973) and colony and nest site selection by terns and skimmers (Gochfeld 1977, 1983, Gochfeld and Burger 1987). Important citations by other authors include work conducted by Safina and Burger on tern foraging ecology (1988a, 1988b), a synopsis of colonial waterbird management on National Parks (Kushlan 1983), documentation of a Least Tern colony on Watch Hill (Gugliemone 1983), and a study

of nesting ecology in a Common Tern colony on a dredge-spoil island near Moriches Inlet (Houde 1983). Only one study was conducted specifically on long-legged wader ecology (Yellow-crowned Night Heron, Riegner 1983), and one focused on a secretive marsh bird (Clapper Rail, *Rallus longirostris*, Macnamara and Udell 1970).

Although these authors provide important information on the habitat associations, foraging strategies, and factors that affect the distribution and abundance of colonial waterbirds, the majority of their work was conducted in the 70s and 80s. An academic literature search uncovered six additional citations, although none were specific to FIIS and three were published in the 1980s. We suggest that these papers are worth reviewing, as they provide insight to ecological processes occurring in the region.

Safina et al. (1988a) studied Common Terns nesting between Jones and Fire Island Inlets (1986-87), and Common Terns and Roseate Terns at Cedar Beach (1984-85, Safina et al. 1989). Similar to the Buckley and Buckley (2000) paper noted above, they failed to find differences between nesting success on beach versus marsh habitats. They also noted incidents of Herring Gull (*Larus argentatus*) nesting within or near these colonies, and documented Least Tern nesting within the beach colonies (Safina et al. 1988a). A study based on helicopter surveys for gull, tern and skimmer colonies conducted between 1978 and 1980 was published by Erwin et al. (1981), and focused on differences in colony size and turnover rates among species and habitats (e.g., marsh vs. barrier island vs. dredge spoil island) on the New Jersey coast. Burger et al. (1996) conducted an intensive study of reproductive success in Roseate Terns at Cedar Beach, 1987-1990, where they monitored between 52 and 105 nests/year. Parsons et al. (2001) examined regional patterns of wading bird productivity (e.g., Black-crowned night heron, Snowy Egret [*Egretta thula*], Cattle Egret [*Bubulcus ibis*], and Glossy Ibis [*Plegadis falcinellus*]) in the Northeastern U.S. between 1988 and 1992, including Shooter's Island, Prall's Island, and Isle of Meadows sites in New York.

Recommendations – Colonial Nesters

Factors affecting the distribution and abundance of waterbirds may have changed since many of these studies were conducted, including the distribution of resources that underlie patterns of bird habitat use. Furthermore, these studies do not address disturbance issues, which are recognized as a potential serious threat to nesting colonial waterbirds in general (Carney and Sydeman 1999, Nisbet 2000), and in the Great South Bay region specifically, where Least, Common and Roseate Terns are suspected to be undergoing declines or redistribution due to disturbance to critical nesting habitats (U.S. Fish and Wildlife Service 1997a). As noted above (see *Shorebirds*), a variety of questions remain concerning the effects of human disturbance on avian behavior, distribution, and fitness during breeding and non-breeding seasons. Uncertainty in this subject area offers a broad opportunity for future research on FIIS. Issues that require further attention include the potential effects of personal watercraft on avian distributions (National Park Service 2002), how pedestrian and dog activity may affect behavior and breeding success (Carney and Sydeman 1999, Nisbet 2000), the spatial

scale at which different species react to disturbance (Peters and Otis 2007), and how habituation may play a role in disturbance processes (Nisbet 2000).

Little work appears to have been conducted on Roseate Tern on FIIS despite the fact that it is listed as Federally Endangered and appears to be declining in the park. Roseate Terns arrive in the coastal areas around Fire Island in April, undergo breeding activities from May through August, and most leave by the end of September (Taylor 2001b, National Park Service 2002). The only nesting colony within National Seashore boundaries is on West Inlet Island, where it has undergone significant declines (Taylor 2001b, National Park Service 2002). According to NYDEC records, 200 pairs of roseate terns were documented on Fire Island at one time, whereas no pairs of roseate terns were documented between 1987 and 1996, and 36 pairs were documented in 1997 (Taylor 2001b, National Park Service 2002). As stated above, a recent paper by Buckley and Buckley (2000) that contains important information on Roseate Tern nesting activity on Long Island, is not included in Naturebib. The paper includes information on numbers of nesting pairs, and turnover rates in Long Island marshes from 1974-1978. Published results based on more current data from the region are not available, nor are data examining nesting success indicators, such as daily nest survival rates or number of chicks fledged.

We also found few references to studies focusing on long-legged waders on FIIS. Yellow-crowned Night Heron is the only species which appears to have received extensive attention within the park (Riegner 1983). However, several regional efforts provide information that is likely relevant to Fire Island. For instance, reports on the inventory and monitoring efforts by NYC Audubon Society's Harbor Herons Program are important resources that document wading bird and Double-crested Cormorant (*Phalacrocorax auritus*) nesting activity within New York Harbor and its surrounding waterways. Summary reports of these surveys are available from 2004-2006 at

<http://www.nycaudubon.org/projects/harborherons/HHSurveyReports.shtml>. As suggested in an earlier report (Mizrahi 2004), NPS should consider implementing studies similar to this program to monitor colonial waterbirds in relevant areas such as FIIS. Another important study focused on changes in nesting populations of colonial waterbirds in JBWR between 1974 and 1998 (Brown et al. 2001). The authors suggest that several species, like, Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), Little Blue Heron (*Egretta caerulea*), Glossy Ibis (*Plegadis falcinellus*) have experienced significant declines throughout the refuge during this period, whereas Great Egret (*Ardea alba*) has shown significant increases during the same period. Parsons et al. (2001) found that wading bird productivity in several species of long-legged waders was higher in New York Harbor than in Delaware Bay, but similar to other northern sites such as Cape Cod Bay and Boston Harbor.

Few of these published works evaluate changes in waterbird populations during the last 30 years, or what environmental factors may be underlying changes. Brown et al. (2001) posit several hypotheses for declines in colonial waterbird species, however, their study was not designed to investigate them. The relationships among decreases in some species and increases in others are also important areas of investigation. One important consideration is

that long-legged colonial waterbirds (i.e., herons, egrets) nest in several locations in or adjacent to FIIS (e.g., Smith County Park, William Floyd Estate). Determining whether variation in heron and egret populations in the Long Island region are similar to trends on FIIS, or if declines in the region coincide with increases on FIIS, would be helpful in evaluating the status of these species and the role that FIIS plays in providing suitable habitat in a larger context. Furthermore, long-legged waders not breeding on FIIS, but in the region, may be using emergent marsh or other shallow-water habitats in the park for foraging, and terns and skimmers from breeding colonies outside the park may be foraging in open water habitats within the park. The status and use of these habitats should be monitored.

Specific factors that have been implicated as threats to colonial waterbird populations in the SSER, including FIIS, include human disturbance, mammalian and avian predation, habitat contamination, and contaminants (NYDOS and USFWS 1998).

It is possible that recreational activity on islands where colonial birds are nesting is detrimental to the breeding success of some species (NYDOS and USFWS 1998). Species suspected to be particularly vulnerable to direct disturbance include several species of terns and long-legged wading birds (NYDOS and USFWS 1998). However, as noted above (see *Shorebirds*), much remains to be understood about the relationships between human disturbance and avian behavior, breeding success, and overall fitness. For instance, Nisbet (2000) suggests that tern colonies regularly habituate to human intrusion. Much research needs to be done in this area, and FIIS represents a great opportunity for study, as it is site characterized by intense human activity, particularly during the April-August period. Because several nesting colonies are present on Fire Island beaches, research could be initiated to study potential responses to various kinds of human intrusion, including trampling, picnicking, boat landing, off-road vehicle use, and pets (NYDOS and USFWS 1998). Several peer-reviewed papers have been published that provide a general framework for conducting sound, informative studies concerning human disturbance and wildlife (Gill et al. 1996, 2001; Hill et al. 1997; Frid and Dill 2002).

Declines in some species may also be related to water-borne toxins (Parsons and McColpin 1995; Parsons et al. 2000, 2001). Degradation of water quality, especially by non-point source runoff, is a growing concern in the Great South Bay area. Low water quality has adversely impacted several fisheries in the bay (U.S. Fish and Wildlife Service. 1997a), and may be affecting avian populations indirectly, by lowering resource quality or availability, or directly by creating embryotoxic conditions (Albers 1995, Parsons et al. 2001). Problems have primarily arisen from increased runoff and nitrogen loading to ground and surface water from roads and septic systems, and from discharges of pesticides and fertilizers (U.S. Fish and Wildlife Service. 1997a). Evidence also exists to indicate that high lead levels are also a problem for colonial waterbirds breeding on Long Island (Burger et al. 1994).

Research that could be implemented to investigate the effects of water quality and contaminants on colonial waterbirds include (1) behavioral studies of their food habits to model contaminant intake, (2) studies of bird movements from the breeding colonies to the

foraging grounds using directional observations and telemetry; and (3) studies on breeding success, chick growth and health at the nesting colonies. Contaminant loads in bird tissues can be assessed directly by analyzing egg, feather or blood tissues, and their effects can be assessed through the analysis of serum cholinesterase activity.

Results - Solitary Nesters

Solitary nesting species that are known to, or potentially, breed at FIIS, like American Bittern (*Botaurus lentiginosus*), Least Bittern (*Ixobrychus exilis*), Clapper Rail (*Rallus longirostris*) and Virginia Rail (*R. limicola*) have received very little inventory and monitoring attention at FIIS. Red-necked Grebe (*Podiceps grisegena*), and Horned Grebe (*P. auritus*) are also known to be “residents” of the NY Bight Watershed and may be present on FIIS (USFWS 1997a); the former represents a rare winter resident, while the latter is a common winter resident in mid-Atlantic coastal waters. Only one waterbird reference found in NatureBib focuses on a solitary nesting species (MacNamara and Udell 1970), and the breeding status of several species in the park is unclear. For instance, Black Rail (*Laterallus jamaicensis*) is listed in NPSpecies as a “vagrant” in the park, although FIIS is one of the few Long Island locations where the species has been sighted and they are regularly heard or observed at nearby Oak Beach and Oak Island (USFWS 1997a). Furthermore, the highly productive bay waters of the Fire Island National Seashore Wilderness Area are known for high concentrations of wintering pied-billed grebe (*Podilymbus podiceps*, USFWS 1997a).

Recommendations – Solitary Nesters

The need for monitoring secretive marsh birds in general was recognized by NPS staff, who expressed interest in more inventory and monitoring of marsh species such as Clapper Rail, Virginia Rail, Seaside Sparrow, and Saltmarsh Sharp-tailed Sparrow (Appendix 6). Many are highly secretive and enigmatic, nesting and foraging in dense stands of marsh grass (e.g., *Spartina sp.*). This makes them difficult to detect by most observers during Breeding Bird Atlases and Breeding Bird Surveys. Consequently, patterns of distribution and abundance for most species are poorly understood throughout their range, and thus, there is a need for more thorough information.

An assessment of the conservation status of 43 solitary-nesting waterbird species -- nicknamed “marshbirds” -- was completed in early 2006 using the same protocol as for colonial waterbirds. Although there is no printed second version of the NAWCP Plan, these new and updated plan elements are available on-line (<http://www.waterbirdconservation.org>). Several of the species documented on FIIS are included in the plan, including Black Rail, American Bittern, Least Bittern, and Pied-billed Grebe. The three subspecies of Clapper Rail that are considered of conservation concern (Light-footed, California, and Yuma) were unlikely to be present on FIIS.

New York considers American Bittern a species of special concern (Table 7), and the PIF SONE and BCR 30 plans include American Bittern as a conservation priority species because of its state protected status in the region. In FIIS, this species is known as a "possible" breeder in the park, and efforts to establish its status in the park should be made. American Bittern breeds in tall, dense vegetation at the edges of fresh or brackish marshes, making many areas of Fire Island, particularly the Otis Pike Wilderness Area, potentially suitable breeding habitat. During courtship and territory defense, males advertise using a distinctive "booming" call (Gibbs et al. 1992). They are much more difficult to detect when foraging because they typically stand and wait for prey, or slowly stalk along the edges of dense vegetation.

The conservation priority status of Least Bittern is strikingly similar to American Bittern. Its inclusion in the SONE and BCR 30 plans results from its state protected status in New York and New Jersey (Table 7). Least Bittern is suspected to breed in BBA block 6751D, which encompasses the western half of Smith Point County Park and the southern half of the William Floyd Estate (Appendix 3). This species is more typical of freshwater marshes, but will nest in brackish water habitats (Gibbs et al. 1992). During the breeding season, it is most vocal at dawn and dusk, but its call is not as conspicuous as American Bittern. Additionally, Least Bittern, unlike other herons, does not wade through water while foraging. Instead it climbs through vegetation and hangs over the water to grab prey (Gibbs et al. 1992). These characteristics make it a difficult species to detect and one that could easily be missed by BBA and BBS surveyors.

Of the solitary nesting species that likely breed at FIIS, Black Rail is the species of greatest conservation importance. This inconspicuous species is listed as "endangered" in New York State, and the SONE plan ranks it as a "high overall priority/low regional priority" species that requires immediate management attention (Table 7). The BCR 30 plan assigned Black Rail to the highest conservation priority tier (i.e., 1A-high continental priority/high regional responsibility) and considers it a species requiring immediate management action.

