



Biscayne National Park Colonial Nesting Bird Monitoring Protocol, v. 1.00

Natural Resource Report NPS/SFCN/NRR—2015/994



ON THE COVER

A Great White Heron (*Ardea herodias occidentalis*) stands guard over its eggs. This bird was photographed nesting on a mangrove island within Biscayne National Park.

Photograph courtesy of National Park Service South Florida / Caribbean Network

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Abstract

Breeding colonies of wading birds (orders Ciconiiformes, Pelecaniformes) and seabirds (orders Suliformes, Pelecaniformes) serve as important indicators of aquatic ecosystem health, as they respond to changes in food abundance and quality, contaminants, invasive species, and disturbance. The Comprehensive Everglades Restoration Plan, Restoration Coordination & Verification program (CERP-RECOVER) has identified wading-bird colonies as an important ecosystem restoration indicator. The National Park Service South Florida / Caribbean Inventory & Monitoring Network (SFCN) ranked colonial nesting birds 8th out of 44 vital signs of park natural resource conditions for ecological significance and feasibility. However, while large-scale monitoring efforts are occurring in the rest of the Greater Everglades Ecosystem, only minimal historic data collection and no extensive ongoing monitoring of wading bird and seabird nesting have occurred in Biscayne National Park. Consequently, due to their high importance as biological indicators and because they are a gap occurring in regional monitoring efforts, the SFCN has initiated a monitoring program of colonial nesting birds in Biscayne National Park.

This protocol provides the rationale, approach, and detailed Standard Operating Procedures for annual colonial bird monitoring within Biscayne National Park and conforms to the Oakley et al. (2003) guidelines for National Park Service long-term monitoring protocols. The specific objectives of this monitoring program are to determine status and long-term trends in:

- Numbers and locations of active colonies of colonial nesting birds with a special focus on Double-crested Cormorants, Great Egrets, Great White Herons, Great Blue Herons, White Ibises, and Roseate Spoonbills.
- Annual peak active nest counts of colonial nesting birds in Biscayne National Park with a special focus on the species mentioned above.
- An annual nesting index (i.e., sum of monthly nest counts) with a special focus on the species mentioned above.
- Timing of peak nest counts for the focal species.

The protocol involves an annual aerial park-wide survey using a helicopter to locate nesting colonies of wading birds and seabirds within Biscayne National Park, followed by monthly aerial surveys of the nesting colonies. Nesting colonies are photographed and the photographs are analyzed in the office to identify and count active nests by species. An observer also records counts of both nesting and non-nesting birds observed in the field. The methods used are detailed in six Standard Operating Procedures (SOPs):

- A) Personnel Training
- B) Safety Requirements and Procedures to Fly in a Helicopter for Colonial Bird Monitoring in Biscayne National Park
- C) Camera Setup, Geotagger Setup, and Photography Methods from a Helicopter
- D) GPS Track Downloading, Photo Downloading and Archiving, Photo Geotagging, and Photo Tagging in Thumbs Plus

- E) Collecting Data, Circling Nests, and Counting Nests
- F) Data Entry, Data Proofing, and Data Reporting

The SFCN conducted five years of pilot data collection to facilitate the development of this protocol and some of those early results are provided in support of various aspects of the protocol as well as in a sample data summary report included as an appendix. The methods used are intended to provide the precision and power to detect change at the individual park level while also supplementing the regional colonial nesting bird monitoring occurring throughout the Greater Everglades Ecosystem.

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Acronyms

ANHI	Anhinga
BAEA	Bald Eagle
BISC	Biscayne National Park
CAEG	Cattle Egret
CERP	Comprehensive Everglades Restoration Plan
DCCO	Double-crested Cormorant
EVER	Everglades National Park
GBHE	Great Blue Heron
GPS	Global Positioning System (device)
GREG	Great Egret
GWHE	Great White Heron
IHOG	Interagency Operations Guide
LBHE	Little Blue Heron
NPS	National Park Service
OAS	Office of Aviation Safety
OSPR	Osprey
PPE	Personal Protective Equipment
QA/QC	Quality Assurance / Quality Control
REEG	Reddish Egret
ROSP	Roseate Spoonbill
SFCN	South Florida / Caribbean Network
SNEG	Snowy Egret
SOP	Standard Operating Procedure
TRHE	Tricolored Heron
WHIB	White Ibis

Background and Objectives

The National Park Service (NPS) defines vital signs as a small set of characteristics that, when consistently monitored, represent the overall status or condition of a national park. Vital signs are physical, chemical, or biological components that are expected to respond to known environmental stressors or are characteristics highly valued by people. The South Florida / Caribbean Inventory & Monitoring Network (SFCN) systematically monitor vital signs for seven national parks. The information collected is used to support the management of natural resources in those national parks. The Colonial Nesting Bird vital sign ranked 8th in the SFCN Vital Signs Monitoring Plan due to ecological significance and monitoring feasibility (Patterson et al. 2008). The Colonial Nesting Birds Protocol was written and will be updated by SFCN staff. The South Florida / Caribbean Inventory & Monitoring Network will also perform the monitoring duties. This document describes the process used to monitor active bird nests in Biscayne National Park.

Rationale for Selecting This Resource

Colonial nesting birds (e.g., wading birds and seabirds) are an important component of the Biscayne National Park ecosystem. A nesting bird colony is defined as a large congregation of individuals of one or more species of birds that nest in close proximity at particular locations. Nesting colonies on islands are very common among seabirds, as nearly 95% of seabird species are colonial (Danchin and Wagner 1997). Herons, egrets, and other species of wading birds also nest communally with other seabirds in Biscayne National Park. The prominent trophic level these birds have is evidence of the important role they serve as indicators of local and regional ecosystem health (Sadoul 1997, Browder et al. 2005, Ogden et al. 2014). Colonial nesting birds have a moderate foraging range (Figure 1) and are affected by both local and regional scale ecosystem changes. This suggests that the long-term monitoring of colonial nesting birds will provide insight to overall ecosystem health at these scales (Erwin et al. 1993).

Colonial nesting birds require a suitable environment for completing reproductive processes. Reproductive requisites include good hydrological conditions that provide an abundance of prey, predator-free roosting, nesting locations close to feeding areas, and safe areas for juveniles and fledglings. Nesting success requires the ability to acquire food for the establishment of reproductive condition, egg production, and to feed chicks and fledgling young. Thus, successful nesting at Biscayne National Park would suggest the environment adequately supports avian reproductive effort. Double-crested Cormorants have been reported to forage between 1.5 miles (Custer and Bunk 1992 as reported in Duffy 1995) and between 18 to 50 miles (Ainley et al. 1990) from the colony. As a conservative foraging distance estimate, we chose a five mile radius to overlay on a map of the park, thus providing a visual reference of possible foraging grounds relative to park boundaries. Using a 5-mile foraging radius, approximately 66% of Biscayne National Park is supporting the known colonies (Figure 1). If a ten mile radius is used, 100% of the park would be in the foraging area. Significant variations in nest counts may indicate that birds are encountering changing environmental conditions (Sadoul 1997). Reproductive needs of these animals also include subtle environmental factors not immediately apparent to managers.

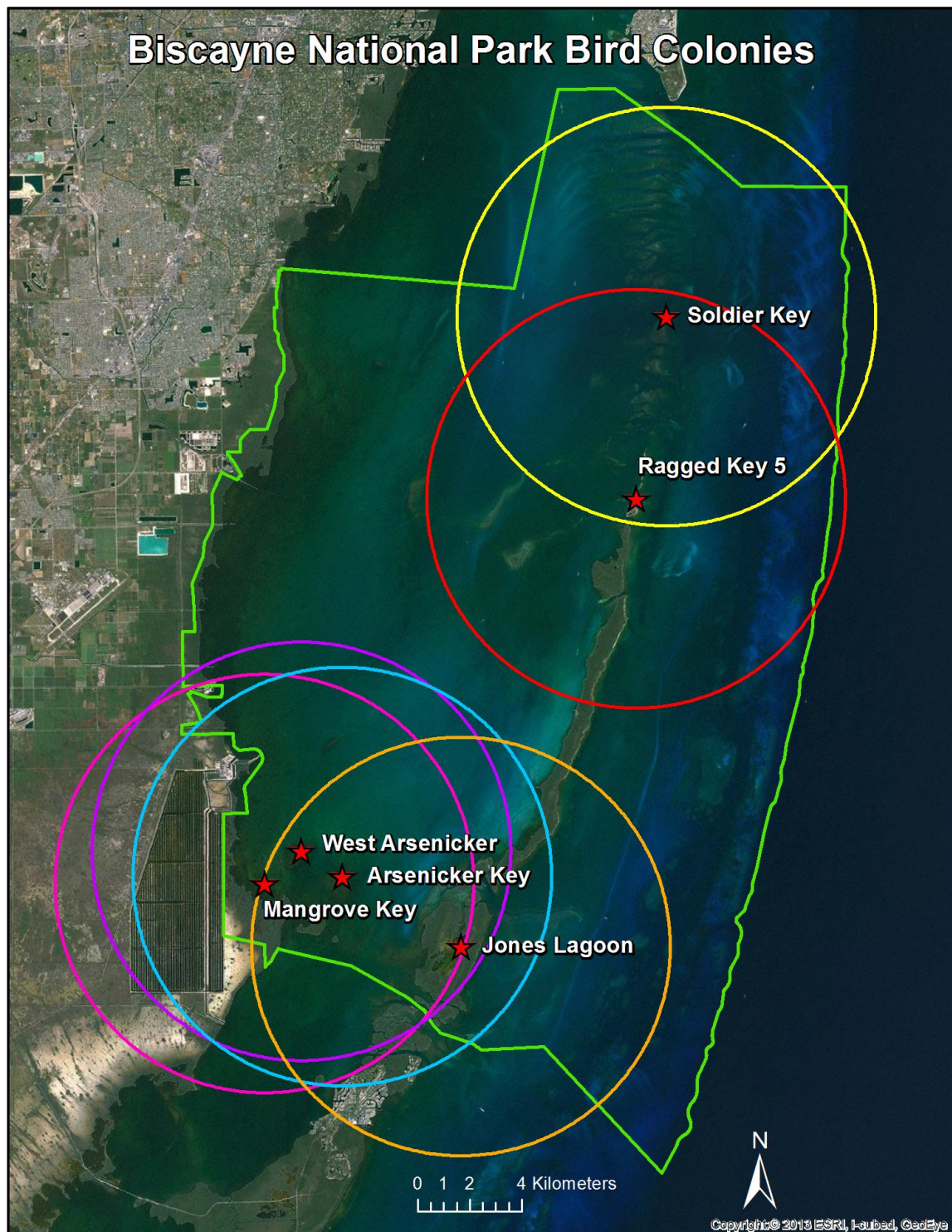


Figure 1. The six known island sites within Biscayne National Park with colonial nesting bird colonies and assumed foraging radius. The circles around each colony are five miles in radius and represent common foraging grounds for birds nesting or roosting at a colony. Approximately 66% of BISC is within the foraging radius of these colonies.

The presence of nesting bird colonies as well as colony size and nesting success indicate the ecosystem's ability to support these energy intensive activities.

Evidence suggests that seabird and wading bird reproductive success is linked with ecosystem ecology and hydrology at several spatial and temporal scales (Frederick and Ogden 2003). Consequently, in South Florida, colonial wading birds including Wood Storks (*Mycteria americana*), Roseate Spoonbills (*Platalea ajaja*), egrets and ibises have been identified as important performance measures for the Comprehensive Everglades Restoration Plan (CERP) in order to track the success of the ecosystem restoration. Much of wading bird foraging success relies on the quality, quantity, and timing of water flow draining from the Everglades (Browder et al 2005). Specifically, colonial bird nesting success is being used as a measure of success regarding water flow into Biscayne Bay. The Comprehensive Everglades Restoration Plan aims to influence the path and timing of water delivery as well as levels of contaminants entering the bay. Changes in the quantity and quality of freshwater entering Biscayne Bay affect salinity and turbidity levels and in turn affect mangroves, oysters, and seagrass communities. One of the 14 research questions addressed in the CERP Biscayne Bay Conceptual Ecological Model is: "Will wading bird nesting activity, nesting success, and foraging activity be improved by the reestablishment of more natural hydro-patterns in Biscayne Bay's coastal wetlands?" (Browder et al. 2005). The Biscayne Bay Conceptual Ecological Model and the SFCN Vital Signs Monitoring Plan provide more comprehensive descriptions of these processes. Estuarine communities serve as foraging grounds for several species of birds (Browder et al. 2005), including the Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea herodias*), and Roseate Spoonbill. Many authors (Frohring et al. 1988, Crozier and Gawlik 2003, Cook et al. 2010, and Ogden et al. 2014) consider monitoring of colonial bird population status and trends vital to a greater understanding of ecosystem decline, the potential for recovery, and overall ecosystem health. Long-term monitoring of Biscayne National Park bird nesting can be used to understand impact of short-term events such as oil spills or hurricanes and of long-term progressive events such as sea-level rise resulting from climate change, fisheries management, seagrass health, effects of invasive species, and water quality in Biscayne Bay. Data collected will provide species-specific nesting information separate from community level trends, which is an important consideration (Crozier and Gawlik 2003). The State of Florida considers several of the bird species nesting, roosting and/or foraging in Biscayne National Park to be imperiled. State-listed species of special concern include the Brown Pelican (*Pelecanus occidentalis*), Little Blue Heron (*Egretta caerulea*), Reddish Egret (*Egretta rufescens*), Roseate Spoonbill (*Platalea ajaja*), Snowy Egret (*Egretta thula*), Tricolored Heron (*Egretta tricolor*), and White Ibis (*Eudocimus albus*) (FWC 2013). The Least Tern (*Sterna antillarum*) and White-crowned Pigeon (*Patagioenas leucocephala*) are listed as threatened by the state, and the Wood Stork (*Mycteria americana*) is listed as federally threatened (Federal Register 2014).