Black Rail is a high marsh species, inhabiting areas dominated by salt meadow cordgrass (*Spartina patens*), black rush (*Juncus gerardi*), and salt grass (*Distichlis spicata*) (Eddleman et al. 1994). High marsh habitats currently are threatened by sea level rise attributed to global warming, marsh management practices to restore tidal flow to impounded areas, and current mosquito control strategies (e.g., open marsh water management, OMWM). Consequently, Black Rail and other high marsh species are threatened by dramatic flux in their primary habitat.

Currently, Black Rails are not known to breed in the park. They are, however, highly secretive, and are known to be present in the marshes of Great South Bay (USFWS 1997a). They are rarely seen and most often heard during surveys. Given this, they are best surveyed by playing their calls to elicit responses from breeding individuals.

Clapper Rail is a ubiquitous breeder in the tidal marshes of the mid-Atlantic. This game species is not listed by New York or New Jersey, nor is it identified by the SONE PIF plan as a conservation priority species. In contrast, the BCR 30 plan considers this species a "high regional responsibility" that requires long-term planning (Table 7).

Clapper Rail is a "probable" breeder in BBA blocks 6751D and 6851C, and a "possible" breeder in Block 6751D, which indicates likely breeding activity in Smith County Park (Appendix 3). They are also possible breeders in Block 6650B, which includes the Otis Pike Wilderness Area. Clapper Rail nests predominantly in salt marshes and infrequently in brackish areas. They are highly vocal during most of the breeding season, and throughout the day (Eddleman and Conway 1998), making them more easily surveyed than other secretive waterbirds of the marshes.

Virginia Rail is listed as a breeder in Great South Bay and Moriches Bay (USFWS 1997), and is listed as a "possible" breeder in BBA Block 6751B, which includes part of the William Floyd Estate (Appendix 3). Virginia rail is also a game species and is not given priority status under the SONE PIF plan.

As noted previously (see Landbirds), standardized monitoring protocols have been developed and are available to natural resource managers wishing to implement a marsh bird monitoring plan (Conway and Nadeau 2006). The marsh bird monitoring program was initiated to focus on secretive marsh birds, particularly rails (*Rallus sp.*, 1998 Marsh Bird Monitoring Workshop, 2006 Marsh Bird Monitoring Technical Workshop). Again, proceedings and documentation presented at these workshops are available online at <http://www.fws.gov/birds/waterbirds/monitoring/marshmonitoring.html>.

Resource managers can use data generated from a marsh bird monitoring program to direct restoration of degraded habitats, manage existing high quality habitats, and identify and abate threats. New Jersey Audubon Society has extensive experience using these techniques to assess densities of secretive waterbirds, including a recent survey using taped call playback surveys at Cape May National Wildlife Refuge under contract with USFWS.

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VI. LITERATURE CITED

- Albers, P.H. 1995. Petroleum and individual polycyclic aromatic hydrocarbons. Pages 330-355 *in* Handbook of Ecotoxicology (D.J. Hoffman, B.A. Rattner, G.A. Burton, and J.Cairns, Eds.). CRC Press, Boca Raton.
- Andrews R. (Compiler) 1990. Coastal Waterbird Colonies: Maine to Virginia 1984–1985. US Fish and Wildlife Service, Newton Corner, MA. pp 429.
- Andrle, R. F., J. R. Carroll. 1988. The Atlas of Breeding Birds in New York State. <http://www.dec.ny.gov/animals/7312.html>; website accessed 4/29/2008.
- Atlantic Coast Joint Venture. 2005. North American Waterfowl Management Plan; Waterfowl Implementation Plan Revision, June 2005. Draft. <http://www.acjv.org/resources.htm>.
- [ASMFC] Atlantic States Marine Fisheries Commission. 2006. Addendum IV to the Interstate Fishery Management Plan for Horseshoe Crab. Fishery Management Report no. 32c.
- Baird, J, A.M. Bagg, I.C.T. Nisbet, and C.S. Robbins. 1959. Operation-recovery – Report on mist-netting along the Atlantic coast in 1958. *Bird Banding* 30:143-171.
- Bellrose, F. C.. 1980. Ducks, geese, and swans of North America. 2nd ed. Stackpole Books, Harrisburg, PA.
- Brown, K.M., J.L. Tims, R.M. Erwin, and M.E. Richmond. 2001. Changes in the nesting populations of colonial waterbirds in Jamaica Bay Wildlife Refuge, New York, 1974-1998. *Northeastern Naturalist* 8:275-292.
- Brown, S., S. Schulte, B. Harrington, B. Winn, J. Bart, and M. Howe. 2005. Population size and winter distribution of eastern American Oystercatchers. *Journal of Wildlife Management* 69: 1538-1545.
- Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling. Oxford: Oxford University Press.

- Buckley, F. G. 1980. What constitutes a waterbird colony? Reflections from the northeastern United States. Proceedings of the 1979 Conference of the Colonial Waterbird Group 3:1-15.
- Buckley, P.A. 1959. Recent specimens from southern New York and New Jersey affecting A.O.U. checklist status. Auk 76:517-520.
- Buckley, P. A. 1972. Preliminary check-list of the birds of the Fire Island National Seashore area. US Department of Interior, National Park Service, Office of Natural Science, Washington, DC.
- Buckley, P.A. 1974. Recent specimens of western vagrants at Fire Island National Seashore, Long Island, New York. Auk 91: 181-185.
- Buckley, P. A. 1982. Microenvironmental determinants of survival in saltmarsh-nesting Common Terns. Colonial Waterbirds. Vol. 5:p. 39-48.
- Buckley, P. A. and F. G. Buckley. 1983. Conservation of colonial waterbirds Oceanus 26:55-61.
- Buckley, P.A. and F.G. Buckley. 2000. Patterns of colony-site use and disuse in saltmarsh-nesting common and roseate terns. Journal of Field Ornithology 71:356-369.
- Buckley, P. A., H. S. Ginsberg and H. B. Underwood. 1994. Research Proposal: Quantifying Interactions of Neotropical Migratory Birds, Deer, Small Mammals, Ticks and Vegetation in the Epidemiology of Lyme Disease at Fire Island National Seashore, Long Island, NY. University of Rhode Island.
- Buckley, F. G. and S. Mitra. 1998. Identification of Deer Tick Predators, [The Importance of birds and ticks in the spread and control of human diseases at Fire Island National Seashore]. University of Rhode Island.
- Buckley, P. A., H. S. Ginsberg, H. B. Underwood and F. G. Buckley. 1998. The Ecology of Lyme Disease, Migratory Birds, and Resident Mammals in the Lighthouse Tract at Fire Island National Seashore, A Progress Report. State University of New York, Stony Brook, NY.
- Buckley, F.G., P.A. Buckley, and S. Mitra. 2002. Species of birds captured at the Fire Island Lighthouse tract, 1995-2002. *Unpublished data*.
- Bull, J. 1964. Birds of the New York Area. Harper and Row Publishers, New York. 540 pp.

- Bull, J. 1974. Birds of New York State. Garden City, NY: Doubleday/Natural History Press.
- Burger, J. 1981. The effect of human activity on birds at a coastal bay. *Biological Conservation* 21:231-241.
- Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in the northeastern United States. *Environmental Conservation* 13:123-130.
- Burger, J. 1987. Physical and social determinants of nest site selection in Piping Plover in New Jersey. *Condor* 98:811-818.
- Burger, J. 1991. Foraging behavior and the effect of human disturbance on the Piping Plover, *Charadrius melodus*. *Journal of Coastal Research* 7:39-52.
- Burger, J. 1994. The effect of human disturbance on foraging behavior and habitat use in Piping Plover (*Charadrius melodus*). *Estuaries* 17:695-701.
- Burger, J., M. Horoszewski Lavery, and M. Gochfeld. 1994. Temporal changes in lead levels in common tern feathers in New York and the relationship of field levels to adverse effects in the laboratory. *Environmental Toxicology and Chemistry* 13:581-586.
- Burger, J., M. Gochfeld, and L.J. Niles. 1995. Ecotourism and birds in coastal New Jersey: Contrasting responses of birds, tourists, and managers. *Environmental Conservation* 22:56-65.
- Burger, J., I.C.T. Nisbet, C. Safina, and M. Gochfeld. 1996. Temporal patterns in reproductive success in the endangered roseate tern (*Sterna dougallii*) nesting on Long Island, New York, and Bird Island, Massachusetts. *Auk* 113: 131-142.
- Burton, N.H.K., P.R. Evans, and M.A. Robinson. 1996. Effect on shorebird numbers of disturbance, the loss of a roost site and its replacement by an artificial island at Hartlepool, Cleveland. *Biological Conservation* 77:193-201.
- Carney K.M., W.J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. *Waterbirds*. 22:68-79.
- Chan, S. 2003. A plan for monitoring shorebirds during the non-breeding season in Bird Monitoring Region New York – BCR 30.
- Clark, L.B. 2000. Temporal and Spatial Distributions of Trace Metals, Organic Carbon, and Inorganic Nutrients in a Barrier Island Estuary: The Great South Bay System. Master of Science Thesis. Marine Environmental Sciences State University of New York at Stony Brook.

- Clark, K. E., and L. J. Niles. 2000. North Atlantic regional shorebird plan. New Jersey Division of Fish and Wildlife, Woodbine, New Jersey.
- Cohen, J.B., J. S. Barclay, A. R. Major and J. P. Fisher. 2000. Wintering Greater Scaup as Biomonitor of Metal Contamination in Federal Wildlife Refuges in the Long Island Region. *Archives of Environmental Contamination and Toxicology* 38:83-92.
- Cohen, J.B., J.D. Fraser, and D.H. Catlin. 2006. Survival and site fidelity of Piping Plovers on Long Island, New York. 2006. *Journal of Field Ornithology* 77:409-417.
- Conway, C. J., and C. P. Nadeau. 2006. Development and field testing of survey methods for a continental marsh bird monitoring program in North America. Wildlife Research Report # 2005-11. USGS Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ.
- Curtis, O. E., R. N. Rosenfield and J. Bielefeldt. 2006. Cooper's Hawk. (*Accipiter cooperii*). The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Laboratory of Ornithology; Retrieved from The Birds of North American Online database: http://bna.birds.cornell.edu/BNA/account/Coopers_Hawk/.
- Davis, T. 1976. First record of Smiths Longspur in New York *Auk* 93(4):838-839. No title.
- Diefenbach, D.R., D.W. Brauning, and J.A. Mattice. 2003. Variability in grassland bird counts related to observer differences and species detection rates. *Auk* 120:1168-1179.
- Dettmers, R., and K. V. Rosenberg. 2000. Partners in Flight Bird Conservation Plan for Southern New England (Physiographic Area #44), Version 1.0. http://www.blm.gov/wildlife/pl_09sum.htm/.
- Dillon, C. J. 1997. Categorical Exclusion for the Research on Quantifying the Relationships Among Migrating Birds, Mammals, and Ticks in the Ecology of Lyme Disease at the Lighthouse Tract of Fire Island National Seashore. National Park Service, Fire Island National Seashore, Patchogue, NY.
- Dunn, E.H., C.M. Francis, P.J. Blancher, S.R. Drennan, M.A. Howe, D. Lepage, C.S. Robbins, K.V. Rosenberg, J.R. Sauer, and K.G. Smith. 2005. Enhancing the scientific value of the Christmas Bird Count. *Auk* 122: 338-346.
- Durrell, S.E.A.L., R.A. Stillman, P. Triplet, C. Aulert, D.O.D. Biot, A. Bouchet, S. Duhamel, S. Mayot, and J.D. Goss-Custard. 2005. Modelling the efficacy of proposed mitigation areas for shorebirds: a case study on the Seine estuary, France. *Biological Conservation* 123:67-77.

- Eddleman, W. R., R. E. Flores, and M. L. Legare. 1994. Black Rail (*Laterallus jamaicensis*). In *The Birds of North America*, No. 123 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.
- Eddleman, W. R., and C. J. Conway. 1998. Clapper Rail (*Rallus longirostris*). In *The Birds of North America*, No. 340 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Eggeman, D. R. and F. A. Johnson. 1989. Variation in effort and methodology for the midwinter waterfowl inventory in the Atlantic Flyway. *Wildlife Society Bulletin* 17:227-233.
- Elias-Gerken, S.P., J.D. Fraser, and P.A. Buckley. 2000. Piping Plover brood foraging ecology on New York barrier islands. *Journal of Wildlife Management* 64:346-354.
- England, M. 1989. The Breeding Biology and Status of the Northern Harrier (*Circus Cyaneus*) on Long Island, New York. Master's Thesis, C.W. Post Library, Long Island University, Brookville, NY.
- Erwin, R. M. 1979. Coastal waterbird colonies: Cape Elizabeth, Maine to Virginia US Department of Interior, Fish and Wildlife Service, Office of Biological Services, Coastal Ecosystems Project, Washington, DC 212 pp.
- Erwin, R. M. and C. E. Korschgen. 1979. Coastal waterbird colonies: Maine to Virginia, 1977 An atlas showing colony locations and species composition.
- Erwin, R.M. J. Galli, and J. Burger. 1981. Colony site dynamics and habitat use in Atlantic coast seabirds. *Auk* 98:550-561.
- Fabre, L.L. 2003. Review of monitoring programs for vertebrates of the Northeast Coastal and Barrier Network. United States Department of the Interior, National Park Service. 260 pp.
- Farmer, C.J., D.J.T. Hussell, and D. Mizrahi. 2007. Trends in numbers of migrating raptors at Hawk Mountain Sanctuary, PA and Cape May Point, NJ, 1976-2003. *Auk* 124:1047-1062 .
- Farnsworth, G.L., K.H. Pollock, J.D. Nichols, T.R. Simons, J.E. Hines, and J.R. Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. *Auk* 119:414-425.

- Ferland, C.L., and S.M. Haig. 2002. The 2001 International Piping Plover and Snowy Plover Census. Report to USGS Forest and Rangeland Ecosystem Science Center, Corvallis, OR. 287 pp.
- Flemming, S.P, R.D. Chiasson, P.C. Smith, P.J. Austin-Smith, and R.P. Bancroft. 1988. Piping Plover status in Nova Scotia related to its reproductive and behavioral responses to human disturbance. *Journal of Field Ornithology* 59:321-330.
- Frid, A. and L. M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. *Conservation Ecology* 6:11 pp.
- Gibbs, J. P. , S. Melvin, and F. A. Reid. 1992. American Bittern. *In* The Birds of North America, No. 18 (A. Poole, P. Stettenheim, and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, DC: The American Ornithologists' Union.
- Gill, J.A., W.J. Sutherland, and A.R. Watkinson. 1996. A method to quantify the effects of human disturbance on animal populations. *Journal of Applied Ecology* 33:786-792.
- Gill, J. A., K. Norris, and W. J Sutherland. 2001. Why behavioral responses may not reflect the population consequences of human disturbance. *Biological Conservation* 97:265-268.
- Ginsberg, H. S., F. G. Buckley and H. B. Underwood. 1994. Research Plan: Quantifying the Relationships Among Migrating Birds, Mammals, and Ticks in the Ecology of Lyme Disease at Fire Island National Seashore, Long Island, NY. University of Rhode Island.
- Ginsberg, H.S., E. Zhioua, S. Mitra, J. Fischer, P.A. Buckley, F. Verret, B.H. Underwood, and F.G. Buckley. 2004. Woodland type and spatial distribution of nymphal *Ixodes scapularis* (Acari: Ixodidae). *Environmental Entomology* 33:1266-1273.
- Ginsberg, H.S., P.A. Buckley, M.G. Balmforth, E. Zhioua, S. Mitra, and F.G. Buckley. 2005. Reservoir competence of native North American birds for the Lyme disease spirochete, *Borrelia burgdorferi*. *Journal of Medical Entomology* 42:445-449.
- Gochfeld, M. 1973. Effects of artifact pollution on the viability of seabird colonies on Long Island, New York *Environmental Pollution* 4(1):1-6. No title.
- Gochfeld, M. 1977. Colony and nest site selection by Black Skimmers. Colonial Waterbirds, Proceedings of 1977 Conference of the Colonial Waterbird Group.
- Gochfeld, M. 1983. Colony site selection by Least Terns: Physical attributes of sites Colonial Waterbirds 6:205-213.

- Gochfeld, M. and J. Burger. 1987. Nest site selection: Comparison of Roseate and Common Terns (*Sterna dougalli* and *S. hirundo*) in a Long Island, New York colony. *Bird Behavior* 7(2):58-66.
- Green, M.G., T. Swem, M. Morin, R. Mesta, M. Klee, K. Hollar, R. Hazlewood, P. Delphey, R. Currie, and M. Amaral. 2006. Monitoring results for breeding American Peregrine Falcon (*Falco peregrinus anatum*), 2003. U.S. Department of Interior, Fish and Wildlife Service, Biological Technical Publication FWS/BTP-R1005-2006, Washington DC.
- Greenlaw, J. S. 1996. Eastern Towhee (*Pipilo erythrophthalmus*). In *The Birds of North America*, No. 262 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Greenlaw, J.S., and J.D. Rising. 1994. Sharp-tailed Sparrow (*Ammodramus caudacutus*). In, *The Birds of North America*, No. 112 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences, Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- Grieg, R. A., A. Adams, and D. R. Wenzloff. 1977a. Trace metal content of plankton and zooplankton collected from the New York Bight and Long Island Sound. *Bull. Environ. Toxicol.* 18:3-8.
- Grieg, R.A., Reid, R.N., and Wenzloff, D.R., 1977b. Trace metal concentrations in sediments from Long Island Sound: *Marine Pollution Bulletin*, v. 8, p. 183-188.
- Grieg, R. A., and G. Sennefelder. 1985. Metal and PCB concentrations in mussels from Long Island Sound. *Bull. Environ. Toxicol.* 35:331-334.
- Guglielmone, K. 1983. A Least Tern colony, Watch Hill, Fire Island National Seashore, New York: Summer 1983 Unpublished, US Department of Interior, National Park Service, Fire Island National Seashore, Patchogue, NY 7 pp.
- Haig, S.M., Ferland, C.L., Cuthbert, F.J., Dingleline, J., Goossen, J.P., Hecht, A., McPhillips, N., 2005, A complete species census and evidence for regional declines in piping plovers: *Journal of Wildlife Management*, v. 69, no. 1, p. 160-173.
- Harrington, B. and S. Brown. 2002. Preliminary Report: ISS sites and shorebird counts in BCR 30: New England/Mid Atlantic Coast. Manomet Center for Conservation Sciences, Manomet, MA.
- Hill, D., D. Hickin, D. Price, G. Tucker, R. Morris, and J. Treweek. 1997. Bird disturbance: improving the quality and utility of disturbance research. *Journal of Applied Ecology* 34: 275-288.

- Houde, A. E. 1983. Nest density, habitat choice, and predation in a Common Tern colony. *Colonial Waterbirds* 6:178-184.
- Houghton, L.M. 2005. Piping Plover population dynamics on a rebuilt barrier island. Ph.D. dissertation, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Huntington, C.E. 1952. Hybridization in the Purple Grackle, *Quiscalus quiscula*. *Systematic Zoology* 1:149-170. Institute for Bird Population Studies. 2004. Monitoring Avian Productivity and Survival (MAPS). <http://www.birdpop.org/maps.htm/>.
- Karpanty, S.M., J.D. Fraser, J. Berkson, L.J. Niles, A. Dey, and E.P. Smith. 2007. Horseshoe crab eggs determine red knot distribution in Delaware Bay. *Journal of Wildlife Management* 70:1704-1710.
- Katzner, T. S. Robertson, B. Robertson, J. Klusarits, K. McCarty, and K.L. Bildstein. 2005. Results from a long-term nest-box program for American Kestrels: implications for improved population monitoring and conservation. *Journal of Field Ornithology* 76:217-226.
- Kirby J. S., C. Clee, V. Seager. 1993. Impact and extent of recreational disturbance to wader roosts on the Dee estuary: some preliminary results. *Wader Study Group Bulletin*. 68:53-58.
- Klopfer, S.D., A. Olivero, L. Sneddon, and J. Lundgren. 2002. Final report of the NPS Vegetation Mapping Project at Fire Island National Seashore. CMI-GRS-02-03. Conservation Management Institute, Virginia Tech, Blacksburg, VA. <http://biology.usgs.gov/npsveg/fiis/report.pdf>
- Kricher, J. C. 1995. Black-and-white Warbler (*Mniotilta varia*). In *The Birds of North America*, No. 158 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union, Washington, D.C.
- Kushlan, J. A. 1983. Special species and ecosystem preserves: Colonial waterbirds in US National Parks. *Environmental Management* 7(3):201-207.
- Kushlan, J. A., M. J. Steinkamp, K. C. Parsons, J. Capp, M. A. Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Mills, R. Paul, R. Phillips, J. E. Silva, B. Sydeman, J. Trapp, J. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, D.C. 78 pp.

- Levine, E., B. B. Lincoln, and S. R. Lincoln. 1998. Bull's Birds of New York State. Comstock Publishing Associates, A division of Cornell University Press, Ithaca and London.
- Longcore, J. R., D. G. McAuley, G. R. Hepp, and J. M. Rhymer. 2000. American Black Duck (*Anas rubripes*). In, The Birds of North America, No. 481 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- Lynch, P. 1986. Ecological inventory: William Floyd Estate, Fire Island National Seashore. Unpublished report. Fire Island National Seashore. Patchogue, NY.
- MacKenzie, D.I., J.D. Nichols, J.A. Royle, K.H. Pollock, L.L. Bailey, and J.E. Hines. 2005. Occupancy Estimation and Modeling: Inferring Patterns and Dynamics of Species Occurrence. Academic Press. Burlington, MA, USA.
- Macnamara, E. E. and H. F. Udell. 1970. Clapper Rail investigations on the South Shore of Long Island Limnological Society, Proceedings 71:120-131.
- Marti, C.D. 1992. Barn Owl (*Tyto alba*). In, The Birds of North America, No. 1 (A. Poole, P. Stettenheim and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- McCarty, J. P. 1996. Eastern Wood-Pewee (*Contopus virens*). In The Birds of North America, No. 245 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- McGowan, C.P., T.R. Simons, W. Golder, and J. Cordes. 2005. A comparison of American Oystercatcher reproductive success on barrier beach and river island habitats in coastal North Carolina. Waterbirds 28:150-155.
- McCormick, Jack, and Associates, Inc. 1975. Environmental Inventory of Fire Island National Seashore and the William Floyd Estate, Suffolk County, New York US Department of Interior, National Park Service, Denver Service Center, Denver, CO 461 pp.
- Mitra, S., and J. Putnam, J. 1999. Birds of Fire Island National Seashore.
- Mizrahi, D.S. 2004. Avian Inventory and Monitoring Needs for Gateway National Recreation Area: A Review of Available Literature and Data.
- Moore, F.R. 2000. Stopover ecology of Nearctic-Neotropical landbird migrants: Habitat relations and conservation implications. Studies in Avian Biology. 133 pp.

- Morrison, R.I.G., R.E. Gill, Jr., B.A. Harrington, S. Skagen, G.W. Page, C.L. Gratto-Trevor, and S.M. Haig. 2001. Estimates of shorebird populations in North America. Canadian Wildlife Service Occasional Paper no. 104. Canadian Wildlife Service, Ottawa..
- Morrison, R.I.G., B.J. McCaffery, R.E. Gill, S.K. Skagen, S.L. Jones, G.W. Page, C.L. Gratto-Trevor, and B.A. Andres. 2006. Population estimates of North American Shorebirds, 2006. Wader Study Group Bulletin 111:67-85.
- Mosher, J. A., M. R. Fuller, M. R. Kopeny. 1990. Surveying woodland raptors by broadcast of conspecific vocalizations. J. Field Ornithol. 61: 453–461.
- Mosher, J. A., M. R. Fuller. 1996. Surveying Woodland Hawks with broadcasts of Great Horned Owl vocalizations. Wildl. Soc. Bull. 24(3): 531-536.
- Myers, J. P., R. I. Morrison, P. Z. Antas, B. A. Harrington, T. E. Lovejoy, M. Sallaberry, S. E. Senner, and A. Tarak. 1987. Conservation strategy for migratory species. American Scientist 75:19-26.
- Nadareski, C.A. and D. Riepe. 1997. Osprey banding project: A cooperative project between the National Park Service and New York City Department of Environmental Project. 5 pp.
- National Park Service. 2002. Fire Island National Seashore: Personal Watercraft Use Environmental Assessment. 200 pp.
http://www.nps.gov/fiis/EA_PersonalWatercraftUse_Aug-2002_with_maps.pdf
- National Park Service. 2004. Natural Resource Inventories in the National Parks.
http://www.nature.nps.gov/Challenge/brochures/Inventories_MAR_2004_screen.pdf
- New York Department of Environmental Conservation. 1999. Long Island Colonial Waterbird and Piping Plover Survey. (current data also available in active database: <http://www.pwrc.usgs.gov/cwb/database/>).
- New York State Department of State and the United States Fish and Wildlife Service. 1998. Coastal Colonial Waterbirds. South Shore Estuary Reserve Technical Report Series. Prepared for the South Shore Estuary Reserve Council by the Southern New England - New York Bight Coastal Ecosystems Program.
http://www.nyswaterfronts.com/Final_Draft_HTML/Tech_Report_HTM/Living_Resources/Shorebird_Concentration/First_Shorebird.htm
- New York State Department of Environmental Conservation. 2006. New York Breeding Bird Atlas. <http://www.dec.state.ny.us/apps/bba/results/index.cfm>.

- New York State Ornithological Association. 2004. Annual winter waterfowl count.
<http://www.nybirds.org/ProjWaterfowl.htm>.
- Nisbet, I. C. T. 2000. Disturbance, habituation, and management of waterbird colonies. *Waterbirds* 23: 312-332.
- Nol, E. and R.C. Humphrey. 1994. American Oystercatcher (*Haematopus palliatus*). In, *The Birds of North America*, No. 82. (A. Poole and F.Gill, Eds.). The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- Nolan, V., Jr., E.D. Ketterson, and C.A. Buerkle. 1999. Prairie Warbler (*Dendroica discolor*). In, *The Birds of North America*, No. 455. (A. Poole and F.Gill, Eds.). The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- Olijnyk, C.G. and Brown, K.M. 1999. Results of a seven years effort to reduce nesting by Herring and great Black-backed Gulls. *Waterbirds* 22(2):285-289.
- Panko, D. 2007. Fire Island Yearly Summary of Hawk Watch Data. Hawk Migration Association of North America. Fire Island Raptor Enumerators website
<http://www.battaly.com/fire/>.
- Parsons, K.C. and A.C. McColpin. 1995. Great Blue Heron reproductive success in upper Delaware Bay. *Journal of Field Ornithology* 66:184-191.
- Parsons, K.C., A.C. Matz, M.J. Hooper, and M.A. Pokras. 2000. Monitoring wading bird exposure to agricultural chemicals using serum cholinesterase activity. *Environmental Toxicology and Chemistry* 19:1317-1323.
- Parsons, K.C., S.R. Schmidt, and A.C. Matz. 2001. Regional patterns of wading bird productivity in northeastern U.S. estuaries. *Waterbirds* 24: 323-330.
- Peters, K.A. and D.L. Otis. 2005. Using the risk-disturbance hypothesis to assess the relative effects of human disturbance and predation risk on foraging American oystercatchers. *Condor* 107:716-725.
- Peters, K.A. and D.L. Otis. 2007. Shorebird roost-site selection at two temporal scales: is human disturbance a factor? *Journal of Applied Ecology* 44:196-209.
- Perkins, C.R. and J.S. Barclay. 1997. Accumulation and mobilization of organochlorine contaminants in wintering greater scaup. *Journal of Wildlife Management* 61:444-449.