Colonial nesting birds can in turn have an influence on their surroundings. Added nutrient loads from guano factor into determining which species of seagrass will grow in the area. Changes in seagrass species affect species richness and density of demersal fish and invertebrates (Fourqurean et al. 1992). Thus, knowledge of colony locations and size may assist interpretation of other environmental variables.

Long-term monitoring will provide useful information on the status and trends of these natural resources, and may detect environmental problems before severe damage occurs (Sadoul 1997, Bennetts et al. 2007). Monitoring colonial nesting birds can be a powerful tool in understanding the ecology of the birds and their ecosystem (Frederick and Ogden 2003). Monitoring Biscayne National Park colonial bird populations in association with other environmental monitoring programs is expected to provide further understanding of the birds' ecology and that of their surrounding ecosystem. This can be particularly useful for managers to make informed decisions about habitat threats, species protection, resource use, and restoration needs (Gibbs et al. 1999, Parrish et al. 2003).

Existing Monitoring Programs

Bird monitoring efforts in South Florida began long ago, prior to the formation of Everglades National Park. Early records were gathered by wardens and biologists of the National Audubon Society in the 1930s.

Many of today's monitoring programs include performance measures related to the Everglades restoration efforts. Specifically, surveyors monitor birds and nests in Everglades National Park (EVER), Big Cypress National Preserve (BICY), and the Water Conservation Areas (WCAs) north of EVER. Monitoring methods used today include flying aerial transects to spot nesting colonies. These systematic aerial surveys of the Water Conservation Areas began in 1986 followed soon after by aerial surveys of EVER (Frederick and Ogden 2003). Ground surveys assist in locating small colonies and dark birds possibly missed by aerial surveys. Aerial surveys also provide data on wading bird distribution.

The southernmost portion of Everglades National Park is Florida Bay. This bay area supports a significant population of wading birds and has been monitored for decades. Aerial counts for birds in the bay date back as far as 1935 (Powell et al. 1989). Roseate Spoonbills have been a species of interest for several years after nearly being extirpated by hunters seeking meat and plumage. These charismatic birds are still monitored today and are considered an indicator species for the Comprehensive Everglades Restoration Plan RECOVER program.

Multiple agency, university, and non-governmental monitoring programs report their results in the South Florida Wading Bird Report and the reader is referred to this resource for a more complete description of wading bird monitoring in South Florida (Cook 2013).

Although various agencies have measured the numbers of colonial nesting birds and their reproductive success in South Florida for years, few data are available for Biscayne National Park. There were limited surveys occurred during the 1970s and sporadic surveys by the State of Florida. A consistent monitoring program in Biscayne National Park can serve as an early warning to park management to detect declines in ecosystem integrity and species viability before irreversible loss occurs (Kushlan 1993). In addition monitoring in Biscayne National Park will help complete a regional wading bird picture. When combined with data from other nesting areas (e.g., Florida Bay), a more comprehensive understanding can be achieved for species which nest in Florida Bay, Everglades National Park, Water Conservation Areas, and Biscayne Bay.

Implementation Park: Biscayne National Park

The South Florida / Caribbean Inventory & Monitoring Network will implement this colonial nesting protocol at Biscayne National Park. Biscayne National Park was established first as a monument in 1968 and then as a national park in 1980. Biscayne National Park islands, waters, and surrounding areas currently provide suitable habitat for bird reproduction. Biscayne National Park covers an area of 173,000 acres, approximately 95% of which are submerged marine environments. Birds utilize the bay and the approximately 42 islands protected within the park boundary year-round. Mangroves cover 74% of the terrestrial environments, hammock/hardwoods cover 23%, marshes 0.4%, and beaches <0.1% (Whelan et al. 2013). The shallow waters surrounding Biscayne National Park mangrove islands are suitable habitat for foraging and offer protection for nesting colonies from most land predators. These islands, which serve as refuge to colonial nesting birds, will be the focus of SFCN monitoring efforts.

Urbanization has reduced the mangrove wetlands and other habitats on the western boundary of the park and modified the natural tidal creeks. These creeks historically mixed freshwater flows with the marine system during the wet season, but these areas are now dominated by canal discharges and unnatural pulses. The modified hydrology of the bay has affected the seasonal salinity patterns and the bay ecology and is one of the targets of the Comprehensive Everglades Restoration Plan. The park receives approximately a half million visitors each year, many of which come to boat, fish, snorkel, and dive within the park.

Focal Species

Though many colonial nesting bird species utilize Biscayne National Park, this protocol focuses on monitoring nesting trends and patterns of five focal species: Double-crested Cormorant (*Phalacrocorax auritus*), Great Blue Heron (*Ardea herodias*) and its subspecies Great White Heron (*Ardea herodias occidentalis*), Great Egret (*Ardea alba*), Roseate Spoonbill (*Platalea ajaja*), and White Ibis (*Eudocimus albus*). For the purposes of this document, the Great White Heron is considered a subspecies.

These bird species are either top-canopy or highly-visible upper sub-canopy nesters. All except the cormorants are monitored in other parts of South Florida such as Everglades National Park, both mainland and Florida Bay, the Water Conservation Areas, and Big Cypress National Preserve. The results of these monitoring efforts are published in the South Florida Wading Bird Report (Cook 2013). Monitoring these species allows for inter-regional comparisons to be made. These species cover a variety of feeding techniques, including diving (Double-crested Cormorants), stalk and strike (Great Blue Heron, Great White Heron, Great Egret), and tactile feeding (Roseate Spoonbill, White Ibis), reflecting the complexity of the food web in the park and providing upper trophic-level responses to foraging conditions at different portions of the lower food web.

Double-crested Cormorant

Double-crested Cormorants are a dark to glossy black duck-like bird of medium size (Figure 2). This species feeds by diving and then pursuing prey, primarily fish. Double-crested Cormorants feed in coastal bays, lakes, estuaries, and nearshore open water, including freshwater, brackish, and marine habitats. Cormorants dive below the water surface as deep as 20 ft (Sullivan et al. 2006) and actively chase fish thereby accessing prey in habitats unavailable to the herons and egrets. The stick nest is built by both the male and female. It takes approximately three months from egg laying to fledged young capable of flying and diving (Nellis 2001). This species is presumed to be sensitive to changes in food supply from local fish populations, contaminants (especially DDT and other organochlorine pesticides), and disturbance of nesting colonies by invasive species (e.g., pythons, rats), native predators (e.g., raccoons), and humans. Historically they were also hunted as fishermen saw them as competition for fish.

Annual censuses of the Double-crested Cormorant population in Biscayne Bay from 1980 to 1986, average as follows: 3,500 in January and February, 2,500 in March, 1,300 from April to September, 2,500 in October, and 3,500 in November and December (Cummings 1987). These results suggest the resident population may be supplemented by a strong winter migration population.

Double-crested Cormorant nests are also the most numerous type of nest counted in this monitoring project. Cummings' (1987) findings also indicate peak breeding months of April through August which corresponds with our data (see sample data summary report in Appendix 4).

A banding study reported by Dolbeer (1991) shows that Double-crested Cormorants banded from 1923 to 1988 migrated south from New England, the St. Lawrence River, and the St. Lawrence Gulf region. These northern populations would migrate in October and November and supplement cormorant populations from Texas to Florida, including the Biscayne Bay nesting population. The banding data suggests the majority of cormorants that migrate north eventually return to the proximity of their natal colony, within a median distance of 25 km (Dolbeer 1991). We consider it unlikely that this migratory population is nesting in Biscayne Bay and note that we are not seeing a large winter time nesting pulse in our data.



Figure 2. Double-crested Cormorant nesting in Biscayne National Park.

Great Blue Heron

Great Blue Herons are the largest North American heron (Figure 3). The heron's body is gray-blue with the neck having a tan coloration. It feeds using a stalk and strike method, standing still, waiting for unsuspecting prey, and then striking with its beak. Great Blue Herons can be found feeding in freshwater, brackish, and saltwater habitats that are shallow enough for these tall herons to wade in and clear enough to see prey including marshes, sloughs, lakes, open coasts, and riverbanks. They occasionally forage in grasslands and agricultural fields. Their primary diet includes fish, amphibians, reptiles, small mammals, insects and other birds that they can grab using a stalk and strike method. Males gather sticks and the female constructs the nesting platform (Nellis 2001). Nest platforms are sometimes reused. It takes approximately three months from egg laying to fledge young. Gibbs (1991) found a correlation between size of foraging areas and size of colony sites for Great Blue Herons. In general, birds conserve energy by nesting in areas centrally located to food sources. They can be sensitive to changes in hydrology that affect food supplies, contaminants (e.g., DDT and mercury), habitat loss, and disturbance of nesting colonies by invasive species, raccoons, and humans.



Figure 3. Great Blue Heron with chicks and nesting.

Great White Heron

The Great White Heron (Figure 4) is currently considered a subspecies of the Great Blue Heron (Peterson 2010), although they were once considered their own species and debate continues regarding their taxonomic position. They are only found in South Florida and their diet is similar to the Great Blue Heron. They are often seen on seagrass flats and in mangroves. The South Florida / Caribbean Inventory & Monitoring Network has detected the Great White Heron nesting as far north as Soldier Key in Biscayne National Park. Previous reports showed these herons nesting in the Arsenickers (FWC 2003) in Biscayne Bay, approximately 25 km SSE of Soldier Key.

Documentation of Great White Heron nesting in Biscayne National Park is important because they have a limited nesting area that has historically only been reported in the Florida Keys, Florida Bay, and the Sarasota/ Bradenton area (FWC 2003). Increases in freshwater flows that affect estuarine and bay fish communities are expected to affect great white herons (Ogden et al. 2014) along with contaminants (e.g., DDT and mercury), habitat loss, and disturbance of nesting colonies by invasive species, raccoons, and humans.



Figure 4. Great White Heron leaving nest in Biscayne National Park.

Great Egret

The Great Egret is a medium-sized, strikingly elegant all-white heron with black legs (Figure 5). It can be confused with the Great White Heron; however, Great Egrets are slightly smaller and have black legs as opposed to the Great White herons which have yellowish legs. Great Egrets feed using the stalk and strike method. Previously built nests may be reused. It takes just over two months from egg laying to fledge young (Nellis 2001). Great Egrets and Great White Heron nesting times and locations often overlap, making it difficult to distinguish between the two species when a complete view of the birds is not available. Great Egrets can be found feeding in freshwater, brackish, and saltwater habitats that are shallow enough for them to wade in and clear enough to see prey including marshes, sloughs, lakes, open coasts, and riverbanks. They occasionally forage in grasslands and agricultural fields. Their diet is mostly fish but also includes crustaceans, amphibians, and invertebrates and in fields can include insects, rodents, and small birds.



Figure 5. Great Egret at West Arsenicker Key in Biscayne National Park.

Roseate Spoonbill

Roseate Spoonbills are medium-sized pink birds with a uniquely spoon-shaped bill (Figure 6). Roseate Spoonbills are tactile feeders, and they swing their spoonbill through the mud feeding on small fish, shrimp, and aquatic insects. They feed in shallow, estuarine, seasonally flooded wetlands involving a diverse array of habitats including mangrove swamps, tidal ponds, saltwater lagoons, and other areas of brackish water. Males gather sticks and wood materials for the nest and the female builds the nest. It takes approximately two months to lay eggs and fledge young (Nellis 2001). Roseate Spoonbills were once hunted to near extinction for their pink plumage. Roseate Spoonbills were detected nesting in Biscayne National Park by the South Florida / Caribbean Inventory & Monitoring Network in 2009. It is not known exactly when these birds started using Biscayne National Park as a nesting site, but through SFCN monitoring efforts we can follow trends in their nesting effort within the park. Roseate Spoonbills are considered an indicator species for the Comprehensive Everglades Restoration Plan Monitoring and assessment Plan program and are expected to respond positively to restoration of freshwater flows to Florida Bay (Ogden et al. 2014). What impact (if any) this may have on Roseate Spoonbills nesting in Biscayne National Park is unclear. However one of the lowest nesting seasons in Florida Bay (winter 2010–2011; RECOVER 2014a) coincided with the highest peak nest count recorded to date by the South Florida / Caribbean Inventory & Monitoring Network in Biscayne National Park (12 nests, see Appendix 4). Thus, monitoring Roseate Spoonbills in Biscayne National Park may help complete interpretations of status and trends in Everglades National Park (EVER). Roseate Spoonbills are also sensitive to contaminants and disturbance of nesting colonies by invasive species, raccoons, and humans.



Figure 6. Roseate Spoonbills adult and juveniles in Jones Lagoon.

White Ibis

White Ibises are smaller white birds with a distinctly curving orange-red bill (Figure 7). The White Ibis is a tactile feeder that uses its long slender beak to reach into holes and crannies seeking out prey including crayfish, crabs, insects, snails, frogs, marine worms, snakes, and small fish. They forage in freshwater, brackish, and saltwater shallow habitats and seasonal wetlands including marshes, mudflats, flooded pastures, lake edges, mangrove lagoons, and grassy fields. Males gather sticks and the female builds the nest. Nests are lined with green leaves. It takes almost three months to lay eggs and fledge young (Nellis 2001). In our experience the White Ibis nests lower in the canopy and their nests are small relative to the size of the bird. However, the bird's white coloring, location in the canopy, body posture and well-defined nesting season improve our ability to detect nesting. Thus, detection of White Ibis colonies is fairly easy, however because this is a sub-canopy nester, only a proportion of the nests may be visible from the air. Second to the cormorants, White Ibises have the highest peak nest numbers of the species monitored. White Ibises were initially detected at West Arsenicker but subsequently were detected at Arsenicker Key. White Ibises are considered an indicator species for the Comprehensive Everglades Restoration Plan Monitoring and assessment Plan program as nesting colony size and location is expected to respond to regional changes in amount and timing of freshwater hydrology and associated fish productivity. In addition the timing and length of dry periods is critical as fish are concentrated into small shallow pools that are a potent food source allowing wading birds to complete nesting successfully (RECOVER 2014b). White Ibises are also sensitive to contaminants and disturbance of nesting colonies by invasive species, raccoons, and humans.



Figure 7. White Ibises nesting in Arsenicker Key in Biscayne National Park.

Other species

Colonies of the smaller egrets and darker herons such as the Tricolored Heron (*Egretta tricolor*), Little Blue Heron (*Egretta caerulea*), Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), Reddish Egret (*Egretta rufescens*) and the Yellow-crowned Night-Heron (*Nyctanassa violacea*) also nest in the sub-canopy. These birds, although present, are not detected well from aerial surveys. Because of lower detection probabilities, these species are not considered focal species of the protocol although colonies, visible active nests, and observed birds are recorded. Species such as Brown Pelican (*Pelecanus occidentalis*) and Magnificent Frigatebirds (*Fregata magnificens*) have been observed roosting, but not seen nesting in the park.

Measurable Objectives

The specific objectives of this colonial bird monitoring effort are to determine status and long-term trends in:

- Numbers and locations of active colonies of colonial nesting birds with a special focus on Double-crested Cormorants, Great Egrets, Great White Herons, Great Blue Herons, White Ibises, and Roseate Spoonbills.
- Annual peak active nest counts of colonial nesting birds in Biscayne National Park with a special focus on the species mentioned above.
- An annual nesting index (sum of monthly nest counts) with a special focus on the species mentioned above.
- Timing of peak nest counts for the focal species.

The number of colonies and peak nest counts are used as primary metrics by other large-scale colonial nesting bird monitoring efforts (Crozier and Gawlik 2003, Cook et al. 2010). Peak nest counts tend to show similar trends and variability to total nest counts but are more robust with respect to unexpected changes in sampling; for example, cancelled survey flight due to a fire, tropical storm, or a government shutdown. For the purposes of this study, the South Florida / Caribbean Inventory & Monitoring Network is monitoring active nests, whether they are occupied or unoccupied. The rationale for counting non-occupied nests is to provide a more accurate active nest count because birds (especially Double-crested Cormorants) often fly away when the helicopter approaches. For the year 2013, we counted 4,260 active Double-crested Cormorant (DCCO) nests, of these nests 3,950 were occupied and 310 were empty (i.e., non-occupied), therefore, our data indicate that 7.28% of the active DCCO nests were empty. We observe Double-crested Cormorants leaving the nest when the helicopter approaches and then return to the nest upon our departure. We are specifically clarifying that these non-occupied nest are active nests that experience short-term vacancies and are likely reoccupied shortly after the survey. In our estimation, excluding non-occupied, but actively maintained nests, from the data would provide an inaccurate census of active nests.

A “Nesting Index” is another metric used in our monitoring effort. We define this “Nesting Index” as the annual sum of monthly nests counted across all 12 months. These two metrics bracket the less easily measured but more ideal metric of total nest starts. Using both peak nest counts and the annual nesting index as metrics will provide greater confidence in the analysis if the two metrics coincide. If the two metrics display different trends, this would lead to more analysis and a review of methods.

The trends developed using these metrics should be considered as indices of nesting and not true nest counts, because the same nest may be counted in more than one month.

The South Florida / Caribbean Inventory & Monitoring Network also considered using other metrics for monitoring colonial nesting birds such as total nest starts but determined it is not feasible at this time with the technology and NPS resources available. The South Florida / Caribbean Inventory & Monitoring Network will consider other methods and options of monitoring and metrics as new technology emerges.

Link to Management Decision-Making

This protocol does not identify quantitative thresholds to trigger management actions at this early stage in the program. However, abrupt declines or abandonment of nesting colonies and large changes in total number of active nests may trigger an investigation into reasons, e.g., invasive species may be colonizing nesting colony islands (Figure 8), native predators such as raccoons may be able to reach islands via newly formed land bridges, people may be disturbing nesting colonies, bay and marine fish communities may be showing increases or declines due to hydrological changes, coastal habitat changes and/or implementation of marine protected areas (MPAs); contaminants may be affecting reproductive success; and/or changes may be part of region-wide trends, etc. These in turn may suggest actions for management.

The improved knowledge of where the nesting colonies are located and the seasonal timing of nesting have already been informative to park planning.



Figure 8. Two non-native Green Iguanas (*Iguana iguana*), circled in blue, occupy a spoil island near the mainland in Biscayne National Park. Iguanas have not been spotted at nesting colonies yet, but they may become a disturbance to nesting birds if they extend their current range.

Sampling Design

Overview of Sampling Design

The sampling design chosen for this monitoring protocol at Biscayne National Park is a complete aerial survey of visible colonies within the park and a systematic monthly sample in time of visible active nests by species in located colonies using photographs taken from a helicopter. Our pilot work indicates that monthly sampling is necessary to capture the active nesting season for the colonial birds in Biscayne National Park (Figures 9–10).

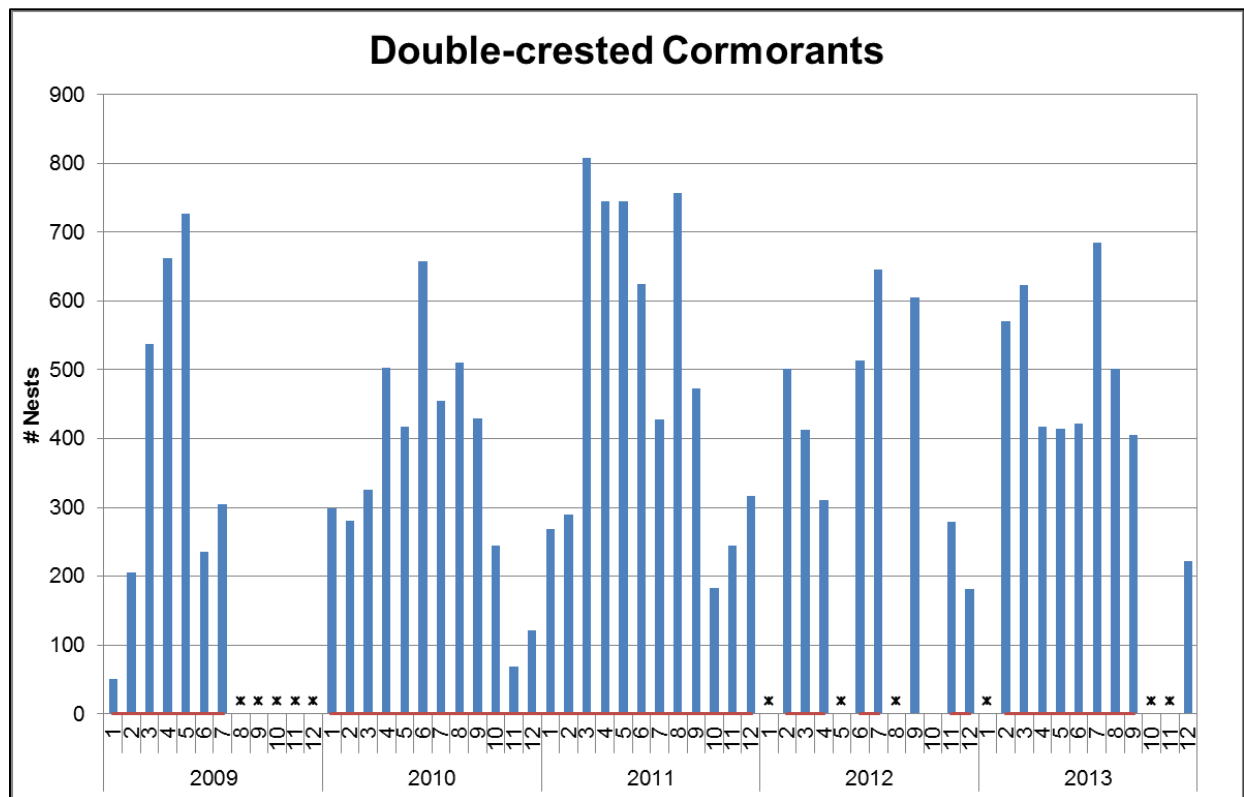


Figure 9. Number of Double-crested Cormorant nests per month and peak nesting periods. * = Months not sampled.

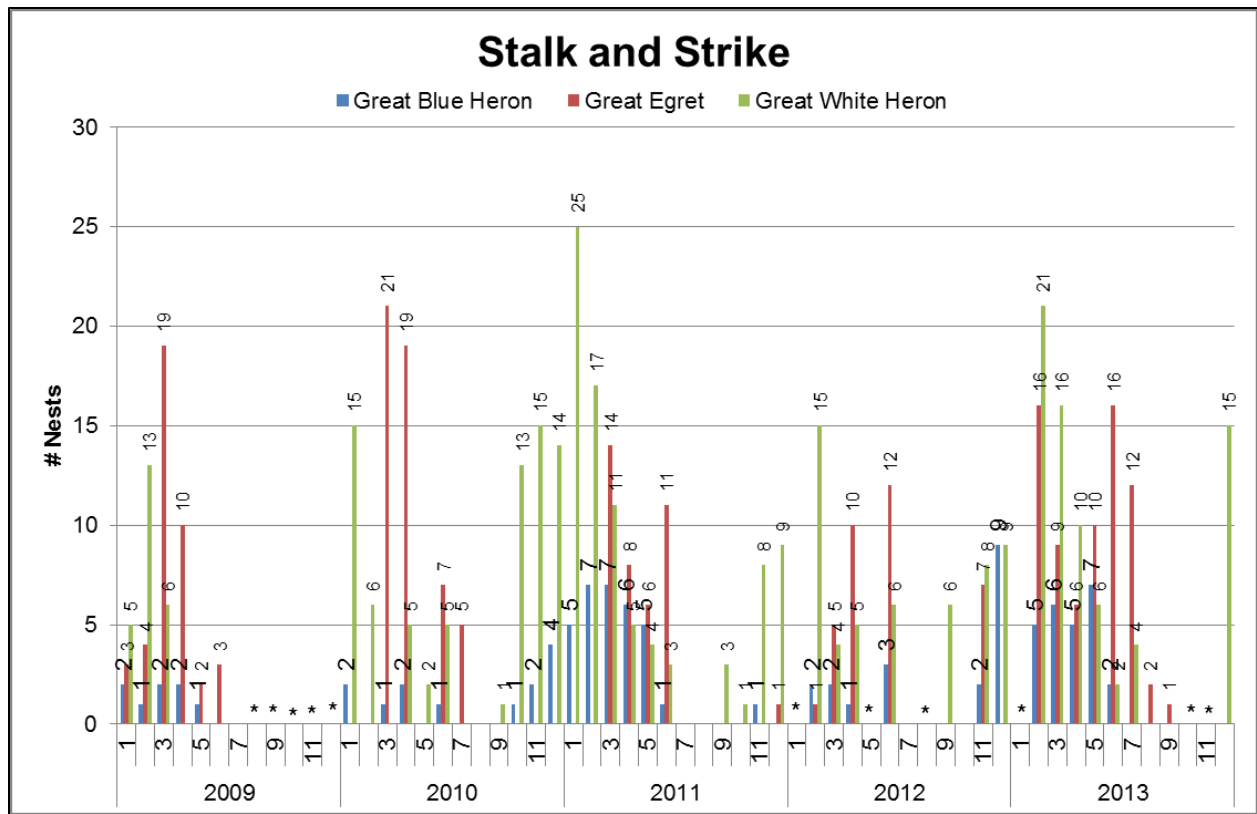


Figure 10. Number of nests and peak nesting periods by month for selected stalk and strike species: Great Blue Heron, Great Egret, and Great White Heron. * = Months not sampled.

Rationale for Selecting This Sampling Design

The South Florida / Caribbean Inventory & Monitoring Network conducted a pilot study to field-test geographically extensive survey techniques within Biscayne National Park. Field tests have shown that the most effective and efficient way to monitor colonies within Biscayne National Park is to conduct an aerial survey from a helicopter. This method provides high detection of a majority of colonies, especially colonies of focal species. Monitoring efforts require identifying colony locations, determining the probable nesting periods, and sampling at monthly intervals for nests which are visible in photographs taken from a helicopter. A complete aerial census that encompasses all the islands, as well as the coastline of the park, is conducted twice a year in February and July in order to confirm activity at all known colonies and detect any new colonies. Once colonies are found, monthly flights to these locations (conditions and funding permitting) are conducted to document and monitor nesting activity through photographs. Nest counts from photographs provide a reliable method of data collection (Hutchinson 1979). It is important to limit variability in detection and data collection. The variation in detection must be substantially lower than the variation in the population size being detected (Johnson 2008). The SOPs described in this protocol are designed to ensure consistency and limit variance among personnel performing the tasks.