- Pfister, C., B. A. Harrington, and M. Lavine. 1992. The impact of human disturbance on shorebirds at a migration staging area. *Biological Conservation* 60:115-126.
- Plissner, J.H. and S.M. Haig. 1999. Viability of piping plover *Charadrius melodus* metapopulations. *Biological Conservation* 92:163-173.
- Plissner, J. H. and S. M. Haig. 2000. Status of a broadly-distributed endangered species: results and implications of the second international Piping Plover census. *Canadian Journal of Zoology* 78: 1-12.
- Post, W. 1972. The Social Organization and Behavior of the Seaside Sparrow as an Adaptive Response to Differing Environmental Conditions. Thesis. North Carolina State University at Raleigh Thesis.
- Post, W., and J.S. Greenlaw. 1994. Seaside Sparrow (*Ammodramus maritimus*). In, *The Birds of North America*, No. 127 (A. Poole and F. Gill, Eds.). The Academy of Natural Sciences Philadelphia, PA; The American Ornithologists' Union, Washington, D.C.
- Ralph, C. J., S. Droege, and J. R. Sauer. 1995. Managing and monitoring birds using point counts: Standards and application. Pages 161-168 in *Monitoring bird populations by point counts*. General Technical Report PSW-GTR-149. Albany, California. Pacific Southwest Research Station, Forest Service, U.S. Dept. of Agriculture. 187 pp.
- Riegner, M. 1983. Foraging behavior and ecology of Yellow-Crowned Night Herons (*Nycticorax violaceus*) Unpublished PhD Dissertation, State University of New York, Stony Brook, NY 106 pp. Thesis. Thesis.
- Riepe, D. 1989. Management Plan for the Threatened Piping Plover (*Charadrius melodus*), Breezy Point District. National Park Service. Environmental Assessment.
- Rocque, D. A., and J. S. Barclay. 1999. Greater scaup survival and population status in the Atlantic Flyway. *Journal of Wildlife Management*
- Rodgers, J. A. and H. T. Smith. 1991. Minimum buffer zone requirement to protect nesting bird colonies from human disturbance. Pp. 55-56 in *Proceedings of the Coastal Nongame Workshop, Southeast Region, 10-12 September 1991, Gainesville, FL* (D. P. Jennings, ed.). U. S. Fish and Wildlife Service, and Florida Game and Fresh Water Fish Commission.
- Roth, R. R., M. S. Johnson, and T. J. Underwood. 1996. Wood Thrush (*Hylocichla mustelina*). In *The Birds of North America*, No. 246 (A. Poole and F. Gill, eds.). The

Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

- Rosenberg, K. V., B. D. Watts, and R. Dettmers. 2002. Southern New England/Mid-Atlantic Coastal Plain Bird Conservation Plan (Bird Conservation Region #30): Draft. 15 pp.
- Safina, C. and J. Burger. 1988a. Ecological dynamics among prey fish, bluefish, and foraging Common Terns in an Atlantic Coastal system, pp 95-173 in: Burger, J (ed), Seabirds and Other Marine Vertebrates Columbia University Press, New York, NY.
- Safina, C. and J. Burger. 1988b. Use of sonar and a small boat for studying foraging ecology of seabirds Colonial Waterbirds 11(2):234-244. No title.
- Safina, C., J. Burger, M. Gochfeld, and R.H. Wagner. 1988. Evidence for prey limitation of common and roseate tern reproduction. Condor 90:852-859.
- Safina, C. D. Witting, and K. Smith. 1989. Viability of salt marshes as nesting habitat for common terns in New York. Condor 91: 571-584.
- Sauer, J. R., J. E. Hines, and J. Fallon. 2003. The North American Breeding Bird Survey, Results and Analysis 1966 - 2002. Version 2003.1, USGS Patuxent Wildlife Research Center, Laurel, MD. <http://www.mbr-pwrc.usgs.gov/bbs/bbs.html>
- Schiff, S. and M. Farina. 2005. Peregrine Falcons nesting on Long Island. Kingbird 55 (3).
- Schulte, S., S. Brown, and the American Oystercatcher Working Group. 2006. Version 1.0. American Oystercatcher Conservation Plan for the Atlantic and Gulf Coasts of the United States. Western Hemisphere Shorebird Reserve Network, www.whsrn.org.
- Smallwood, J.A. and D.M. Bird. 2002. American Kestrel (*Falco sparverius*). In The Birds of North America, No. 602 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.
- Smith, J. D. 1962. Animals on the outer beach Long Island Forum 25(8):161,167,180. No title.
- Smith, C.R., Ford, D., Farber, L., Litwin, T. 1983. Habitat use and foraging behavior of migrating songbirds in spring and fall at the Seatuck National Wildlife Refuge, Long Island and at Fire Island Light. Unpublished, Seatuck Research Center, Cornell University, Islip, NY.

- South Shore Estuary Reserve Council. 2001. Long Island South Shore Estuary Reserve Comprehensive Management Plan.
http://www.nyswaterfronts.net/Final_Draft_HTML/Main_Page.htm
- Sullivan, B. L., C. L. Wood. 2005. The changing seasons - a plea for the common birds. *North American Birds* 59: 20-30.
- Swift, B. L. and P. J. Hess. 1999. A comparison of winter waterfowl surveys in New York. *Northeast Wildlife* 54:85-92.
- Taylor, E. 2001a. William Floyd salt marsh bird monitoring, annual report. *Unpublished report*.
- Taylor, E. 2001b. Distribution and Abundance of Listed Terrestrial Vertebrate and Vascular Plant Species on Fire Island: Ocean Beaches and Inter-Dune Swales. Division of Natural Resources. Revision of Dec. 14, 2000, report. On file at Fire Island National Seashore, Patchogue, NY.
- Taylor, E. 2002. Result of the Otis Pike Wilderness 2001 Breeding Bird Survey. *Unpublished report*.
- Taylor, I. R., A. Dowell, T. Irving, I. K. Langford, G. Shaw. 1988. The distribution and abundance of the Barn Owl *Tyto alba* in south-west Scotland. *Scottish Birds* 15: 40–43.
- Tubbs, C.R., J.M. Tubbs, and J.S. Kirby. 1992. Dunlin *Calidris alpina alpina* in The Solent, southern England. *Biological Conservation* 60:15-24.
- U.S. Army Corps of Engineers. 2003. Final Avian Field Sampling Summary Report: May 2002- May 2003. For the Reformulation of the Shore Protection and Storm Damage Reduction Project, South Shore of Long Island, New York – Fire Island Inlet to Montauk Point. USACE, New York District (CENAN-PL-E). 71 pp.
- U.S. Fish and Wildlife Service. 1991. Northeast coastal areas study: Significant coastal habitats of southern New England and portions of Long Island, New York. U.S. Fish and Wildlife Service, Southern New England - Long Island Sound Coastal and Estuary Office, Box 307, Charlestown, Rhode Island 02813.
<http://training.fws.gov/library/pubs5/necas/begin.htm>
- U.S. Fish and Wildlife Service. 1996a. Piping Plover (*Charadrius melodius*), Atlantic Coast Population, Revised Recovery Plan. Hadley, Massachusetts. 258 pp.
- U.S. Fish and Wildlife Service. 1997a. Significant Habitats and Habitat Complexes of the New York Bight Watershed. Southern New England-New York Bight Coastal

Ecosystems Program, Charlestown, Rhode Island.

- U.S. Fish and Wildlife Service. 1997b. South Shore Estuary Reserve Shorebird draft Technical Report. U.S. Fish and Wildlife Service, Southern New England, New York Bight, Coastal Ecosystems Program, Charlestown, RI.
- U.S. Fish and Wildlife Service. 2003. Delaware Bay Shorebird-Horsehoe Crab Assessment Report – Biological Assessment. Shorebird Technical Committee. USFWS, Division of Migratory Bird Management, Arlington, VA.
- U.S. Fish and Wildlife Service. 2004. Preliminary 2004 Atlantic Coast Piping Plover abundance and productivity estimates. Sudbury, MA.
- Varekamp, J.C., E.L. Mecray, and T.Z. Maccalous. 2005. Once spilled, still found: metal contamination in Connecticut coastal wetlands and Long Island Sound sediment from historic industries. *In* America's Changing Coasts (D.M. Whitelaw, G.R. Visgilio, eds.). Edward Elgar Publishing. Northampton, MA. Pages 122-147.
- White, Clayton M., Nancy J. Clum, Tom J. Cade and W. Grainger Hunt. 2002. Peregrine Falcon (*Falco peregrinus*), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: <http://bna.birds.cornell.edu/bna/species/660>
- Wilkins, K. A., M. C. Otto, and M. D. Koneff. 2006. *Waterfowl population status, 2006*. U.S. Department of Interior Fish and Wildlife Service, Laurel, Maryland, USA.
- Wojcinski, Z. W., I. K. Barker, D. B. Hunter and H. Lumsden. 1987. An outbreak of schistosomiasis in Atlantic Brant geese, *Branta bernicla hrota* Journal of Wildlife Diseases 23(2):248-255.

APPENDIX 1

References Used for NPSpecies Database Review Fire Island National Seashore

- Panko, D. 2007. Fire Island Yearly Summary of Hawk Watch Data. Hawk Migration Association of North America. Fire Island Raptor Enumerators website <http://www.battaly.com/fire/>

Provides annual summaries of hawkwatch data from 1982-2006, and daily summaries of data from 2003-2006. The data in this summary was used as additional confirmation of raptor species at Fire Island.

- Mitra, S., Putnam, J. 1999. Birds of Fire Island National Seashore. Fire Island National Seashore, Patchogue, NY.

This checklist provided seasonal abundance information.

- New York Breeding Bird Atlas web site. 2006. Species lists from <http://www.dec.state.ny.us/cfm/xtapps/bba/> Blocks 6449B, 6450D, 6550C, 6550D, 6650C, 6650A, 6650B, 6750A, 6751C, 6751D, 6851C, 6851A and 6751B.

This reference provides the majority of the breeding confirmations. The web site provides a detailed summary of breeding confirmations by atlas block with accompanying topographic maps. The web site provides species lists for the publication The Atlas of Breeding Birds in New York State (1988), as well as current findings for the atlas update that is in progress (expected to be available in 2008).

- New York State Department of Environmental Conservation. 1999. Long Island Colonial Waterbird and Piping Plover Survey.

This report includes a breeding survey for several species of waterbirds. Fourteen locations surveyed were within Fire Island National Seashore. The data were used to supplement the breeding bird confirmations from the atlas data. This report provided four additional confirmations not found in the atlas information.

- USGS Waterbird monitoring partnership database. 2007. Long Island Colonial Waterbird and Piping Plover Survey. <http://www.pwrc.usgs.gov/cwb/database/>.

Raw data were available for 10 sites on FI: Democratic Point (Bayshore), East AKA Smith Point (Shirley), Lighthouse (Islip), Pines (Brookhaven), Quench Creek (nearest town unk.), Sunken Forest (Cherry Grove), Villages (Kismet), Watch Hill (unk), Wilderness (Davis Park), Wilderness Long Cove (Davis Park). Data were available for varying date ranges, 1984-1996. These data were used confirm findings listed in the NYDEC 1999 Long Island Colonial Waterbird and Piping Plover Survey report.

- Buckley, F. G., P. A. Buckley, and S. Mitra. 2002. Species of birds captured at the Fire Island Lighthouse Tract, 1995-2002.

This unpublished summary lists species captured by mist netting. There are no data specifying numbers caught. However, the reference was cited for each species on the list as concrete confirmation of that species presence at Fire Island. In addition, there is one species on this list, Cordilleran Flycatcher, that is not found in any other reference and was added as a vagrant to the database.

- Bull, J. 1964. Birds of the New York Area. Harper & Row, Publishers. New York, Evanston, and London.
- Levine, E., B. B. Lincoln, and S. R. Lincoln. 1998. Bull's Birds of New York State. Comstock Publishing Associates, A division of Cornell University Press, Ithaca and London.

These two books are an account of species occurring in the state of New York. They are used to add to the interpretation of some abundance information and to verify accounts of vagrants at Fire Island. In addition, they are used to help verify the possibility of the presence of species which are found in the McCormick, 1975 reference (see below) but not in any other reference for the database.

- Lynch, P. No Date. Ecological inventory: William Floyd Estate, Fire Island National Seashore. Unpublished report. Fire Island National Seashore. Patchogue, NY.

This report contains a list of avian species for the William Floyd Estate. There were no additional species on this list to those in any other reference. However, the reference was cited for each species on the report's list to document that these species occur specifically on the William Floyd Estate which encompasses different habitats from Fire Island.

- McCormick, J. 1975. Environmental Inventory of the Fire Island National Seashore and the William Floyd Estate, Suffolk County, New York: National Park Service, Denver Service Center.

This report includes a comprehensive list of avian species compiled from both written sources and field investigations. Included is the occurrence of the species in three locations; Fire Island, East Fire Island and William Floyd Estate. Also included is habitat type where the species is commonly found.

- National Audubon Society. 2007. <http://www.audubon.org/bird/cbc/>. Christmas Bird Count Lists. NY28, NYCA, NYCS Circles. Counts 60 to 106.