Detection is the ability to see the subject of interest if it is present in the survey area. Some species are highly visible, nest in the upper canopy, and are more easily detected. These species include the

Double-crested Cormorant (*Phalacrocorax auritus*), Great Egret (*Ardea alba*), and the Great Blue Heron (*Ardea herodias*), which are the most prominent examples of visible nesting birds in Biscayne National Park. There are, however, limitations of aerial monitoring – species such as the White Ibis (*Eudocimus albus*) and Roseate Spoonbill (*Platalea ajaja*) tend to nest lower in the tree canopy, but they are still detected with reasonable confidence and are considered focal species of this protocol. Colonies of the smaller egrets and darker herons such as the Tricolored Heron (*Egretta tricolor*), Little Blue Heron (*Egretta caerulea*), Snowy Egret (*Egretta thula*), Cattle Egret (*Bubulcus ibis*), and the Yellow-crowned Night-Heron (*Nyctanassa violacea*) also nest in the sub-canopy. These birds, although present, are not detected well from the helicopter or from photographs taken while conducting an aerial census. Nesting for these species is therefore documented incidentally during photograph analysis. Because of minimal detection capabilities, these species are not considered focal species but instead are considered ancillary (Table 1).

In this protocol the detection of colonial nesting birds differs by species, colony site, time of year, methodology, and observer. We have taken a number of steps to mitigate detection concerns. We have assessed the difference between visual observation from a helicopter and an abundance index from photographs of colonies. Counts from photographs are a better index of abundance, detection of nests is higher and multiple counts can be made along with the advantage of a permanent record being generated. We have compared nest counts from photographs taken from a helicopter to visual counts done from a boat. Boat estimates consistently under count nests high in the canopy whereas the helicopter platform allowed for a more complete colony survey. We have compared nest counts from photos taken from a fixed-wing plane, blimp, and from a helicopter. The helicopter platform is the most stable, repeatable, and cost effective. The ongoing research and inventory efforts at other parks served as a guide to test and streamline field methodologies and analytical approaches. We used pilot datasets to assess the statistical power of the proposed monitoring program.

Sampling Domain

The study area

The 42 islands and the mainland shoreline protected within Biscayne National Park comprise the study area. These islands and shoreline serve as refuge to colonial nesting birds and will be the focus of the monitoring efforts via aerial census. Two aerial reconnaissance missions of the study area are performed during the year to ensure that all active nesting and roosting sites are found during each survey. If new sites are found, they will be added to our monthly surveys. Over the last five years, the colonies have remained at the same locations with the exception of one colony, Mangrove Key, which disappeared after three years of activity and then reappeared the subsequent year.

Target population, sampling frame, and sampling units

Each year we perform a complete survey of bird nesting colonies of the focal species. Since the lifetime of a bird nesting colony is multiple months (time to build nest, incubate eggs, and raise young) and we perform monthly sampling, we feel that we are not missing colonies. Since bird nesting colonies are highly visible from the helicopter surveying platform we feel that we are not missing colonies during our monthly surveys. The monthly sampling and the complete survey have a very minor difference in total helicopter flight time (1.2 hours compared to 1.5 hours; flight time ~18

minutes) indicating that there is little area not visually surveyed in the monthly samples. The target population is the number of nesting colonies and peak nest counts for colonial nesting birds (Table 1). Peak nest counts via the photographs are nearly a complete sample (high detection) of the top-canopy focal species but are considered an index of nesting for sub-canopy species. The sampling unit for this protocol is each colony site.

Table 1. Nesting location, method of foraging, and target species for some of the bird species identified and monitored in Biscayne National Park.

Species	Location in canopy	Type of forager	Target species for nest counts	Target Species for colony location
Double-crested Cormorant (<i>Phalacrocorax auritus</i>)	Top canopy	Diver	Yes	Yes
Great Egret (<i>Ardea alba</i>)	Top canopy to sub-canopy	Stalk & Strike	Yes	Yes
Great Blue Heron (<i>Ardea herodias</i>)	Top canopy	Stalk & Strike	Yes	Yes
Great White Heron (<i>A. h. occidentalis</i>)	Top canopy	Stalk & Strike	Yes	Yes
White Ibis (<i>Eudocimus albus</i>)	Sub canopy	Tactile	Yes	Yes
Roseate Spoonbill (<i>Platalea ajaja</i>)	Sub canopy to Top canopy	Tactile	Yes	Yes
Tricolored Heron (<i>Egretta tricolor</i>),	Sub canopy	Stalk & Strike	Ancillary	Ancillary
Little Blue Heron (<i>Egretta caerulea</i>)	Sub canopy	Stalk & Strike	Ancillary	Ancillary
Snowy Egret (<i>Egretta thula</i>),	Sub canopy	Stalk & Strike	Ancillary	Ancillary
Cattle Egret (<i>Bubulcus ibis</i>),	Sub canopy	Stalk & Strike	Ancillary	Ancillary
Yellow-crowned Night-Heron (<i>Nyctanassa violacea</i>)	Sub canopy	Stalk & Strike	Ancillary	Ancillary
Reddish Egret (<i>Egretta rufescens</i>)	Sub canopy	Stalk & Strike	Ancillary	Ancillary

For top-canopy nesters the sampling frame is an aerial census of all colonies and a count of all visible nests on a monthly basis. This is used to determine the peak nest counts by species and timing of nesting. For top-canopy nesters the sampling frame is virtually identical to the target population as nearly all nests are readily visible and identifiable.

For sub-canopy nesters, the location of nesting colonies is the primary metric although visible nest counts are recorded. It is possible that some small nesting colonies of sub-canopy nesters are missed by this protocol, although larger colonies should be located.

Sampling frequency and timing

Bi-annual flights looking for new and existing colonies

The bi-annual reconnaissance complete park survey flights are meant to capture new nesting colonies within the park and take place at the start of the year and mid-year to coincide with similar colony location efforts by other regional monitoring programs. The bi-annual monitoring surveys begin at the shoreline near Mangrove Key and then proceed to the Arsenickers and south along the islands on the southern boundary of the park. The flight routes include Swan Key, Old Rhodes, and Totten Key then proceeds north covering Jones Lagoon and the eastern side of Elliott Key and Sands Key. Ragged Key 5 and Soldier Key are surveyed as normal. The surveys continue heading south along

the western shoreline of Sands Key and Elliott Key then moving west to the mainland shoreline. The surveys continue by heading north on the mainland shore covering as much area as safely possible considering fuel level. The flight path is marked in red (Figure 11). We then return to airport. The island colony data sheets are used with additional ‘New Colony’ sheets added in the flight notebook (Appendix 2) in case a new colony is observed. The bi-annual complete surveys include the monthly survey for those months.

Monthly flights for counting nests at existing colonies

The monthly survey focuses on the six known nesting colonies within Biscayne National Park. The flight initiates at Homestead General Airport or Miami Executive Airport and proceeds in order of, Mangrove Key, West Arsenicker, Arsenicker Key, Jones Lagoon, Ragged Key 5, and Soldier Key. After surveying Soldier Key, the crew returns to the airport. The flight path for a monthly survey is shown in orange (Figure 11). A typical monthly flight lasts approximately 1.2 hours.

Sampling takes place every month during the year, from January through December. The SFCN will maintain this sampling frequency subject to budget constraints, weather, personnel, and flight availability. Monthly flights need to be conducted throughout the year in order to determine changes in peak nesting periods, which differ by species and location. Reductions in sampling may decrease the ability to detect the peak nesting period for some species in that sampling year. Generally the time from nesting to fledging takes longer than a month for these species, so monthly flights are considered sufficient to detect peak nest counts.

Number and location of sampling sites

Sampling includes all the colony sites found on the islands and coastal fringes within Biscayne National Park. There are six colony sites that have been regularly identified during the five year pilot study. These six sites are located on six different islands within the park. These island colonies are located at Mangrove Key, West Arsenicker Key, Arsenicker Key, Jones Lagoon, Ragged Key 5, and Soldier Key (Figure 11).

Sampling method

The SFCN has chosen helicopter surveys as the preferred method of gathering data. We have found using a helicopter provides the most stable and functional platform for taking aerial photographs. Helicopter surveys allow for monitoring events to be completed in a timely manner.

For typical monthly monitoring flights we use a consistent flight path around the colonies and take photographs at an altitude of approximately 150 feet. The altitude can vary slightly depending on needs of the photographer and observer, the pilot’s requirements, vegetation density at the colonies, and weather conditions. We try to approach each colony the same way every month (Figures 11 and 12) although changes may be required to accommodate for weather conditions. Upon approach to a colony, an overview photo is taken to help identify and differentiate colonies.

We use two crew members to gather data, an observer in the front seat and the photographer in the back seat. The front seat observer records all the bird species observed while the backseat photographer takes as many overlapping photographs as necessary to capture the nesting areas. Once

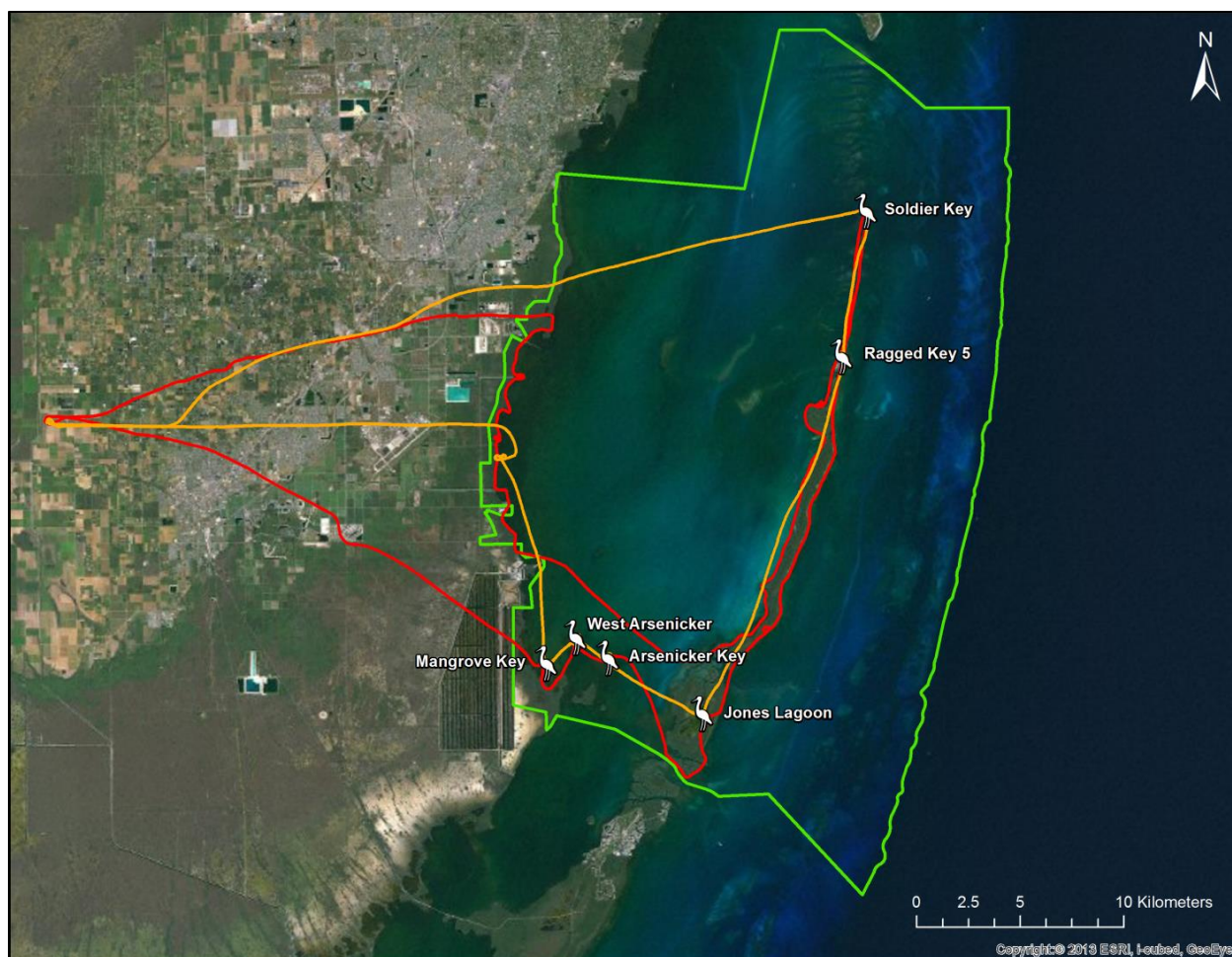


Figure 11. The six nesting locations displayed along the flight path shown in orange, the annual survey flight is shown in red, and the park boundary is in green. This monitoring flight started at Homestead General Aviation Airport, west of the park. The flight paths shown were captured from an on board handheld GPS.

back at the office, SFCN personnel determine which photographs taken during the helicopter flights will be utilized for counting nests. After each flight is completed, photographs taken during the flight are analyzed and the circled nests are counted from the analyzed photographs. It is important not to count the same nest more than once although it may appear in multiple photographs.

The front seat observer collects species richness data not otherwise captured by photographs. For example, 12 American White Pelicans (*Pelecanus erythrorhynchos*) were observed on 16 February 2012 at Arsenicker Key, but none were photographed nesting. These data indicate birds are using the park for purposes other than nesting, such as roosting or foraging. The photographs provide better data to determine nest quantities. For example on 23 March 2011, an visual estimated 250 Double-crested Cormorants were observed at Ragged Key 5, while photographs taken during the aerial survey showed 416 Double-crested Cormorant nests. The two data sets together provide a more complete description of birds nesting and using the park.



Figure 12. Flight path around Arsenicker Key with photograph locations geotagged. Yellow arrows show direction camera was pointing.

Alternative sampling methods investigated

In an effort to gather the best data possible and potentially reduce expenses, the SFCN has attempted other methods to gather data. Boat surveys and walking surveys were performed at various islands in Biscayne National Park to check the feasibility of gathering data from below the tree canopy. Both methods may be valuable to supplement the helicopter surveys, though neither provides the visibility needed for a complete survey of an island, as too many canopy nests are not visible from the ground or water surface. In addition, the time required to complete a survey of all six islands from a boat is not practical. Observations made and photographs taken from these surveys may provide data on sub-canopy nesting birds such as the Little Blue Heron and the Yellow-crowned Night-Heron. Alternate methods of gathering data can be used to supplement helicopter observations and provide information to possible changes in nesting behavior, but are not included as part of this protocol.

In February 2012, both helicopter and boat surveys were performed at Ragged Key 5 and Soldier Key. Active cormorant nests observed from the helicopter were 12 and 10 respectively. The photographs taken from the helicopter were analyzed in the office and nest counts rose to 272 and 78

respectively. Seven days later, a return to Ragged Key 5 and Soldier Key in a boat resulted in nest counts of 55 and 26 respectively. With significantly more nests observed, aerial photography clearly provides the most complete nest count for top-canopy nesters. It should be noted that at locations where all of the nests were observable from the water (nests observed from canoe at small mangrove islands in the Jones Lagoon Colony) field observations and helicopter surveys produced the same number of nests.

In December of 2010, the SFCN performed a nesting survey from a blimp to determine whether this could be a practical survey method. The blimp survey did allow for observations and photographs, similar to those taken from a helicopter, providing similar results to a helicopter survey performed three days earlier. Overall, helicopters provide a better survey method because of better maneuverability and much shorter flight time for a similar cost.

Fixed-wing aircraft may be suitable to fly transects, but are not practical for flying over small island colonies. Planes fly too fast and do not afford the ability to hover. Helicopters allow for a more complete set of photographs, providing better precision of nesting area locations. Overall it is more difficult to photograph and make observations from a fixed-wing airplane. Additionally, it has been shown helicopter surveys are more accurate and cause fewer disturbances to birds than fixed-wing aircraft surveys or ground surveys where observers walk among the birds (Kushlan 1978).

Using unmanned aerial vehicle (UAV) for photography has been considered and will continue to be evaluated in the future as a method to gather data. The benefits of this technology include a higher level of safety, lower costs in the long term, and more control over scheduling. Several other considerations such as: proximity to Homestead Air Reserve Base, licensing, changing federal regulations from Federal Aviation Administration (FAA) and NPS Interim Policy Memorandum 14-05 regarding unmanned aircraft, and training requirements need to be resolved in order for this method of data collection to occur.

In June 2014 a comparison was made of the quality of photography and field observations achieved at three different flight altitudes: 150, 250, and 500 ft. The three photographs (Figures 13, 14 and 15) were taken above West Arsenicker and cover approximately the same area. They demonstrate the reduction in detail as the helicopter is flown higher. The inset images are a 100% view to show the maximum detail level available at each altitude.



Figure 13. View of a Great Egret at an altitude of 150 ft. We found this altitude provides the best opportunity to capture good observational and photographic data. The image inserted is blown up 100% and allows for easier species identification and location of nests.



Figure 14. View of a Great Egret at an altitude of 250 ft. The inset is zoomed to 100%. At this altitude it is difficult to see into the canopy and locate nests.



Figure 15. View of a Great Egret at an altitude of 500 ft. with a lens focal length comparable to the previous photos. From this altitude, it is difficult to determine species and see into the canopy. At this altitude, it is impractical to locate nests, locate birds and identify bird species.

An altitude of 150 ft. was determined to provide the best data for the photographer and the observer. When flying too low, it is difficult to completely photograph the colony and birds may be flushed off their nests. When flying too high, it is difficult for the observer to locate nests and birds with the naked eye. At 150 ft., Figure 7 clearly shows the narrow, yellow bill and black legs that are the signature identification of a Great Egret. In Figure 8 at 250 ft. the yellow bill is distinguishable in this bird but the clarity is obviously less and the thickness of the bill and the black legs are not distinguishable. Figure 9 photographed from 500 ft., shows a loss in the ability to distinguish the key characteristics to reliably separate species such as Great Egrets, Great White Heron, Snowy Egrets and White Ibis, even when magnified to fullest extent. It is important to note these photographs are of a bird out in the open, not obscured by branches or in shadows and so provide the best opportunity to capture good observational and photographic data. Without the ability to magnify the birds, the field observer generally loses the ability to distinguish species at 500 ft.

Level of Change Detectable

Any change in the number of colonies for top-canopy nesters is considered a difference as the monitoring completes a census for the park. White Ibis colony counts are also considered a census as White Ibis is a highly-visible bird even in the sub-canopy and usually nests in large numbers. However the range of natural variation is still to be determined.

For peak nest counts (maximum nests counted in any month by colony then summed across colonies) and annual nesting index (annual sum of monthly nest counts; missing months interpolated by averaging number of nests in months before and after missing month), a very preliminary change detection analysis for regression was conducted for years 2010–2014 data using Gerrodotte’s equations (as published in Thompson et al. 1998 and calculated using “Fishmethods” package in the statistical program R) with an $\alpha=5\%$, power=80% and an assumption that variance is proportional to $1/\sqrt{\bar{x}}$. This means we are 95% confident that a trend declared statistically significant will actually be occurring and 80% confident that if a trend is occurring, we will actually detect it. Results for peak nest counts and annual nesting index are summarized in Tables 2 and 3 respectively. Variability in peak nest counts for top-canopy nesters may be associated with annual rainfall, freshwater flows, and/or other factors and future analyses that take these factors into account may further improve the estimates. The equations produce slightly different results for a negative trend (decline) than for a positive trend (increase). The results below show reasonable positive and negative trends should be detectable for four of the six species after 10 years of sampling. However for Roseate Spoonbills and White Ibises, detection of a negative trend will be difficult as a 100% decline has low power of detection. Instead for these species a negative trend might be better measured using the probability of multiple years with no nesting assuming a Poisson distribution. It should also be noted that if a trend is already occurring in the data set, that these change detectable estimates will be inflated.

Table 2. Preliminary estimates of percent change detectable in peak nest counts with $\alpha=5\%$ and power=80% based upon data collected from 2010–2014. A negative percent change indicates the amount of change detectable as a negative trend or decline and conversely a positive percent change is the change detectable as an increase. Detected peak months includes data from 2009–2013. If a trend is already occurring, then estimated percent change detectable results will be inflated.

Variable		DCCO	GBHE	GREG	GWHE	ROSP	WHIB
Peak Nesting Months (2009–2014)		Mar–Sep	Dec–Jun	Nov–Jul	Sep–Apr	Nov–Feb	Apr–Jul
Average Annual Peak Nest Count (2010–2014)		958.0	10.4	18.2	22.2	6.0	54.6
Std. Deviation (2010–2014)		225.9	2.7	3.8	4.2	3.7	24.6
Coefficient of Variation (2010–2014)		0.24	0.26	0.21	0.19	0.61	0.45
Maximum Peak Nest Count (2010–2014)		1294	13	23	29	12	92
Minimum Peak Nest Count (2010–2014)		746	6	14	18	3	28
Total % change detectable with $\alpha=5\%$ and power=80%	5 Years	-94%, +176 %	-99%, +196 %	-86%, +14 9%	-79%, +131 %	<-100%, +690 %	<-100%, +430 %
	10 Years	%, +92%	-67%, +101 %	-57%, +79 %	-52%, +70 %	<-100%, +310 %	<-100%, +201 %
	15 Years	-53%, +71%	-56%, +78%	-47%, +61 %	-43%, +54 %	<-100%, +230 %	-86%, +151 %
	20 Years	-46%, +60%	-50%, +65%	-41%, +52%	-38%, +46%	-96%, +184%	-77%, +125%

Table 3. Preliminary estimates of percent change detectable in the annual nesting index with $\alpha=5\%$ and power=80% based upon data collected from 2010–2014. The nesting index is defined as the annual sum of monthly nest counts. Missing months are interpolated. The same nests may be counted in more than one month so the nesting index does not equal total number of independent nesting starts. A negative percent change indicates the amount change detectable as a negative trend or decline and conversely a positive percent change is the change detectable as an increase. If a trend is already occurring, then estimated percent change detectable results will be inflated.

Variable		DCCO	GBHE	GREG	GWHE	ROSP	WHIB
Months Any Nesting Detected (2009–2013)		All	Oct–Jun	All except Oct	All except Aug	Oct–Apr	Apr–Aug
Average Annual Nesting Index (2010–2014)		5421.1	25.0	53.1	83.5	12.4	96.0
Std. Deviation (2010–2014)		756.3	7.8	16.4	12.7	5.3	44.8
Coefficient of Variation (2010–2014)		0.14	0.31	0.31	0.15	0.43	0.47
Maximum Nesting Index (2010–2014)		6320	32	81	104	21	150
Minimum Nesting Index (2010–2014)		4309	13	40	71	7	40
Total % change detectable with $\alpha=5\%$ and power=80%	5 Years	-63%, +91%	<-100%, +249%	<-100%, +249%	-66%, +98%	<-100%, +400%	<-100%, +460%
	10 Years	-40%, +50%	-77%, +125%	-77%, +125%	-43%, +54%	-98%, +189%	<-100%, +213%
	15 Years	-33%, +39%	-65%, +95%	-65%, +95%	-35%, +42%	-83%, +142%	-89%, +159%
	20 Years	-29%, +33%	-57%, +80%	-57%, +80%	-30%, +36%	-75%, +118%	-80%, +132%

Observer Bias

SFCN examined differences in nest detection by five different observers (Table 4). Sixty-seven photographs were used from three colonies. While there were some differences among observers, generally this represented about 2–4% of the variation. As such, observer bias is not included in calculations of the number of nests. Instead every effort is made to train new observers until their nest identification is not statistically different from the trained observers using standardized photograph sets. An example is observer 5 who was trained and then her results were compared with the other observers. Her nest counts are in the middle of the range of the Observers 1–4. None of the five observers was statistically different from the others in an ANOVA test where observer and photograph number were used as factors, thus there was not a consistent bias detectable among the observers.

Table 4. Total Active Nests detected by five different observers.

Colony	Observer 1	Observer 2	Observer 3	Observer 4	Observer 5	Average	Std. Dev.	CV
Arsenicker	169	155	163	169	161	163.4	5.9	3.6%
Jones Lagoon	57	57	58	57	55	56.8	1.1	1.9%
West Arsenicker	150	144	144	149	147	146.7	2.7	1.8%
Grand Total	376	356	365	375	363	366.9	8.3	2.3%

Field Methods

The field methods section is intended to ensure consistent methodology and repeatability in light of changing personnel (Beard et al. 1999). Aspects of field methodology that must be repeated consistently are written in the form of Standard Operating Procedures (SOPs). SOPs provide detailed instructions intended to ensure uniformity and consistency in the performance of a given procedure within the protocol. This section describes general methods for gathering data. For more information please refer to the SOPs in this document.

Field Season Preparations and Equipment Setup

The Colonial Bird Monitoring in Biscayne National Park has a year-round operational season, hence no additional preparation or equipment is necessary (See SOPs). Monitoring flights are scheduled approximately one week in advance of the flight with the goal of flying in the middle of the month. All participants are responsible for complying with flying authorization requirements.

Field equipment includes a Nikon D300s SLR camera with a Nikon AF-S 70–300mm f/4.5–5.6 VR zoom lens, Garmin 60CSx GPS unit, personal protective equipment (SOP B), and field data sheets. SFCN will be responsible for verifying that participants conform to requirements and are equipped with all necessary gear.

Sequence of Events During Field Season

SFCN personnel perform an aerial reconnaissance of the park at the beginning of each calendar year. If any new nesting colonies are observed during the reconnaissance flights they will be added to the routine monthly monitoring flights. The SFCN then determines which sites within Biscayne National Park will be sampled through the year based on the bi-annual reconnaissance flights and the historical nesting locations. Once a new location is found to have active bird nests, it will be included in the monthly monitoring process. Monthly sampling schedules may vary due to weather, helicopter availability, and budgetary concerns. Flights are usually scheduled in the middle of the month (in the second or third week) allowing time to reschedule the flight in the same month if there is a delay. Timing is important because we try to space the monitoring flights approximately one month apart.

A single monitoring event, from planning to data storage may take approximately two weeks (Table 5).

Pre-flight Preparations

Certain preparations must be made prior to the actual flight (SOP B). The helicopter must be reserved with the contractor. Notifications with the flight date, helicopter tail number, and pilot information are sent to Florida Power & Light (local power utility), Everglades flight following (park service flight monitoring), and Biscayne National Park management.

Specific gear is required to perform the monitoring flights. Much of the gear is required to be worn for flight safety. The personal protective equipment (PPE) includes; leather boots, Nomex flight gloves, flight suit, personal flotation devices, and helmet. The PPE is designed to protect the user

Table 5. Sampling timeline for a single monitoring event.