This reference is only used for one species, Red-breasted Merganser. In general the Christmas Bird Count data cannot be used as a reference for this database because each circle includes significant birding habitat beyond the park boundaries. Therefore the winter

abundance data cannot be extrapolated with an accurate degree of certainty. However, due to the specific habitat use by this species, analysis of the CBC data does indicate an abundance change for this one species, so the reference is cited in the database.

- Taylor, Earnest. 2001. William Floyd Salt Marsh Bird Monitoring. Annual Report. May 1, 2001. Unpublished document.

This report summarizes surveys of the salt marsh at the William Floyd Estate from May, 2000 to April, 2000. There is a comprehensive list of species observed and number of observations. Since the number of observations is for the total year and not by season, the data could not be used to further analyze relative seasonal abundance. However, the reference was cited for each species on the report's list to document that these species occur specifically on the William Floyd Estate which encompasses different habitats from Fire Island.

- Taylor, E. and Kiss S. 2002. Result of the Otis Pike Wilderness 2001 breeding bird survey. Unpublished Park file. January 24, 2002.

This report summarizes a breeding bird survey for the Otis Pike Wilderness in 2001. There is a list of species and number of observations. Since the area surveyed is only approximately 20% of the total park, the number of observations could not be used to further analyze relative seasonal abundances. There were no additional breeding confirmations to the data from The Atlas of Breeding Birds in New York State; however this reference was cited for each species on the report's list as further confirmation of breeding.

- US Fish and Wildlife Service. 1997. Significant Habitats and Habitat Complexes of the New York Bight Watershed. Southern New England-New York Bight Coastal Ecosystems Program, Charlestown, Rhode Island.

This document provides a list of Species of Special Emphasis for each ecological complex within the New York Bight Watershed. Additionally Appendix 1 is a comprehensive list of all Species of Special Emphasis for the entire bight. Since the complexes that encompass Fire Island National Seashore include a significant amount of habitat beyond the park boundaries, this reference cannot be used as a final determination of any status for a species.

Park personnel chose to use this reference consistently when initially populating the database in the following manner. Fire Island National Seashore occurs within two complexes; Complex #13, Moriches Bay and Complex #14, Great South Bay. For each species that occurs on the lists of Species of Special Emphasis for these complexes, this reference was cited. In addition, a comment was entered into the Park Status details that stated in which complex that species could be found. These comments have been maintained within the database. However, the reference was also cited for any species which occurs on the Appendix 1 list for the entire bight, but is not found on the lists for the specific complexes. In those cases, a comment was entered in the Park Status

Details, Residency Details, and/or Data Source fields. For these records, a general comment has been added in the Comments field to specify that the USFWS, 1997 information is for the watershed overall and not specific to the park.

- The American Ornithologists' Union. 1998. Check-list of North American Birds. 7th edition. American Ornithologists' Union, Washington, D.C.
- American Ornithologists' Union. 2000. Forty-second supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 117(3):847-858.
- Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J.V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2002. Forty-third Supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 119(3):897-906.
- Banks, R. C., C. Cicero, J. L. Dunn, A. W. Kratter, P. C. Rasmussen, J.V. Remsen, Jr., J. D. Rising, and D. F. Stotz. 2003. Forty-fourth Supplement to the American Ornithologists' Union Check-list of North American Birds. *The Auk* 120(3):923-931.

The Check-list of North American Birds and its three supplements are used to determine if an avian species is native or non-native to North America. In addition, these references provide current and historical taxonomic classification. They also provide the most current Common Name for each species.

- Bird Point Count Database website. 2007. www.pwrc.usgs.gov/point/main

This database was used to confirm several species occurrences listed in other sources. This database provides findings from several standardized point count surveys conducted on breeding forest, grassland, and saltmarsh birds on Fire Island, 2001-2005. The website provides metadata on field protocols and survey point coordinates.

APPENDIX 2

Protocols for Assigning Values to "Residency" and "Abundance" Fields and for Documenting Information in "Details" Fields of the NPSpecies, Fire Island National Seashore

Following are the general guidelines that were used to choose avian Residency and the associated Abundance values for the database. The systematic method for classifying the residency status of birds coincided with the National NPS NPSpecies Data Dictionary (<https://science1.nature.nps.gov/npspecies/web/main/start>). Due to the high mobility of avian fauna across the span of a year, it is difficult to accurately assign just one value to both a species' residency status and abundance. Therefore, the combination of the detailing of the abundance throughout the year in the Abundance Details field along with a concise statement of the change in residency status across the year in the Residency Details field gives a more accurate portrayal of a species' use of and occurrence in the park throughout the year.

If a species is determined to be a breeder, then the Residency Status of Breeder is always chosen. The Abundance Value selected is the abundance that matches the breeding season. Residency Details then include a statement that reflects the occurrence of the species during the rest of the year followed by details about the confirmation of breeding. Following are examples of species with a status of Breeder:

174999 Canada Goose Residency: Breeder Abundance: Abundant
Abundance Details: Spring=abundant; Summer=abundant; Early Fall=abundant; Late Fall=abundant; Winter=abundant
Residency Details: **Also winter resident and spring and fall migrant.**
Breeding information for NYBBA blocks:
Wholly in Park
Confirmed:2003 6450D
Probable:1985 6750A
Possible:2003 6449B
Likely in Park
Confirmed:2003 6751D, 1985 6851C

175073 Gadwall Residency: Breeder Abundance: Rare
Abundance Details: Spring=uncommon; Summer=rare; Early Fall=uncommon; Late Fall=uncommon; Winter=uncommon
Residency Details: **Also occurs predominately as winter resident and spring and fall migrant.**
Breeding information for NYBBA blocks:
Wholly in Park
Probable:1985 6450D
Possible:1985 6750A

Likely in Park

Confirmed:1985 6751D

If a species is a non-breeder, then the species is evaluated to determine if it occurs predominately as a migrant or a resident. If summer or winter abundance is rare or occasional and the spring/fall abundances are uncommon, common or abundant, then the Residency Status of Migratory is chosen. The Abundance Value selected is the highest occurring during the migration season. The Residency Details state when the species is present as a migrant and then any occurrence of the species as a resident during the rest of the year. Note that several species are also migratory in summer and that the Residency Details will reflect when summer abundance has been evaluated as migratory versus resident. Following are examples of species with a status of Migratory:

175613 Merlin Residency: Migratory Abundance: Common

Abundance Details: Spring=uncommon; Early Fall=common; Late Fall=common;
Winter=rare

Residency Details: **Present as spring and predominately fall migrant; Also rare winter resident.**

176571 Ruddy Turnstone Residency: Migratory Abundance: Common

Abundance Details: Spring=common; Summer=uncommon; Early Fall=common; Late
Fall=uncommon; Winter=rare

Residency Details: **Present predominately as spring, summer and fall migrant; Also rare winter resident.**

178846 Prothonotary Warbler Residency: Migratory Abundance: Rare

Abundance Details: Spring=rare; Early Fall=rare

Residency Details: **Present spring and early fall.**

If a species is a non-breeder and has a summer or winter abundance of uncommon, common or abundant, then the Residency Status of Resident is chosen. The Abundance Value selected is the abundance that matches the season the species occurs as a resident. The Residency Details state whether the species is a non-breeding summer resident or winter resident and then any occurrence of the species as a migrant during the rest of the year. Following are examples of species with a status of Resident:

174856 American Bittern Residency: Resident Abundance: Uncommon

Abundance Details: Spring=rare; Late Fall=rare; Winter=uncommon

Residency Details: **Winter resident; Also spring and fall migrant.**

176891 Roseate Tern Residency: Resident Abundance: Uncommon

Abundance Details: Spring=uncommon; Summer=uncommon; Early Fall=uncommon

Residency Details: **Non-breeding summer resident; Also spring and early fall migrant.**

Some non-breeding species have abundances that are the same across the seasons. In those cases the Residency Status of migratory or resident is chosen based on the field knowledge of the experts that review all the species in the database. For example:

175074 Northern Pintail Residency: Resident Abundance: Rare
Abundance Details: Spring=rare; Late Fall=rare; Winter=rare
Residency Details: **Winter resident; Also spring and late fall migrant.**

176242 Sora Residency: Migratory Abundance: Rare
Abundance Details: Spring=rare; Early Fall=rare; Late Fall=rare; Winter=rare
Residency Details: **Present predominately as spring and fall migrant; Also rare winter resident.**

Appendix 3
Protocols and data sources used to determine avifauna breeding status in
Fire Island National Seashore

The Atlas of Breeding Birds in New York State and the associated website, <http://www.dec.state.ny.us/apps/bba/results/index.cfm>, were used as the foundation of breeding confirmations for this park. The topographic maps on the website were examined to ascertain all atlas blocks that included any part of the park (Figure A-3). Each block was reviewed to determine how much of each block is within park boundaries. Also important was the evaluation of the type of habitat that occurs outside of the park limits. Based on this examination, it was decided which blocks were most likely to have the breeding confirmations occur within park boundaries.

The website provides two lists of species for each atlas block. The first list includes the confirmations from 1980 to 1985. This is the information used for the published atlas. The atlas is currently being updated and the information starting from 2000 is also available. The data were reviewed as of 2006 for this project. If a species has Probable or Confirmed breeding status within a block that is likely to have breeding occur within park boundaries, then that species is given a residency status of Breeder. Any species with just a Possible breeding status is not considered a breeder; however, comments detailing the possibility of breeding are included within the Residency Details field.

Additionally, the report *NYDEC's LI Colonial Waterbird and Piping Plover Survey* was checked for any additional breeding confirmations. Four more species were confirmed as breeders from the data in this report. Also checked was the report, *Result of the 2001 Otis Pike Breeding Bird Survey*. No additional breeding bird confirmations resulted from the data in that report.

The Residency Details field includes information on which resource the status as Breeder is based. The entered atlas information includes block, year (1985 or 2003), and type of breeding confirmation, which allows additional references or surveys that may become available to be checked against the criteria used to assess the status of a species as a breeder.

Following is a description of each atlas block that includes any part of Fire Island National Seashore and the decision of whether the block could be used to definitively designate a species as a breeder.

Descriptions of New York BBA Blocks for Fire Island National Seashore

Block 6449B

The block begins at the West end of park (by Robert Moses Park) to just below clam pond and takes in ocean side of Fair Harbor on the barrier island. Any breeding bird information from this block is wholly within park boundaries.

Block 6450D

The block includes from Fair Harbor to Atlantique on the barrier island and the islands, East Fire Island and West Fire Island in the Great South Bay. Any breeding bird information from this block is wholly within park boundaries.

Block 6550C

The block includes from Robbins Rest through about two thirds of the Sunken Forest on the barrier island. Any breeding bird information from this block is wholly within park boundaries.

Block 6550D

The block includes the eastern end of the Sunken Forest past the community of Fire Island Pines and to the jeep trail (part of Barrett Beach Park?) on the barrier island. Any breeding bird information from this block is wholly within park boundaries.

Block 6650C

The block includes Barrett Beach Park to the beginning of the community of Davis Park on the barrier island. Any breeding bird information from this block is wholly within park boundaries.

Block 6650A

The block includes Davis Park to Bayberry Dunes on the barrier island. Any breeding bird information from this block is wholly within park boundaries.

Block 6650B

The block includes from Bayberry Dunes to Molasses Point on the barrier island. This includes the Otis Pike Wilderness Area. Any breeding bird information from this block is wholly within park boundaries.

Block 6750A

The block includes from Molasses Point to just below Pelican Island on the barrier island. This includes the Otis Pike Wilderness Area. Any breeding bird information from this block is wholly within park boundaries.

Block 6751C

The block includes Ridge Island in the bay. It includes from Pelican Island to the end of Otis Pike Wilderness at the toll bridge from Shirley on the mainland. This block also includes a part of Shirley, which is residential/urban and part of the Wertheim Wildlife Refuge. The park makes up only about 15% of the land area in the block and it there is other suitable breeding habitat in this block outside of the park boundaries. Therefore this block cannot be used definitively for breeding confirmations.

Block 6751D

The block includes the western half of Smith Point County Park on the barrier island. It also includes the southern half of the William Floyd Estate. The park makes up approximately 50% of the land area within this block. However, the rest of the block includes an urbanized area of Mastic. Therefore it is highly likely that breeding confirmations occur within park boundaries.

Block 6851C

The block includes the eastern half of Smith County Park, except for the furthest point, and just the tip of Cupsoque Beach on the next island. Therefore it is highly likely that breeding confirmations occur within park boundaries.

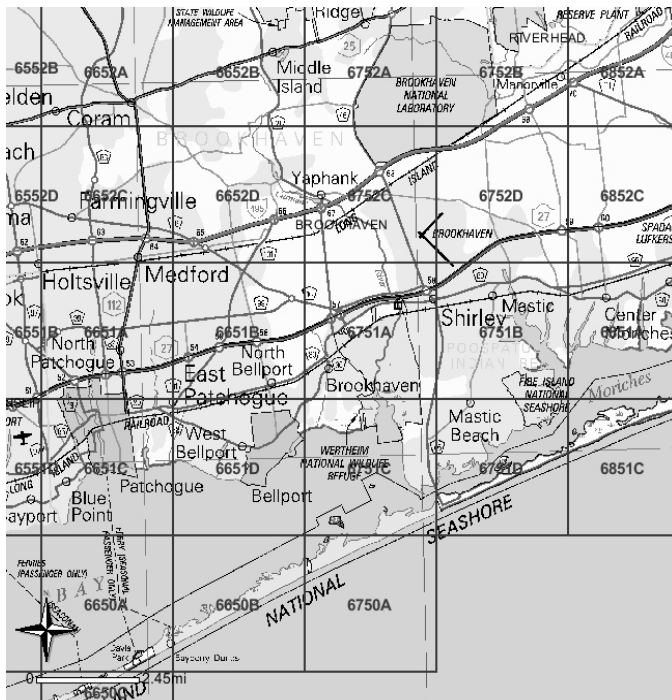
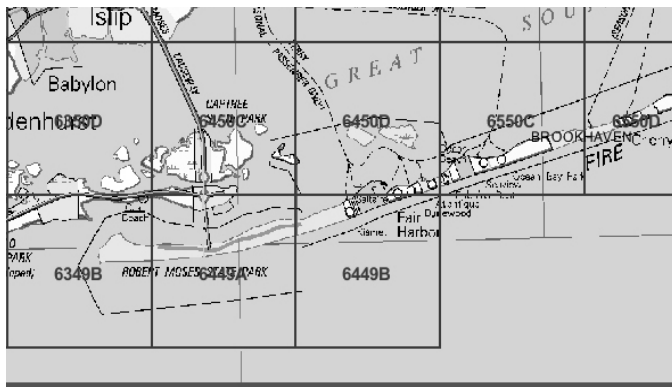
Block 6851A

The block includes the eastern tip of Fire Island (Smith County Park) at Moriches Inlet. This bit of the park makes up less than 5% of the atlas block. Therefore, breeding confirmations cannot be definitively attributed to park habitat.