Personnel	Timetable	Task
Team leader	One week prior to flight	• Consult with team members for their availability • Contact helicopter contractor for helicopter/ pilot availability
Team leader	Friday prior to flight	• Submit ENP 9400 to EVER aircraft dispatcher • Submit ENP 9400 & mission requirements to helicopter contractor • Notify Biscayne National Park management and FPL of flight details by email • Check expected weather conditions for flight date
Team leader/ team member	One day prior to flight	• Organize required personal protective equipment, camera, GPS, data sheets, & personal locator beacon • Verify operation with helicopter contractor • Fill out SFCN office safety sheet • Check expected weather conditions for flight date
Team leader/ team member	Day of flight	• Monitor weather conditions • Post SFCN office safety sheet • Follow all required safety protocols pre/during/post flight • Ensure pilot & helicopter are certified for mission • Review mission with pilot and flight services personnel
Team leader/ team member	Day of flight (upon returning to office)	• Store & secure gear • Send completed flight paperwork to EVER Aviation Manager • Download camera & GPS • Burn CD of photos & GPS tracklines • Rename & place photographs on Z drive
Team leader/ team member	Post flight	• Analyze & process photographs • Enter observed & photographic data into Access data base • Scan & store data sheets

from flames and impacts in case of a crash. For a complete list of safety gear see SOP B. A handheld park radio and personal locator beacon are part of the safety geared carried on each mission.

A Nikon camera and GPS are used to collect data. For more detailed information see SOP B and SOP C. The data sheets are carried in a notebook along with a pen and the SFCN Helicopter Go/No-Go Checklist (Appendix 7). We also carry a map of the park as an aid for a pre-flight briefing with the pilot.

Helicopter Crew Roles and Data Collection

A helicopter crew consists of three people for each flight: the pilot, an observer seated next to the pilot, and a photographer seated in the rear on the port side. The pilot is responsible for safely flying to nesting colonies and maneuvering into position for photographs to be taken. The observer assists the pilot in navigating by using a track plotting GPS loaded with a pre-determined flight path. The observer also scans the horizon for other aircraft and birds, searches the target islands for nesting bird colonies, and records observations on field data sheets (SOP B). The photographer sits behind the observer and visually scans the islands and the sky. Using a Nikon camera equipped with a vibration-reducing zoom lens, the photographer attempts to capture the entire nesting areas of the islands (SOP C). It is imperative to systematically photograph as many nests as possible, since digital photographs

provide the data used to determine the quantity of occupied and non-occupied active nests. A single flight lasts approximately one hour and fifteen minutes, but may vary slightly because of weather conditions, new colonies observed, or other unforeseen circumstances.

Data Handling, Analysis and Reporting

The colonial bird monitoring vital sign creates several types of data at different points in the monitoring process. The survey flights generate field data sheets and a large number of digital photographs. In the office these photographs are analyzed and processed using photo processing data sheets. Ultimately all of these data are entered and linked together in a Microsoft Access geodatabase. The outline below summarizes the process:

- 1) Survey activities (Previous section)
 - a) Complete pre-flight data sheet
 - b) Fill out field data sheet
 - c) Photograph nesting bird colonies
- 2) Post-Flight Survey Activities
 - a) Download photographs
 - b) Burn DVD with photographs and GPS tracklines
 - c) Geotag photographs (optional)
 - d) Rename photographs
 - e) Tag photographs in ThumbsPlus
- 3) Photograph Processing
 - a) Circle nests in the photographs as described in SOP E
 - b) Print the analyzed photographs
 - c) Total the nest counts on each photo sheet
 - d) Compare photographs sequentially so you do not count the same nest more than once
 - e) Fill out photo data sheet
- 4) Data entry, QA/QC, and Reports
 - a) Enter field and photo data sheets into database
 - b) 100% verification of all database entries
 - c) 10% random check of database entries
 - d) Run reports
 - e) Scan and archive field / photo processing data sheets

Table 6 provides a guide to all file locations and naming conventions.

Post Flight Survey Activities

Several steps occur as soon after the flight as possible to reduce errors. Each survey generates a large number of digital photographs. These photographs should be downloaded, geotagged (optional), and renamed immediately upon return from the field (SOP D). These photographs should also be tagged in ThumbsPlus with the “FlightDate” and “SiteName” user fields (SOP D). These user fields allow the photographs to be linked to information in the database, and they also allow the photographs to be displayed in the database.

Photograph Processing

Data from one flight requires a minimum of one week processing time, during which data from the five or six colonies can usually be processed and analyzed. Photos are processed before the next flight in case anything unusual needs to be verified or investigated on subsequent flights. Processing of photographs at each site consists of circling and counting all visible nests by a trained technician.

Table 6. Critical field and data management file locations. Note: Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\ is replaced by "...\".

File type	Folder	Filename
Flight and safety documents	Z:\Helicopter\Colonial_birds\Forms\ Z:\Helicopter\Colonial_birds\Post_flight_forms\ Also in: Z:\SAFETY\SFCN Safety Program\Section 3A - SFCN Standard Operating Procedures - SOP's\Colonial_Birds\	20140319_HMC_Bird_Aircraft_Daily_Diary_HCM-1_Use.xls SFCN_Helicopter_Go_No_Go_Checklist_Mod_USE.docx GAR_Risk_Assessment_Model_Birds_USE.doc Flight_Request_Form_9400_blank_use_this.pdf Aviation_Risk_Assessment.docx HAZARDOUS_MATERIALS_MANIFEST.docx
Blank data sheet	...\data\BISC\Data_sheets\	20130213_data_sheet_BISC.xlsx
Photos	...\images\BISC\YYYY\ YYYYMMDD _BISC_BirdFlight\ YYYYMMDD _ISLANDCODE\	YYYYMMDD_BISC_BirdFlight_ISLANDCODE_Photonumber.jpg
Geotag file	...\spatial_info\BISC\YYYY\gpx\	GPSUnitName_YYYYMMDD.gpx (e.g., GPSUnitName=Garmin60Unit3)
Flight tracklines	...\spatial_info\BISC\YYYY\	GPSUnitName_YYYYMMDD_tracklines.shp
Scanned field sheets	...\data\BISC\Scanned_data_sheets\YYYYMMDD_BISC_DataSheets\	Flight_Info_Sheet ISLANDCODE_OBS ISLANDCODE_PHO OBS = Observed, PHO = Photographed
Database	...\data\	SFCN_ColonialBirds.mdb
Exports	...\data\BISC\Exports\	YYYYMMDD_ColonialBirds.csv
Graphing Template	...\data\BISC\Graphs\	Colonial_Birds_Graphing_Template.xlsx
Data Summary Reports	...\documents\summaries_reports\SFCN_data_summaries\YYYY_BISC_ColBirds_Summary_Report\	YYYYMMDD_YYYY_BISC_ColonialBirds_Summary_Report.docx (YYYYMMDD=draft date) YYYY_BISC_ColonialBirds_Summary_Report..pdf
Backup Templates	...\documents\protocol\backup_templates\	Backup of graphing template
Protocol	...\documents\protocol\	YYYYMMDD_BISC_ColonialBirds_v1.docx, *.pdf
Archive	Z:\SFCN_Archive\Vital_Signs\Colonial_Nesting_Birds\BISC\	Database, reports, analysis code

The nests are categorized by type, i.e., active nests may contain eggs, juveniles, adult birds, or are non-occupied but appear maintained. Overlapping photos are evaluated to ensure the same nests are not counted twice. Nest counts are recorded on photo processing data sheets (one per colony) which are then used for data entry.

Additional details on nest circling are provided in SOP E. Once a photo processing sheet has been filled out for each site, it should be scanned along with the field data sheet and a copy placed in the following folder for archiving:

Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\BISC\Scanned_data_sheets

Database

The colonial bird database (Figure 16) is located in:

Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\SFCN_ColonialBirds.mdb

Database Summary:	
Number of Surveys: 57	
Latest Survey: 5/20/2014	
 Double-crested Cormorant Observed nesting on 55 surveys High nest count: 1048 (Apr 2014)	 Roseate Spoonbill Observed nesting on 26 surveys High nest count: 12 (Jan 2011)
 Great Blue Heron Observed nesting on 45 surveys High nest count: 11 (Mar 2014)	 Reddish Egret Observed nesting on 10 surveys High nest count: 1 (Apr 2012)
 Great White Heron Observed nesting on 49 surveys High nest count: 25 (Jan 2011)	 White Ibis Observed nesting on 25 surveys High nest count: 92 (Apr 2010)
 Tricolored Heron Observed nesting on 22 surveys High nest count: 3 (Apr 2010)	 Osprey Observed nesting on 8 surveys High nest count: 2 (Mar 2010)
 Great Egret Observed nesting on 38 surveys High nest count: 21 (Mar 2010)	 Bald Eagle Observed nesting on 21 surveys High nest count: 2 (Feb 2009)

Figure 16. Startup form for the SFCN Colonial Bird Monitoring Database.

circled photographs (e.g., if 260 photos are used in the circling process, 13 photos will be reviewed). These photographs will be chosen at random by the person performing the verification.

To verify the accuracy of data entry, the data from the photo processing data sheet compiled from the bird survey photographs, is entered into the Microsoft Access database and printed out. All the printed data is then checked against the photo processing data sheets. When data verification has been completed for each site, the “Checked?” box on the data entry form in the database is then checked indicating the verification process is complete. The name of the person who did the verification is then selected from the drop-down menu that appears. This provides an easy way to track the progress of data verification.

Once all photographed data has been processed and entered, the SFCN data management plan (Witcher 2008) requires 100% verification of the data entry. This is completed by first printing out a report of the data and manually comparing the printout to the original datasheets. Any discrepancies are marked in red so the project leader can review and correct them in the database. The project leader initials and dates the printouts when the corrections have been entered.

Additionally, the SFCN data management plan requires a 10% check of the verified data as an additional safeguard against data errors. This 10% check starts by running a query that randomly selects 10% of the flight date/colony pairs between two given dates. Each chosen flight date and colony is viewed within the database and the data is checked against the original datasheets. If any errors are found, that particular flight must go through 100% verification again.

Observed data is entered into the data base and verified for accuracy of entry. The entered observed data is compared to the field data sheet directly. The nature of the observed data is better suited to show presence of species versus quantitative results, therefore we do not use the observed data for statistical analysis.

The database is designed with lookup lists for species, islands names, and observer names to reduce data transcription errors.

Data Reporting and Analysis

After data entry and verification is complete, the database can run several reports to summarize the data. Three basic types of reporting occur from this protocol:

- Basic quick look reports can be produced directly from the database
 - Nesting reports: Number of nests counted by species and month during a specific year and location.
 - Observation reports: Number of field observed birds by species and month during a specific year and location.
 - Species report: Number of nests counted for a specific species during a specific year.
 - Percentage empty nests report: This calculates the % empty nests by species, location, year and month.
- Graphing template: The database exports all the routine and annual census photo and field observation data into a Microsoft Excel document which contains pre-set graphs and tables

that automatically update upon opening. The same export for the graphing template is saved as a *.csv file for archiving and for responding to data requests.

- Data Summary Report: An annual report published in the National Data Report Series containing basic graphs and tables summarizing the results through the current year.

Below are some of the fundamental metrics produced from this monitoring protocol:

- List of species detected nesting or visually observed as adults in field
- # colonies by species
- # colonial nesting species detected nesting at each colony (species richness)
- Peak nesting by focal species and colony
- Peak nesting by focal species summed across all colonies
- Annual nesting index by focal species summed across all colonies (annual sum of monthly active nests counted)
- Months nesting occurs and proportion of nesting by focal species
- Printout of total active nests and field observed birds by month and colony for all species

These metrics are to be reported in an annual data summary report produced after the conclusion of each calendar year and will be published in the NPS Natural Resource Data Summary Series with anticipated submission in February or March of the following year. The timing of this report coincides with the regional multi-agency South Florida Wading Bird Report (Cook 2013) and SFCN expects to submit results from this protocol to that report as well.

Reporting is focused on the five focal species and one subspecies: Double-crested Cormorant, Great Blue Heron, Great White Heron (subspecies), Great Egret, Roseate Spoonbill, and White Ibis. In 2013, these represented 98% of the visible nests recorded in the park with cormorants alone representing 92%. Graphing of these species is organized into the three types of feeding behavior: diver, stalk and strike, and tactile. Double-crested Cormorants are divers, and the most abundant bird in Biscayne National Park. Data collection has already shown that different nesting seasonality is evident for the various species, including species with similar feeding methods, e.g., Roseate Spoonbills and White Ibises are both tactile feeders, yet each nests during different seasons.

The data summary report format will be cumulative, allowing each year of data to be added to the existing tables and graphs. The automated graphing template is designed to allow easy update of tables and graphs to reduce the time to create annual reports. Details for compiling the report using the graphing template are provided in SOP F and an example data summary report is included in Appendix 4. Additional summary tables and/or information can be added to the summary data report as needed. Data are summarized park-wide and by colony. Figures 18–20 provide examples from data collected. For more complete results, see Appendix 4.

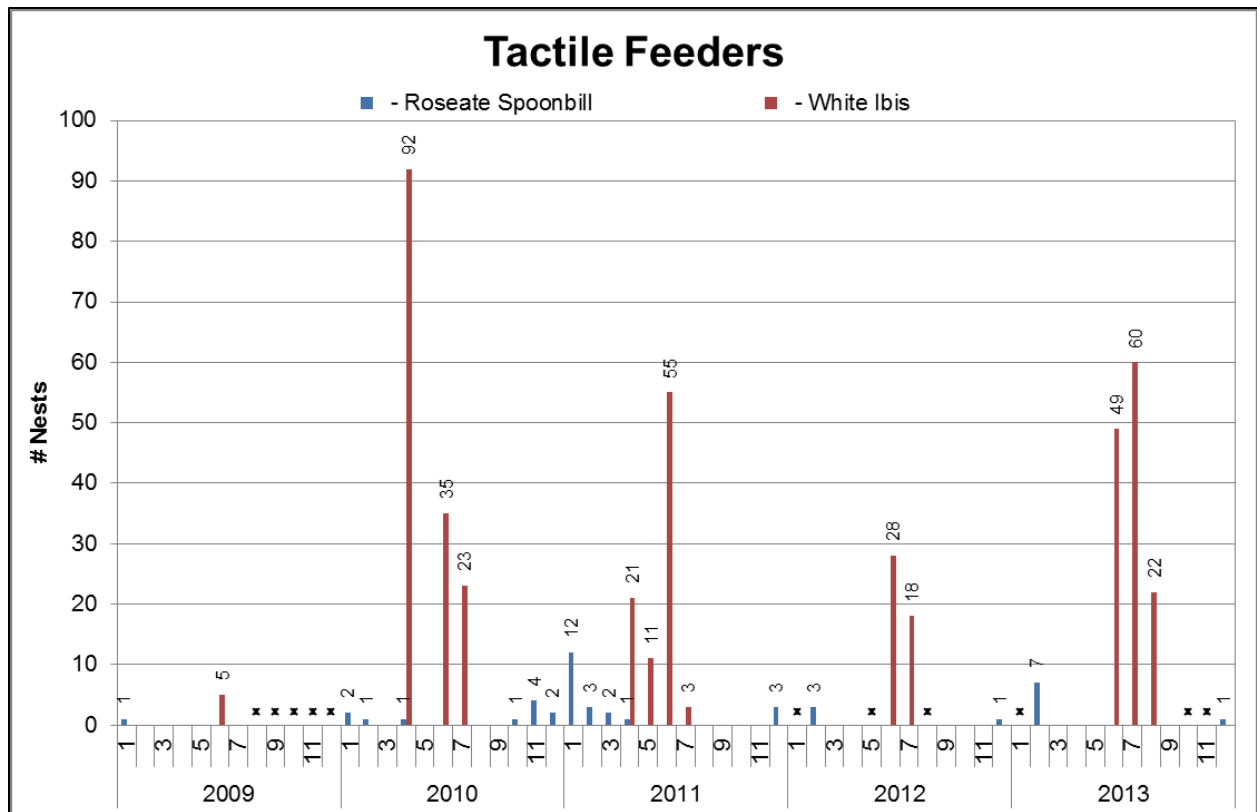


Figure 18. The number of nests and peak nesting periods by month for selected for two tactile feeder species: Roseate Spoonbills and White Ibis. This graph shows Roseate Spoonbills nest in the dry season and White Ibis nest in the wet season. * = Months not sampled.

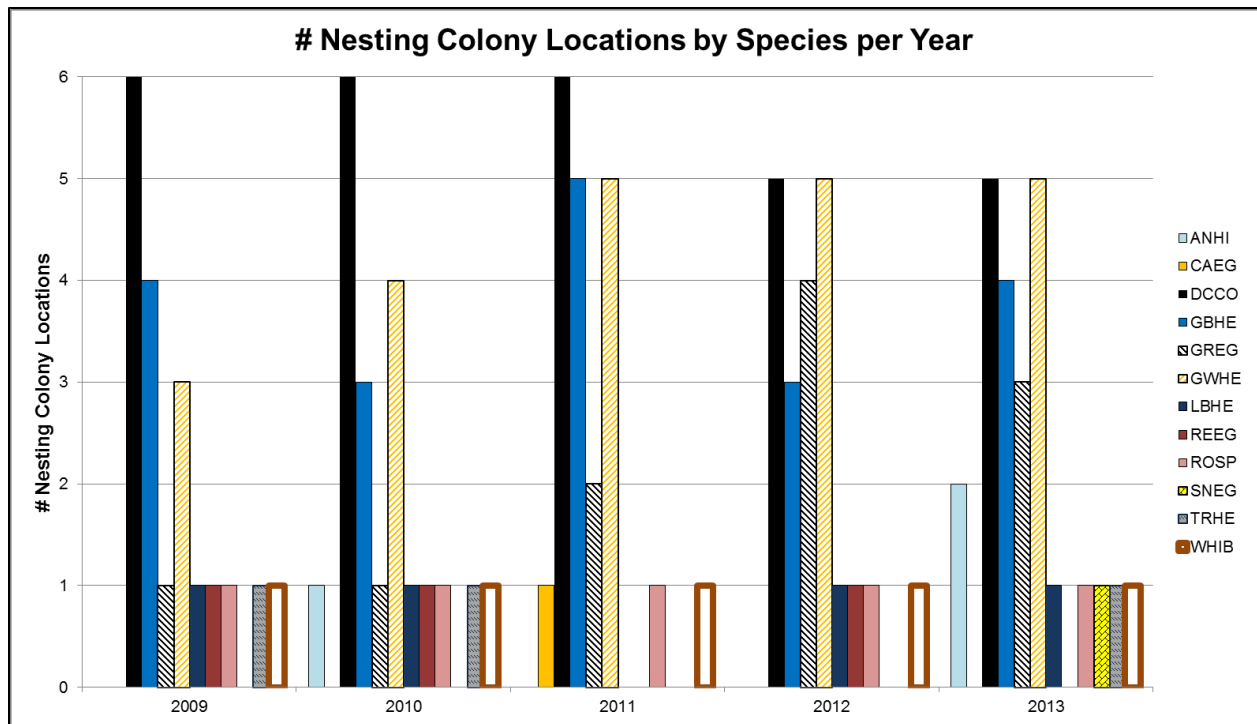


Figure 19. Sample graph showing number of nesting colony locations by species per year. Includes all egrets, ibis, and herons.

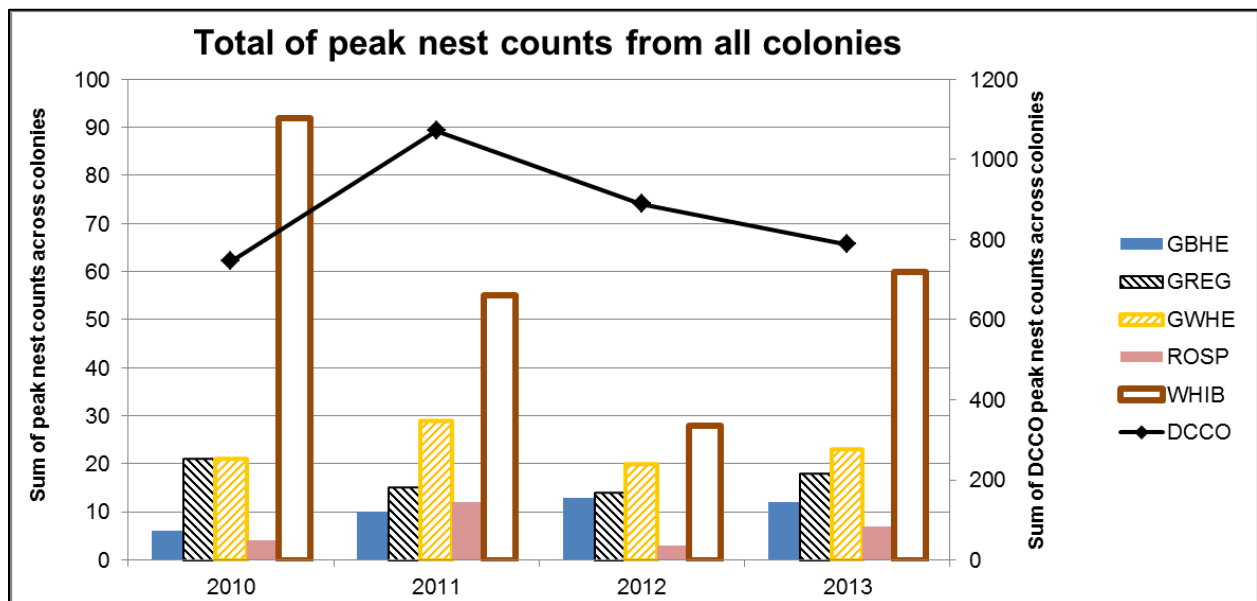


Figure 20. Sample graph showing how the peak number of nests detected per colony vary through time. Peak nest counts by colony were summed to create a total of peak nest counts across all colonies for the six focal species.

Presently there is not enough data to determine the natural range of variability that should be expected within BISC in numbers of colonies, locations of colonies, peak nests, peak nesting periods, and the annual nesting index. These are expected to vary with annual rainfall, amount and timing of freshwater flows into the bay, and how they in turn affect food availability within and outside the park. Separating natural background variability from actual trends will be difficult at first and will be approached cautiously and with common sense. In general the first years of data collection will be used to establish a cautious baseline for comparison as more data is collected (Table 7).

The number of colonies will be reported and graphed by species. Any change in the number of colonies for top-canopy nesters is considered a difference as the monitoring completes a census for the park. The number of colonies of White Ibis is similarly considered a census as it is a highly-visible bird even in the sub-canopy, and typically nests in large groups. The simplest approach at this time is to note whether a current year's number of colonies is outside the range seen from years 2010–2013 and whether new colonies have developed or colonies have been abandoned as the locations of colonies has been fairly stable through the development phase of this protocol. For other sub-canopy nesters this protocol is still experimental and generally their numbers are only adding to the number of species detected nesting by colony.

For focal species, trends in peak nest counts are determined by colony and then across all colonies to provide a park-wide estimate. Similar to the colony count, peak nest numbers can be compared to the range detected in 2010–2013. In addition, once five or more complete years of data have been gathered, a regression analysis may be used to evaluate trends (SOP F). For species with small whole numbers (i.e., all species except cormorants) which may violate the assumption of normally

Table 7. Initial baseline ranges from 2010–2013 of number of colonies, peak nest counts, and annual nesting index for focal species. The nesting index is the annual sum of monthly active nest counts. New data outside this range may be noted as worth watching as a trend may be developing.

	Species=	DCCO	GBHE	GREG	GWHE	ROSP	WHIB
Colonies	Colony locations where nested at least once	All	All except Mangrove Key	All except Mangrove Key	All except Mangrove Key	Jones Lagoon	Arsenicker, West Arsenicker
	Maximum # Colonies	6	5	4	5	1	1
	Minimum # Colonies	5	3	1	4	1	1
Peak Nest Counts	Maximum Peak Nest Count	1072	13	21	29	12	92
	Minimum Peak Nest Count	746	6	14	20	3	28
	Average Annual Peak Nest Count	874	10.3	17	23.3	6.5	58.8
	Std. Deviation	145	3.1	3.2	4.0	4.0	26.2
	Peak Nesting Months	Mar–Sep	Dec–Jun	Nov–Jul	Sep–Apr	Nov–Feb	Apr–Jul
Nesting Index	Maximum Nesting Index	5880	32	81	104	21	150
	Minimum Nesting Index	4309	13	40	76	7	69
	Average Nesting Index	5196	25	56	87	13	110
	Std. Deviation	653	9	18	12	6	37
	Months Any Nesting Detected	All	Oct–Jun	All except Oct	All except Aug	Oct–Apr	Apr–Aug

distributed data, a Poisson regression analysis may be used. Different statistical thresholds may be used to indicate a “caution/change possible/warning” threshold (e.g., $\alpha=10\%$) versus a “change likely occurring” threshold (e.g., $\alpha=5\%$) but SFCN will be looking at the data in total against the backdrop of climatic and regional changes. The network will interpret results cautiously during the early years of this program rather than using absolute thresholds.

A similar analysis will be conducted of the annual nesting index. The nesting index is calculated as the sum of monthly active nest counts. If a month is missing (e.g., helicopter is unavailable because firefighting takes priority), then the nest count for the missing month will be interpolated by taking the average nest count from the month before and the month after the missing month. In general peak nest counts and the annual nesting index should bracket the preferred metric of number of nest starts.

This annual report will be presented to Biscayne National Park Managers for their consideration. Together, these patterns and trends provide indicators of conditions in the park that support nesting behavior and can be used as part of a comprehensive approach to resource decisions within the park. The report and data will also be available on the SFCN website and irma.nps.gov.

Additional Analyses

After implementation of five or more complete years of data collection, a regression analysis will be run. If no trend is detected, the maximum and minimum of the data can be updated to include 2014 as initial “Control Limits”. As more data is collected the range can be replaced with 90% and 95% calculated “Control Limits” (Montgomery 2001) which provide a quick way of evaluating whether a current year of data is outside what is expected given the initial baseline data. This process can be repeated as time moves forward (see SOP F for details). A switch to non-parametric regression may be considered once at least 10 years of data are accumulated as this approach involves even fewer assumptions. Before / after analyses using *t*-tests or Poisson confidence limits may be considered if events cause a sharp decline in numbers.

The Double-crested Cormorant is a year-round nester with what appears to be multiple peak nesting events. Incorporating this behavior into a better estimate of total peak nesting is worth investigating as more data is acquired.