Block 6751B

The block includes the northern half of the William Floyd Estate and no other land within park boundaries. Less than 10% of the block encompasses area within the park. Approximately another 40% of the block is non-urban. Therefore, breeding confirmations cannot be definitively attributed to park habitat.

Figure A-3. Breeding Bird Atlas Blocks covering FIIS.



APPENDIX 4

Description of Christmas Bird Count Data Used to Determine Winter Status and Abundance at Fire Island National Seashore

There are three Christmas Bird Count (CBC) circles that include some part of Fire Island National Seashore (FIIS) that have data for the count years 60 to 106. Data for each circle was extracted from the web site <http://www.audubon.org/bird/cbc/>. Only a small percentage of each of these circles is park habitat and each circle includes significant birding habitat outside of park boundaries. While a review of the CBC data may help to gain an understanding of the species that can be found in the general area of the park during winter, it is not possible to use this data to make any changes to entries in the database for Fire Island. The circles are:

LI Fire Island (NY28) 4040N 7316W – 9 years of data 63-71

The NY28 CBC is centered just north of Captree Island. The part of FIIS that is included in the circle is from the western most edge to approximately Atlantique on Fire Island. Also included are the islands, West Fire Island and East Fire Island, that are in Great South Bay.

LI Captree (NYCA) 4042N 7315W – 35 years of data 72-106

The NYCA CBC appears to be a relocation and renaming of the LI Fire Island circle. The center is shifted Northeast to Brightswater Canal. The data begins at count 72 where NY1Y leaves off and continues to present. The part of FIIS that is included in the circle is from the western most edge to approximately Ocean Beach on Fire Island. This circle includes just a bit more of the park than circle NY28. Also included are the islands, West Fire Island and East Fire Island, that are in Great South Bay.

LI Central Suffolk County (NYCS) 4050N 7247W– 47 years of data 60-106

The NYCS CBC is centered in Manorville on the mainland. The part of FIIS that is included in the circle is most of Smith County Park, which is the eastern most edge of the park. Also included is all of the William Floyd Estate.

APPENDIX 5

Interviewees and Sample Questions used to Assess Inventory and Monitoring Needs At Fire Island National Seashore

Name	Affiliation	Position
Marie Lawrence	FIIS	Natural Resource management
Michael Bilecki	FIIS	Chief of Resources Management & Planning

Sample Questions

- 1) Are you aware of any additional avian work on Gateway properties that may be absent from the database including current projects?
- 2) What avian research should be done in the future? What about breeding bird censuses for species of scrub-shrub habitat?
- 3) Any thoughts on future research on the productivity of breeding birds of coastal scrub-shrub passerines or secretive marsh species?
- 4) Do you think that data on productivity of breeding species in FIIS is valuable?
- 5) Do you think it is important to evaluate the effects of recreational activities on species viability? Is this an important area of study for FIIS?
- 6) What kinds of recreation are compatible with birds? Is there a need to understand the affects of certain types of recreational activities with wildlife?

APPENDIX 6

Responses to Questions Asked by Scott Barnes, New Jersey Audubon Society, during interviews with Fire Island National Seashore Staff

Question 1: Are you aware of any additional avian work on Gateway properties that may be absent from the database including current projects?

They were aware of the usual data (CBC, Lighthouse Hawk watch, annual NPS report on nesting Piping Plover and Least Tern). Fire Island National Seashore (hereafter FIIS) has their inventory & monitoring data in Procite Database. This database is available for our use by appointment.

Contacts for possible missing data are Ernie Taylor (Wildlife Biologist) who did inventory work on birds, specifically neotropical migrants; Richard Stavdal (manager of William Floyd Estate) who is currently involved in a marsh restoration program there; and Paul Buckley—FIIS would really like his more recent data for their General Management Plan

Question 2: What avian research should be done in the future? What about breeding bird censuses for species of scrub-shrub habitat?

FIIS doesn't have good information on avian populations in terms of species and densities, specifically for year-round residents and marsh species. No censusing has been done on breeders outside of T & E species. No information is available on American Woodcock or Whip-poor-will.

Future research on the impacts of feral animals should be done, especially Mute Swans and feral cats.

Future research should include data from Smith Point County Park. Because of county ownership, little "federal/NPS" data has been collected there, though the park is technically within the boundaries/management of FIIS.

A GIS vegetation map is available through FIIS for future research applications. Possible future research might be on the affects of invasive/non-native plants on avian productivity and habitat use.

Question 3: Any thoughts on future research on the productivity of breeding birds of coastal scrub-shrub passerines or secretive marsh species?

Yes, this data would be of value to FIIS. Staff interviewed agreed that though the New York State Breeding Bird Atlas data is useful, it merely notes probable/confirmed species

but not densities. Staff also expressed interest in more inventory & monitoring of marsh species such as Clapper Rail, Virginia Rail, Seaside Sparrow, and Saltmarsh Sharp-tailed Sparrow.

Question 4: Do you think that data on productivity of breeding species in FIIS is valuable?

Yes, especially now because FIIS is in the process of forming a General Management Plan for the park. Future land use and recreation decisions should be based in part on all available avian data.

Question 5: Do you think it is important to evaluate the effects of recreational activities on species viability? Is this an important area of study for FIIS?

Yes. Examples include rule-making processes for Personal Watercraft and other boating activities; impacts of recreation on nesting Piping Plover and Least Tern

Future studies might include inventory and monitoring of marsh species as it relates to fishing and boating activities (potential disturbance of breeders); disturbance of species that utilize beaches and mudflats by dogs; and recreational driving on beaches (hunting, fishing, & contractors) that occurs October through January.

Question 6: What kinds of recreation are compatible with birds? Is there a need to understand the affects of certain types of recreational activities with wildlife?

Backcountry camping is probably o.k. Ferry service serves to limit the number of people that utilize FIIS.

No studies have been done on the affects of kayaking, especially the access it allows to the wilderness area.

No studies have been done on the impacts (both positive and negative) that US Army Corps of Engineers projects have on FIIS. Probably the biggest project they do within FIIS is dredging and the spoils they create.

No studies have been done on the impacts that fireworks displays have on breeding species. All thirteen communities within FIIS have their own Fourth of July fireworks displays.

Overuse concerns center around anchorage areas for boats and associated concessionaires. Sailor's Haven, Talisman/Barrett, and Bellport Beaches all allow boats to anchor/moor just offshore. Some informal anchorages allow visitors to wade ashore in otherwise undisturbed locations. Boats and waders in this capacity often number in the hundreds during the summer season. No studies have been done on the potential impacts that this type of recreation may have on marsh species, both in terms of disturbance and predator attraction.

APPENDIX 7

Species, species groups, or guilds identified as requiring inventory and monitoring to address significant gaps in knowledge and information

<u>Species/Species Group/Guild</u>	<u>Season</u>	<u>Recommended Activities</u>
Salt Marsh Sharp-tailed Sparrow	Breeding	Assess distribution and abundance throughout park. Monitor productivity and survival across years
Seaside Sparrow	Breeding	Assess distribution and abundance throughout park. Monitor productivity and survival across years
Prairie Warbler	Breeding	Assess distribution and abundance throughout park.
Passerine species in early successional habitats	Breeding	Determine species occurrence, distribution and abundance throughout park. Monitor changes in nesting density across years
Landbirds/passerines	Breeding	Determine species occurrence, distribution and abundance throughout park. Monitor productivity and survival across years (MAPS stations). Focus areas should include Smith County Park, The Sunken Forest, and The William Floyd Estate
Northern Harrier	Breeding	Determine distribution and abundance throughout park. Monitor productivity and survival across years
American Kestrel	Breeding	Determine distribution and abundance throughout park. Monitor productivity and survival across years. Establish nest box program
American Oystercatcher	Breeding	Assess distribution and abundance throughout park. Monitor productivity and survival across years

<u>Species/Species Group/Guild</u>	<u>Season</u>	<u>Recommended Activities</u>
Various shorebird species (e.g., Red Knot)	Spring migration	Assess distribution and abundance throughout park and relationship with distribution and abundance of spawning horseshoe crabs
Various long-legged wading bird species (e.g., Little Blue Heron, Snowy Egret)	Breeding	Conduct inventory and monitoring efforts similar to those implemented in the Harbor Herons Program (NYC Audubon Society)
Wood Duck	Breeding	Implement Wood Duck nest box monitoring program, or, if already in effect, incorporate findings into NPSpecies and NatureBib
American Black Duck	Breeding	Assess distribution and abundance throughout park. Monitor productivity and survival across years
Various solitary nesting waterbird species (e.g., Pied-billed Grebe, American/Least Bittern, Black Rail)	Breeding	Assess distribution and abundance throughout park
Various shorebird and colonial waterbird species	Breeding and overwintering	Assess potential effects of recreational disturbance on behavior, productivity, spatial distribution, and overall population health.
Common and Roseate Tern	Breeding	Assess current status of breeding colonies. Examine breeding productivity and spatial distribution in beach and marsh habitats

APPENDIX 8

Fire Island National Seashore List in Taxonomic Species Number (TSN) Order

TSN	Scientific name*	Common Name
-9728180	<i>Ammodramus sandwichensis princeps</i>	"Ipswich" Sparrow
178339	<i>Empidonax virescens</i>	Acadian Flycatcher
178340	<i>Empidonax alnorum</i>	Alder Flycatcher
176721	<i>Recurvirostra americana</i>	American Avocet
174856	<i>Botaurus lentiginosus</i>	American Bittern
175068	<i>Anas rubripes</i>	American Black Duck
176292	<i>Fulica americana</i>	American Coot
179731	<i>Corvus brachyrhynchos</i>	American Crow
174976	<i>Phoenicopterus ruber</i>	American Flamingo
176564	<i>Pluvialis dominica</i>	American Golden-Plover
179236	<i>Carduelis tristis</i>	American Goldfinch
175622	<i>Falco sparverius</i>	American Kestrel
176472	<i>Haematopus palliatus</i>	American Oystercatcher
554127	<i>Anthus rubescens</i>	American Pipit
178979	<i>Setophaga ruticilla</i>	American Redstart
179759	<i>Turdus migratorius</i>	American Robin
179432	<i>Spizella arborea</i>	American Tree Sparrow
175094	<i>Anas americana</i>	American Wigeon
176580	<i>Scolopax minor</i>	American Woodcock
174471	<i>Gavia arctica</i>	Arctic Loon
176890	<i>Sterna paradisaea</i>	Arctic Tern
177025	<i>Fratercula arctica</i>	Atlantic Puffin
174561	<i>Puffinus lherminieri</i>	Audubon's Shearwater
176655	<i>Calidris bairdii</i>	Baird's Sandpiper
175420	<i>Haliaeetus leucocephalus</i>	Bald Eagle
179083	<i>Icterus galbula</i>	Baltimore Oriole
178436	<i>Riparia riparia</i>	Bank Swallow
177851	<i>Tyto alba</i>	Barn Owl
178448	<i>Hirundo rustica</i>	Barn Swallow
175014	<i>Branta leucopsis</i>	Barnacle Goose
175144	<i>Bucephala islandica</i>	Barrow's Goldeneye
176687	<i>Limosa lapponica</i>	Bar-tailed Godwit
178912	<i>Dendroica castanea</i>	Bay-breasted Warbler
179003	<i>Vireo bellii</i>	Bell's Vireo
179004	<i>Vireo bellii bellii</i>	Bell's Vireo (subspecies)
178119	<i>Ceryle alcyon</i>	Belted Kingfisher
554148	<i>Catharus bicknelli</i>	Bicknell's Thrush
-501461	<i>Branta bernicla nigra</i>	Black Brant
176263	<i>Laterallus jamaicensis</i>	Black Rail
175171	<i>Melanitta nigra</i>	Black Scoter

554447	<i>Rynchops niger</i>	Black Skimmer
176959	<i>Chlidonias niger</i>	Black Tern
178844	<i>Mniotilta varia</i>	Black-and-white Warbler
176567	<i>Pluvialis squatarola</i>	Black-bellied Plover
177834	<i>Coccyzus erythrophthalmus</i>	Black-billed Cuckoo
-501550	<i>Pica hudsonia</i>	Black-billed Magpie
178904	<i>Dendroica fusca</i>	Blackburnian Warbler
554382	<i>Poecile atricapillus</i>	Black-capped Chickadee
174832	<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron
176835	<i>Larus ridibundus</i>	Black-headed Gull
176875	<i>Rissa tridactyla</i>	Black-legged Kittiwake
176877	<i>Rissa tridactyla tridactyla</i>	Black-legged Kittiwake (subspecies)
176726	<i>Himantopus mexicanus</i>	Black-necked Stilt
178913	<i>Dendroica striata</i>	Blackpoll Warbler
178888	<i>Dendroica caerulescens</i>	Black-throated Blue Warbler
178896	<i>Dendroica nigrescens</i>	Black-throated Gray Warbler
178898	<i>Dendroica virens</i>	Black-throated Green Warbler
-501544	<i>Passerina caerulea</i>	Blue Grosbeak
179680	<i>Cyanocitta cristata</i>	Blue Jay
179853	<i>Poliophtila caerulea</i>	Blue-gray Gnatcatcher
179010	<i>Vireo solitarius</i>	Blue-headed Vireo
175086	<i>Anas discors</i>	Blue-winged Teal
178853	<i>Vermivora pinus</i>	Blue-winged Warbler
179108	<i>Quiscalus major</i>	Boat-tailed Grackle
179032	<i>Dolichonyx oryzivorus</i>	Bobolink
176839	<i>Larus philadelphia</i>	Bonaparte's Gull
554386	<i>Poecile hudsonicus</i>	Boreal Chickadee
175011	<i>Branta bernicla</i>	Brant
179094	<i>Euphagus cyanocephalus</i>	Brewer's Blackbird
175365	<i>Buteo platypterus</i>	Broad-winged Hawk
174704	<i>Sula leucogaster</i>	Brown Booby
178803	<i>Certhia americana</i>	Brown Creeper
174685	<i>Pelecanus occidentalis</i>	Brown Pelican
178627	<i>Toxostoma rufum</i>	Brown Thrasher
179112	<i>Molothrus ater</i>	Brown-headed Cowbird
176684	<i>Tryngites subruficollis</i>	Buff-breasted Sandpiper
175145	<i>Bucephala albeola</i>	Bufflehead
554267	<i>Icterus bullockii</i>	Bullock's Oriole
174999	<i>Branta canadensis</i>	Canada Goose
178977	<i>Wilsonia canadensis</i>	Canada Warbler
175129	<i>Aythya valisineria</i>	Canvasback
178887	<i>Dendroica tigrina</i>	Cape May Warbler
178581	<i>Thryothorus ludovicianus</i>	Carolina Wren
176924	<i>Sterna caspia</i>	Caspian Tern
174803	<i>Bubulcus ibis</i>	Cattle Egret
178532	<i>Bombycilla cedrorum</i>	Cedar Waxwing

178903	<i>Dendroica cerulea</i>	Cerulean Warbler
178911	<i>Dendroica pensylvanica</i>	Chestnut-sided Warbler
178001	<i>Chaetura pelagica</i>	Chimney Swift
179435	<i>Spizella passerina</i>	Chipping Sparrow
177960	<i>Caprimulgus carolinensis</i>	Chuck-will's-widow
176209	<i>Rallus longirostris</i>	Clapper Rail
179439	<i>Spizella pallida</i>	Clay-colored Sparrow
178455	<i>Petrochelidon pyrrhonota</i>	Cliff Swallow
175155	<i>Somateria mollissima</i>	Common Eider
175141	<i>Bucephala clangula</i>	Common Goldeneye
179104	<i>Quiscalus quiscula</i>	Common Grackle
174469	<i>Gavia immer</i>	Common Loon
175185	<i>Mergus merganser</i>	Common Merganser
176284	<i>Gallinula chloropus</i>	Common Moorhen
176974	<i>Uria aalge</i>	Common Murre
177979	<i>Chordeiles minor</i>	Common Nighthawk
177025	<i>Fratercula arctica</i>	Common Puffin
179230	<i>Carduelis flammea</i>	Common Redpoll
176888	<i>Sterna hirundo</i>	Common Tern
176889	<i>Sterna hirundo hirundo</i>	Common Tern (subspecies)
178944	<i>Geothlypis trichas</i>	Common Yellowthroat
178938	<i>Oporornis agilis</i>	Connecticut Warbler
175309	<i>Accipiter cooperii</i>	Cooper's Hawk
554255	<i>Empidonax occidentalis</i>	Cordilleran Flycatcher
203446	<i>Calonectris diomedea</i>	Cory's Shearwater
176660	<i>Calidris ferruginea</i>	Curlew Sandpiper
179410	<i>Junco hyemalis</i>	Dark-eyed Junco
179417	<i>Junco hyemalis oreganus</i>	Dark-eyed Junco Oregon group
179412	<i>Junco hyemalis hyemalis</i>	Dark-eyed Junco slate-colored group
179165	<i>Spiza americana</i>	Dickcissel
174717	<i>Phalacrocorax auritus</i>	Double-crested Cormorant
176982	<i>Alle alle</i>	Dovekie
178259	<i>Picoides pubescens</i>	Downy Woodpecker
176661	<i>Calidris alpina</i>	Dunlin
174485	<i>Podiceps nigricollis</i>	Eared Grebe
179801	<i>Sialia sialis</i>	Eastern Bluebird
178279	<i>Tyrannus tyrannus</i>	Eastern Kingbird
179034	<i>Sturnella magna</i>	Eastern Meadowlark
178329	<i>Sayornis phoebe</i>	Eastern Phoebe
-9728183	<i>Megascops asio</i>	Eastern Screech-Owl
179276	<i>Pipilo erythrophthalmus</i>	Eastern Towhee
178359	<i>Contopus virens</i>	Eastern Wood Pewee
175092	<i>Anas penelope</i>	Eurasian Wigeon
179637	<i>Sturnus vulgaris</i>	European Starling
179173	<i>Coccothraustes vespertinus</i>	Evening Grosbeak
179443	<i>Spizella pusilla</i>	Field Sparrow

179737	<i>Corvus ossifragus</i>	Fish Crow
178294	<i>Tyrannus savana</i>	Fork-tailed Flycatcher
176887	<i>Sterna forsteri</i>	Forster's Tern
179464	<i>Passerella iliaca</i>	Fox Sparrow
175046	<i>Dendrocygna bicolor</i>	Fulvous Whistling-Duck
175073	<i>Anas strepera</i>	Gadwall
176808	<i>Larus hyperboreus</i>	Glaucous Gull
174924	<i>Plegadis falcinellus</i>	Glossy Ibis
175407	<i>Aquila chrysaetos</i>	Golden Eagle
179865	<i>Regulus satrapa</i>	Golden-crowned Kinglet
178852	<i>Vermivora chrysoptera</i>	Golden-winged Warbler
179333	<i>Ammodramus savannarum</i>	Grasshopper Sparrow
178625	<i>Dumetella carolinensis</i>	Gray Catbird
178280	<i>Tyrannus dominicensis</i>	Gray Kingbird
179793	<i>Catharus minimus</i>	Gray-cheeked Thrush
176815	<i>Larus marinus</i>	Great Black-backed Gull
174773	<i>Ardea herodias</i>	Great Blue Heron
174715	<i>Phalacrocorax carbo</i>	Great Cormorant
178309	<i>Myiarchus crinitus</i>	Great Crested Flycatcher
554135	<i>Ardea alba</i>	Great Egret
177884	<i>Bubo virginianus</i>	Great Horned Owl
176796	<i>Catharacta skua</i>	Great Skua
175130	<i>Aythya marila</i>	Greater Scaup
174549	<i>Puffinus gravis</i>	Greater Shearwater
175020	<i>Anser albifrons</i>	Greater White-fronted Goose
176619	<i>Tringa melanoleuca</i>	Greater Yellowlegs
174793	<i>Butorides virescens</i>	Green Heron
175081	<i>Anas crecca</i>	Green-winged Teal
176926	<i>Sterna nilotica</i>	Gull-billed Tern
175599	<i>Falco rusticolus</i>	Gyr Falcon
178262	<i>Picoides villosus</i>	Hairy Woodpecker
175149	<i>Histrionicus histrionicus</i>	Harlequin Duck
179454	<i>Zonotrichia querula</i>	Harris's Sparrow
179340	<i>Ammodramus henslowii</i>	Henslow's Sparrow
179779	<i>Catharus guttatus</i>	Hermit Thrush
176824	<i>Larus argentatus</i>	Herring Gull
176825	<i>Larus argentatus smithsonianus</i>	Herring Gull (subspecies)
175183	<i>Lophodytes cucullatus</i>	Hooded Merganser
178972	<i>Wilsonia citrina</i>	Hooded Warbler
174482	<i>Podiceps auritus</i>	Horned Grebe
554256	<i>Eremophila alpestris</i>	Horned Lark
179191	<i>Carpodacus mexicanus</i>	House Finch
179628	<i>Passer domesticus</i>	House Sparrow
178541	<i>Troglodytes aedon</i>	House Wren
176690	<i>Limosa haemastica</i>	Hudsonian Godwit
176811	<i>Larus glaucoides</i>	Iceland Gull

179150	<i>Passerina cyanea</i>	Indigo Bunting
179315	<i>Passerculus sandwichensis princeps</i>	Ipswich Sparrow
176851	<i>Pagophila eburnea</i>	Ivory Gull
178937	<i>Oporornis formosus</i>	Kentucky Warbler
176520	<i>Charadrius vociferus</i>	Killdeer
175160	<i>Somateria spectabilis</i>	King Eider
176207	<i>Rallus elegans</i>	King Rail
179526	<i>Calcarius lapponicus</i>	Lapland Longspur
179312	<i>Calamospiza melanocorys</i>	Lark Bunting
179371	<i>Chondestes grammacus</i>	Lark Sparrow
176837	<i>Larus atricilla</i>	Laughing Gull
174628	<i>Oceanodroma leucorhoa</i>	Leach's Storm-Petrel
174846	<i>Ixobrychus exilis</i>	Least Bittern
178344	<i>Empidonax minimus</i>	Least Flycatcher
176656	<i>Calidris minutilla</i>	Least Sandpiper
176923	<i>Sterna antillarum</i>	Least Tern
176821	<i>Larus fuscus</i>	Lesser Black-backed Gull
175134	<i>Aythya affinis</i>	Lesser Scaup
176620	<i>Tringa flavipes</i>	Lesser Yellowlegs
179484	<i>Melospiza lincolni</i>	Lincoln's Sparrow
174827	<i>Egretta caerulea</i>	Little Blue Heron
176840	<i>Larus minutus</i>	Little Gull
178515	<i>Lanius ludovicianus</i>	Loggerhead Shrike
176679	<i>Limnodromus scolopaceus</i>	Long-billed Dowitcher
177932	<i>Asio otus</i>	Long-eared Owl
175147	<i>Clangula hyemalis</i>	Long-tailed Duck
176794	<i>Stercorarius longicaudus</i>	Long-tailed Jaeger
178935	<i>Seiurus motacilla</i>	Louisiana Waterthrush
174763	<i>Fregata magnificens</i>	Magnificent Frigatebird
178886	<i>Dendroica magnolia</i>	Magnolia Warbler
175063	<i>Anas platyrhynchos</i>	Mallard
174555	<i>Puffinus puffinus</i>	Manx Shearwater
176686	<i>Limosa fedoa</i>	Marbled Godwit
178608	<i>Cistothorus palustris</i>	Marsh Wren
175613	<i>Falco columbarius</i>	Merlin
177125	<i>Zenaidura macroura</i>	Mourning Dove
178939	<i>Oporornis philadelphia</i>	Mourning Warbler
174985	<i>Cygnus olor</i>	Mute Swan
178861	<i>Vermivora ruficapilla</i>	Nashville Warbler
175863	<i>Colinus virginianus</i>	Northern Bobwhite
179124	<i>Cardinalis cardinalis</i>	Northern Cardinal
178154	<i>Colaptes auratus</i>	Northern Flicker
174536	<i>Fulmarus glacialis</i>	Northern Fulmar
174712	<i>Morus bassanus</i>	Northern Gannet
175300	<i>Accipiter gentilis</i>	Northern Goshawk
175430	<i>Circus cyaneus</i>	Northern Harrier

175431	<i>Circus cyaneus hudsonius</i>	Northern Harrier (subspecies)
178620	<i>Mimus polyglottos</i>	Northern Mockingbird
178868	<i>Parula americana</i>	Northern Parula
175074	<i>Anas acuta</i>	Northern Pintail
178443	<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow
177942	<i>Aegolius acadicus</i>	Northern Saw-whet Owl
175096	<i>Anas clypeata</i>	Northern Shoveler
178511	<i>Lanius excubitor</i>	Northern Shrike
178931	<i>Seiurus noveboracensis</i>	Northern Waterthrush
179814	<i>Oenanthe oenanthe</i>	Northern Wheatear
554221	<i>Contopus cooperi</i>	Olive-sided Flycatcher
178856	<i>Vermivora celata</i>	Orange-crowned Warbler
179064	<i>Icterus spurius</i>	Orchard Oriole
175590	<i>Pandion haliaetus</i>	Osprey
-9728185	<i>Seiurus aurocapilla</i>	Ovenbird
178921	<i>Dendroica palmarum</i>	Palm Warbler
176793	<i>Stercorarius parasiticus</i>	Parasitic Jaeger
176653	<i>Calidris melanotos</i>	Pectoral Sandpiper
175604	<i>Falco peregrinus</i>	Peregrine Falcon
175605	<i>Falco peregrinus anatum</i>	Peregrine Falcon (subspecies)
179022	<i>Vireo philadelphicus</i>	Philadelphia Vireo
174505	<i>Podilymbus podiceps</i>	Pied-billed Grebe
179205	<i>Pinicola enucleator</i>	Pine Grosbeak
179233	<i>Carduelis pinus</i>	Pine Siskin
178914	<i>Dendroica pinus</i>	Pine Warbler
176507	<i>Charadrius melodus</i>	Piping Plover
176792	<i>Stercorarius pomarinus</i>	Pomarine Jaeger
178918	<i>Dendroica discolor</i>	Prairie Warbler
178846	<i>Protonotaria citrea</i>	Prothonotary Warbler
179186	<i>Carpodacus purpureus</i>	Purple Finch
-9728181	<i>Porphyrio martinica</i>	Purple Gallinule
178464	<i>Progne subis</i>	Purple Martin
176646	<i>Calidris maritima</i>	Purple Sandpiper
176971	<i>Alca torda</i>	Razorbill
179259	<i>Loxia curvirostra</i>	Red Crossbill
176642	<i>Calidris canutus</i>	Red Knot
176734	<i>Phalaropus fulicarius</i>	Red Phalarope
178195	<i>Melanerpes carolinus</i>	Red-bellied Woodpecker
175187	<i>Mergus serrator</i>	Red-breasted Merganser
178784	<i>Sitta canadensis</i>	Red-breasted Nuthatch
179021	<i>Vireo olivaceus</i>	Red-eyed Vireo
175125	<i>Aythya americana</i>	Redhead
178186	<i>Melanerpes erythrocephalus</i>	Red-headed Woodpecker
174479	<i>Podiceps grisegena</i>	Red-necked Grebe
176735	<i>Phalaropus lobatus</i>	Red-necked Phalarope
175359	<i>Buteo lineatus</i>	Red-shouldered Hawk

175350	<i>Buteo jamaicensis</i>	Red-tailed Hawk
174474	<i>Gavia stellata</i>	Red-throated Loon
179045	<i>Agelaius phoeniceus</i>	Red-winged Blackbird
176830	<i>Larus delawarensis</i>	Ring-billed Gull
175128	<i>Aythya collaris</i>	Ring-necked Duck
175905	<i>Phasianus colchicus</i>	Ring-necked Pheasant
177071	<i>Columba livia</i>	Rock Pigeon
176891	<i>Sterna dougallii</i>	Roseate Tern
176892	<i>Sterna dougallii dougallii</i>	Roseate Tern (subspecies)
179139	<i>Pheucticus ludovicianus</i>	Rose-breasted Grosbeak
175373	<i>Buteo lagopus</i>	Rough-legged Hawk
176922	<i>Sterna maxima</i>	Royal Tern
179870	<i>Regulus calendula</i>	Ruby-crowned Kinglet
178032	<i>Archilochus colubris</i>	Ruby-throated Hummingbird
175175	<i>Oxyura jamaicensis</i>	Ruddy Duck
176571	<i>Arenaria interpres</i>	Ruddy Turnstone
176573	<i>Arenaria interpres morinella</i>	Ruddy Turnstone (subspecies)
176695	<i>Philomachus pugnax</i>	Ruff
179091	<i>Euphagus carolinus</i>	Rusty Blackbird
176866	<i>Xema sabini</i>	Sabine's Gull
179344	<i>Ammodramus caudacutus</i>	Saltmarsh Sharp-tailed Sparrow
176669	<i>Calidris alba</i>	Sanderling
176177	<i>Grus canadensis</i>	Sandhill Crane
176927	<i>Sterna sandvicensis</i>	Sandwich Tern
179314	<i>Passerculus sandwichensis</i>	Savannah Sparrow
178333	<i>Sayornis saya</i>	Say's Phoebe
179883	<i>Piranga olivacea</i>	Scarlet Tanager
178293	<i>Tyrannus forficatus</i>	Scissor-tailed Flycatcher
179346	<i>Ammodramus maritimus</i>	Seaside Sparrow
178605	<i>Cistothorus platensis</i>	Sedge Wren
176506	<i>Charadrius semipalmatus</i>	Semipalmated Plover
176667	<i>Calidris pusilla</i>	Semipalmated Sandpiper
175304	<i>Accipiter striatus</i>	Sharp-shinned Hawk
176675	<i>Limnodromus griseus</i>	Short-billed Dowitcher
177935	<i>Asio flammeus</i>	Short-eared Owl
179529	<i>Calcarius pictus</i>	Smith's Longspur
179532	<i>Plectrophenax nivalis</i>	Snow Bunting
175038	<i>Chen caerulescens</i>	Snow Goose
174813	<i>Egretta thula</i>	Snowy Egret
-9728184	<i>Bubo scandiacus</i>	Snowy Owl
176615	<i>Tringa solitaria</i>	Solitary Sandpiper
179492	<i>Melospiza melodia</i>	Song Sparrow
174553	<i>Puffinus griseus</i>	Sooty Shearwater
176894	<i>Sterna fuscata</i>	Sooty Tern
176242	<i>Porzana carolina</i>	Sora
176801	<i>Catharacta maccormicki</i>	South Polar Skua

176612	<i>Actitis macularia</i>	Spotted Sandpiper
-9728176	<i>Actitis macularia macularia</i>	Spotted Sandpiper (subspecies)
554145	<i>Calidris himantopus</i>	Stilt Sandpiper
179888	<i>Piranga rubra</i>	Summer Tanager
175170	<i>Melanitta perspicillata</i>	Surf Scoter
179788	<i>Catharus ustulatus</i>	Swainson's Thrush
179488	<i>Melospiza georgiana</i>	Swamp Sparrow
178855	<i>Vermivora peregrina</i>	Tennessee Warbler
176978	<i>Uria lomvia</i>	Thick-billed Murre
178431	<i>Tachycineta bicolor</i>	Tree Swallow
174826	<i>Egretta tricolor</i>	Tricolored Heron
554138	<i>Baeolophus bicolor</i>	Tufted Titmouse
174987	<i>Cygnus columbianus</i>	Tundra Swan
175265	<i>Cathartes aura</i>	Turkey Vulture
176610	<i>Bartramia longicauda</i>	Upland Sandpiper
179773	<i>Ixoreus naevius</i>	Varied Thrush
179796	<i>Catharus fuscescens</i>	Veery
179366	<i>Poocetes gramineus</i>	Vesper Sparrow
176221	<i>Rallus limicola</i>	Virginia Rail
179023	<i>Vireo gilvus</i>	Warbling Vireo
178287	<i>Tyrannus verticalis</i>	Western Kingbird
176668	<i>Calidris mauri</i>	Western Sandpiper
179882	<i>Piranga ludoviciana</i>	Western Tanager
176599	<i>Numenius phaeopus</i>	Whimbrel
177961	<i>Caprimulgus vociferus</i>	Whip-poor-will
174930	<i>Eudocimus albus</i>	White Ibis
174684	<i>Pelecanus erythrorhynchos</i>	White Pelican
178775	<i>Sitta carolinensis</i>	White-breasted Nuthatch
179455	<i>Zonotrichia leucophrys</i>	White-crowned Sparrow
178991	<i>Vireo griseus</i>	White-eyed Vireo
176654	<i>Calidris fuscicollis</i>	White-rumped Sandpiper
174676	<i>Phaethon lepturus</i>	White-tailed Tropicbird
179462	<i>Zonotrichia albicollis</i>	White-throated Sparrow
179268	<i>Loxia leucoptera</i>	White-winged Crossbill
175163	<i>Melanitta fusca</i>	White-winged Scoter
176638	<i>Catoptrophorus semipalmatus</i>	Willet
178208	<i>Sphyrapicus thyroideus</i>	Williamson's Sapsucker
178341	<i>Empidonax traillii</i>	Willow Flycatcher
176736	<i>Phalaropus tricolor</i>	Wilson's Phalarope
176517	<i>Charadrius wilsonia</i>	Wilson's Plover
-9728182	<i>Gallinago delicata</i>	Wilson's Snipe
174650	<i>Oceanites oceanicus</i>	Wilson's Storm Petrel
178973	<i>Wilsonia pusilla</i>	Wilson's Warbler
178547	<i>Troglodytes troglodytes</i>	Winter Wren
175122	<i>Aix sponsa</i>	Wood Duck
174897	<i>Mycteria americana</i>	Wood Stork

179777	<i>Hylocichla mustelina</i>	Wood Thrush
178850	<i>Helmitheros vermivorus</i>	Worm-eating Warbler
176259	<i>Coturnicops noveboracensis</i>	Yellow Rail
178878	<i>Dendroica petechia</i>	Yellow Warbler
178338	<i>Empidonax flaviventris</i>	Yellow-bellied Flycatcher
178202	<i>Sphyrapicus varius</i>	Yellow-bellied Sapsucker
177831	<i>Coccyzus americanus</i>	Yellow-billed Cuckoo
178964	<i>Icteria virens</i>	Yellow-breasted Chat
174842	<i>Nyctanassa violacea</i>	Yellow-crowned Night-Heron
179043	<i>Xanthocephalus xanthocephalus</i>	Yellow-headed Blackbird
178891	<i>Dendroica coronata</i>	Yellow-rumped Warbler
179009	<i>Vireo flavifrons</i>	Yellow-throated Vireo
178905	<i>Dendroica dominica</i>	Yellow-throated Warbler

*Current AOU taxonomic standards (<http://www.aou.org/checklist/index.php3>)

APPENDIX 9

Partner's in Flight/Bird Conservation Region Species Prioritization Scheme and Action Level Descriptions

Tier 1. *High Continental Concern*. -- Species on the *PIF Continental Concern List*, which are typically of conservation concern throughout their range. These are species showing high vulnerability in a number of factors, expressed as any combination of high global parameter scores, with $AI \geq 2$ (so that species without manageable populations in the region are omitted).

Tier 1A. *High Continental Concern - High Regional Responsibility*. Species for which this region shares in major conservation responsibility; i.e., conservation in this region is critical to the overall health of this species. Species with AI of 3 - 5, or a high percent population (above threshold in IIB).

Tier B. *High Continental Concern - Low Regional Responsibility*. Species for which this region can contribute to rangewide conservation objectives where the species occurs. Species with AI of 2.

Tier 2. *High Regional Priority*. Species that are of moderate continental priority (not on *Continental Concern List*), but are important to consider for conservation within a region because of various combinations of high parameter scores, as defined below; total of 7 parameter scores = ≥ 19 .

Tier 2A. *High Regional Concern*. Species that are experiencing declines in the core of their range and that require short-term conservation action to reverse or stabilize trends. These are species with a combination of high area importance and declining (or unknown) population trend; total of 7 parameters ≥ 19 , with $AI + PT \geq 8$.

Tier 2B. *High Regional Responsibility*. Species for which this region shares in the responsibility for long-term conservation, even if they are not currently declining or threatened. These are species of moderate overall priority with a disproportionately high percentage of their total population in the region; total of 7 parameters ≥ 19 , with $AI = 5$ or % population > threshold (see Appendix 3).

Tier 2C. *High Regional Threats*. Species of moderate overall priority that are uncommon in a region and whose remaining populations are threatened, usually because of extreme threats to sensitive habitats. These are species with high breeding threats scores within the region (or in combination with high nonbreeding threats outside the region); total of 7 parameters ≥ 19 with $TB + TN > 6$, or local TB or $TN = 5$.

Tier 3. *Additional Federally Listed*. Species listed under the U.S. Endangered Species Act receive conservation attention wherever they occur.

Tier 4. *Additional State Listed*. - Species on state endangered, threatened, or special concern lists that did not meet any of above criteria. These are often rare or peripheral populations.

Tier 5. *Local concern* - species of justifiable local concern or interest. May represent a geographically variable population or be representative of a specific habitat or conservation concern.

Action Level Descriptions

- 1- crisis recovery needed
- 2 - immediate management or policy needed rangewide
- 3 - management to reverse or stabilize populations
- 4 - long term planning is needed
- 5 - monitoring needed for poorly known populations

APPENDIX 10

North American Waterbird Conservation Plan Species Prioritization Scheme

Five categories of conservation concern were developed, and species were assigned to them using a categorical approach. The categories and the series of categorization rules are presented below. Some species could not be categorized because inadequate data were available to assess risk.

1. Highly Imperiled: This includes all species with significant population declines and either low populations or some other high risk factor.

Rule 1a. PT = 5 *and* either PS, TB, TN, or BD = 5

2. High Concern: Species that are not Highly Imperiled. Populations of these species are known or thought to be declining, and have some other known or potential threat as well.

Rule 2a. PT = 4 or 5 *and* either PS, TB, TN, or BD = 4 or 5; or

Rule 2b. PS = 4 or 5 *and* either TB or TN = 4 or 5

3. Moderate Concern: Species that are not Highly Imperiled or High Concern. Populations of these species are either a) declining with moderate threats or distributions; b) stable with known or potential threats and moderate to restricted distributions; or c) relatively small with relatively restricted distributions.

Rule 3a. PT = 5 *and* either PS, TB, TN, BD, or ND > 1; or

Rule 3b. PT = 4 *and* either PS, TB, TN, BD, or ND > 2; or

Rule 3c. PT = 3 *and* either PS, TB, TN, BD, or ND = 4 or 5; or

Rule 3d. PS = 4 or 5 *and* either BD or ND > 3

4. Low Concern: Species that are not Highly Imperiled, High Concern or Moderate Concern. Populations of these species are either a) stable with moderate threats and distributions; b) increasing but with known or potential threats and moderate to restricted distributions; or c) of moderate size with known or potential threats and moderate to restricted distributions.

Rule 4a. PT = 3 *and* either PS, TB, TN, BD, or ND = 3; or

Rule 4b. PT = 2 *and* either PS, TB, TN, BD, or ND = 4 or 5; or

Rule 4c. PS = 3 *and* either TB, TN, BD, or ND = 4 or 5

5. Not Currently At Risk: All other species for which information was available.

Rule 5: Does not meet any previous rule

Information Lacking: If both Population Trend and Population Size could not be estimated, species were not ranked.