Further research into historical studies and datasets is needed. Our surveys show the Double-crested Cormorant (DCCO) as the dominant nesting species in BISC for which there are few comparable studies. Some earlier surveys from 1980 to 1986 actually suggested a strong DCCO winter nesting period from October to March and reduced nesting in spring and summer from April to September (Cummings 1987, cited in Brugger 1995) which varies from our data that shows increased nesting in the summer months, but further monitoring will be needed to determine whether the current nesting patterns represent a change or whether this is part of the background variability. Research into this data set and other regional datasets for the other focal species are a task for the near future and tentatively may be useful for putting the status of current populations in BISC into a historical and regional context.

The effectiveness of the sampling design may be revisited in the future, e.g., evaluating the frequency and timing of the monthly sampling; whether some months can be dropped from sampling to reduce costs; development of additional metrics or indices; and/or development of methods to augment surveying of deep sub-canopy nesters such as with complimentary boat surveys.

After perhaps ten or more years, linkages to freshwater flows, rainfall and other factors may be tested to better refine the expected baseline and interpretation in “wet” and “dry” years.

Data Sensitivity

Currently, data collected from these monitoring efforts are not considered sensitive therefore no special accommodations are required to limit access. If data gathered in the future is considered sensitive, appropriate measures will be enacted to secure the data.

Metadata and Archiving

SFCN will archive the database together with associated metadata, summary report, and protocol version each year in Z:\SFCN_Archive\Vital_Signs\Colonial_Nesting_Birds\BISC, and then upload copies of the same to <http://irma.nps.gov>. The 100% QA/ QC process for data entry should be completed monthly as the monitoring is completed. The additional 10% check should be completed annually in January. The target date for archiving all SFCN data associated with a survey year will be by the end of the following February. Metadata requirements are further discussed in section 8.3 of the SFCN data management plan (Witcher 2008).

Personnel Requirements and Training

Roles and Responsibilities

Two people are required to fulfill the field monitoring portion of this project. Additional support comes from the data management team and other personnel by assisting with the processing and analyzing of photographs. The Community Ecologist or Biological Technician is responsible for scheduling flights and completing the necessary paperwork for each flight, but these tasks can be shared with other staff members when needed. Training of new personnel involved in the vital sign and maintenance of physical records are responsibilities of the project coordinator. The participants for Biscayne National Park colonial bird monitoring are SFCN personnel. The SFCN has cross-trained personnel making it possible for a variety of people to fulfill the mission. At least one of the two SFCN crew members on any given mission will have previously been on several bird monitoring flights and will be able to provide guidance. One person sits in the front of the helicopter assisting the pilot, while the other takes photographs from the back seat. It is the responsibility of the crew to download data promptly upon their return. Analysis of photographs is performed by technician(s), usually including a member of the flight crew.

The Community Ecologist or Biological Technician is responsible for completing the data summary report. The SFCN Data Manager in cooperation with the Biological Technician oversees the database design, building in adequate quality control procedures into the database, maintaining data security and archiving. The Quantitative Ecologist is responsible for assisting with analyses, updating the graphing template and/or converting the same to R code, and with editing of the data summary report to ensure it meets NPS Natural Resource Publications Management guidelines. The Data Management / Outreach Technician is responsible for updating the colonial nesting birds resource brief, IRMA.gov, and the SFCN web site.

The Community Ecologist's duties include but are not limited to; ensuring all safety protocols are followed, assisting in data collection when needed, helping to determine data to be published, and supervising and providing guidance for the project coordinator.

Qualifications and Training

SOPs A and B discusses the training needed for this protocol in greater detail. Personnel should thoroughly review this protocol, associated Safety SOPs, and associated Job Hazard Analyses (JHA's) before implementing procedures. All DOI personnel participating in helicopter flights for this monitoring project are required to complete the following helicopter training courses every three years; A-107, Aviation Policy and Regulations I (online), A-100, Basic Aviation Safety, S-271, Interagency Helicopter Crewmember, A-110, Aviation Transport of Hazardous Material (if applicable and online), A-200, Aviation Mishap Review, and A-312, Water Ditching and Survival.

Personnel must acquire the ability to complete flight data sheets and take photographs from a helicopter. The project leader and the SFCN Community Ecologist will determine when new personnel have acquired proficient abilities to participate on flight missions.

When bringing a new technician into the project, it is necessary to perform approximately one to two weeks of on-the-job training using this protocol as an aid. Much of the training for photo analysis and data downloading occurs on-the-job, but familiarity with Biscayne Bay and local bird species are beneficial. Identifying characteristics of various bird species and knowing their nesting times will aid in identifying one species versus another. Using available resources such as *Smithsonian Field Guide to the Birds of North America* (Floyd 2008) and *Common Coastal Birds of Florida & the Caribbean* (Nellis 2001) are invaluable. These books aid in identifying adult birds, their eggs, and juveniles as well as providing descriptions of their nesting habits. The SOPs included in this protocol address the training requirements to complete required tasks.

We have specific photos that are used for training new personnel in the analysis portion of gathering data from photos. Using training photographs allows us to check for consistency between personnel analyzing photographs. Inter-observer variability is evaluated to determine if there is significant difference between photo processors. Any difference in photo analysis results will be reviewed by the project leader and the SFCN Community Ecologist to determine when new personnel have acquired proficient abilities to analyze photos.

Operational Requirements

Annual Workload and Field Schedule

This protocol is implemented once a month throughout the year. Pre-flight requirements include scheduling the flight trip, notifying flight following and appropriate facilities of the flight plan, packing gear, and donning flight gear. The actual flight lasts approximately 1.20 hours and is performed by two people plus the pilot. Post-flight duties include, removing gear from the helicopter, completing paperwork, and stowing gear for the return drive to the SFCN office. Upon returning to the office, the tasks of sending post-flight paperwork, downloading pictures and GPS flight tracks onto a computer, burning a hard copy of the photos and flight tracks onto a DVD-R are completed. The majority of time spent for a monitoring event is spent analyzing and processing the photographs. The processing of photos includes; nest circling, printing, counting, and entering the data. These tasks take approximately 42 hours to complete. Flight conditions may affect the number of photographs and possibly affect photo analysis times (Table 8).

Additional time is required during the year for writing the colonial nesting birds portion of the SFCN Annual Report and to submit paperwork for flight contract management. These tasks may take approximately 16 hours. Table 7 provides an approximate annual schedule to complement Table 6 which provides a schedule for each flight.

The initial Colonial Nesting Bird database took approximately 120 hours to construct. The outreach program consisting of the resource brief and annual report required approximately 60 hours to complete. The data management team spends an additional 10–20 hours throughout the year in report writing and database modifications.

Table 8. Project time estimates per monthly monitoring event.

Personnel	Tasks	Approximate time per person	Approximate crew time
Team leader (1person)	Phone calls, flight related paperwork & notification emails	2.0 hours	2.0 hours
Team leader, team member (2 people)	Prep, pack & load gear	1.0 hour	2.0 hours
Team leader, team member (2 people)	Drive to airport	0.75 hour	1.50 hours
Team leader, team member (2 people)	Pre-flight safety briefing, check certifications for pilot & helicopter don flight gear	0.75 hour	1.50 hours
Team leader, team member (2 people)	Store/ secure gear & flight time	1.5 hours	3.0 hours
Team leader, team member (2 people)	Post flight – remove flight gear & complete paperwork	0.50 hours	1.0 hour
Team leader, team member (2 people)	Return drive to office	0.75 hour	1.50 hours
Team leader (1 person)	Complete and send post-flight paperwork	1.0 hour	1.0 hour
Team leader (1 person)	Download camera, burn CD with camera & GPS data	1.0 hour	1.0 hour
Team leader (1 person)	Rename photos and place in folders	1.50 hours	1.50 hours
Team leader, team member (2 people)	Analyze, process & enter data	21.0 hours	42.0 hours
Total time			58.0 hours

Table 9. Annual schedule.

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Annual park-wide survey (w/ colony survey)					Annual park-wide survey (w/ colony survey)					
Colony survey each month followed by data entry & 100% check by end of following month.											
All 100% check & 10% check complete; data archiving (previous year)	Annual Data Summary Report (previous year)	Update Resource Brief (previous year)									

Facility and Equipment Needs

A facility with ample desk space for reviewing photographs is essential, along with a computer capable of running all necessary software. Software used include Adobe Bridge CS3 (or CS4), Adobe Photoshop, ThumbsPlus 7, DNR Garmin, GPS-Photo Link, and GeoSetter as a backup.

For each flight, a helicopter is contracted from a local airport close to both our home office and the islands to be flown over. Appropriate flight gear (helmet, leather boots, flight suit, and gloves), camera, GPS, notebook, and data sheets are required for each flight (SOP B and SOP C).

A SFCN vehicle (for the drive to and from the airport) will be reserved on the calendar in advance of the flight date. We have used two local airports to fly out of for completing our missions. The airports are Miami Executive Airport and Homestead General Aviation Airport. Directions to the airports from the SFCN office can be found in Appendix 8.

Startup Costs and Budget Considerations

Startup costs consist of the equipment mentioned in the SOPs includes a handheld VHF radio, GPS, and flight gear. This equipment costs approximately \$5,243 (Table 8). The B-3, S-271, and A-312 flight training courses are currently provided for no charge but travel expenses may need to be added depending where the training takes place. The ongoing cost of the helicopter runs approximately \$1,290 per trip or \$15,480 annually (Table 11), and the salary of the flight crew should be factored in as well. Budget constraints may limit the quantity of trips. The combination of data processing, data management, and reporting equals approximately 40% of the budget.

Table 10. One-time costs for bird monitoring helicopter flights. (*) indicates used per person. *Note: These costs are approximate based upon 2013 estimates. Costs of vehicles, computers, software, etc. are not included.*

Equipment	Cost
* Leather Boots	\$ 100
* Nomex Flight Gloves	\$ 24
* Flight Suit	\$ 142
* Helmet	\$ 726
* Helmet Bag	\$ 16
Garmin GPS 62s HandheldCSx	\$ 350
Nikon D 300s camera with vibration-reducing lens	\$ 1,560
BK DPHX5102X Radio	\$ 2,035
ACR ResQLink Personal Locator Beacon	\$ 290
Total charges	\$ 5,243

Table 11. Monthly and yearly cost estimates for bird monitoring helicopter flights. *Note: These costs are approximate based upon 2013 salary estimates and helicopter costs.*

Expense	Expense per Monitoring Flight	Annual cost @ 12 flights per year
Flight Prep	\$ 41	\$ 492
Approximate salaries actual flight	\$ 250	\$ 3,000
Approximate helicopter cost	\$ 1,290	\$ 15,480
Approximate salaries for post-flight data processing and analysis	\$ 912	\$ 10,944
Report writing and analysis		\$ 1,000
Additional data management support		\$ 750
Totals		\$ 31,666

Safety

Flying in helicopters requires considerable safety training and then mission specific caution and care. All personnel are responsible for following the safety rules, regulations, requirements, policies, and procedures of DOI as well as of the park they are working within. In general an attitude of a “culture of safety” and “operational leadership” should prevail in which problems are considered proactively and each person must feel empowered to think about potential problems and speak up early about safety concerns regardless of their position and those concerns must be addressed seriously and respectfully by the rest of the flight team and their supervisor(s).

All DOI personnel participating in helicopter flights for this monitoring project are required to complete the following helicopter training courses every three years:

- A-107, Aviation Policy and Regulations I (online)
- A-100, Basic Aviation Safety
- S-271, Helicopter Crewmember
- A-110, Aviation Transport of Hazardous Material (if applicable and online)
- A-200, Aviation Mishap Review
- A-312, Water Ditching and Survival

All personnel must read and follow:

- “SOP B – Safety Requirements and Procedures to Fly in a Helicopter for Colonial Bird Monitoring in Biscayne National Park”
- Appendix 5 - Special Use Aircraft and Safety Plan Everglades National Park: Colonial Nesting Bird and Vegetation Surveys Biscayne National Park”
- Appendix 6 - Job Hazard Analyses

SOP B is dedicated to the required safety precautions, paperwork, equipment, considerations for weather, setting up flight following with Everglades National Park dispatch, notification of Biscayne National Park and Florida Power and Light Turkey Point Nuclear Power Plant, and Homestead Air Reserve Base.

Appendix 7 contains the following documents and forms.

- SFCN_Float_Plan.doc
- Flight_Request_Form_9400_blank_use_this.pdf
- GAR_Risk_Assessment_Model_Birds_USE.doc
- SFCN_Helicopter_Go_No_Go_Checklist_Mod_USE.docx
- Aviation_Risk_Assessment.docx
- Hazardous_Materials_Manifest.docx
- 20140319_HMC_Bird_Aircraft_Daily_Diary_HCM-1_Use.xls

THESE FORMS MAY BE UPDATED AFTER PUBLICATION AND THUS SHOULD BE SEEN ONLY AS EXAMPLES TO HELP PERSONNEL LOCATE THE CORRECT FORMS. The most recent version of the forms are located in

- Z:\Helicopter\Colonial_birds\Forms\

With backups in:

- Z:\SAFETY\SFCN Safety Program\Section 3A - SFCN Standard Operating Procedures - SOP's\Colonial_Birds\

Procedures for Revising the Protocol

As time progresses and monitoring techniques evolve, revisions to the protocol narrative and SOPs may be required. It is important to document revisions so data collection and processing will be handled in a consistent manner (SOP G).

Considerations for revising the protocol narrative and SOPs include:

- 1) Staffing and/or budget adjustments do not allow for completion as previously directed.
- 2) New direction or goals are required.
- 3) Significant technological advances are made in software or equipment used.
- 4) There are new contributions from other parks or agencies which need to be considered.

A review of the changes by the participants and supervisors will help ensure they are beneficial and achievable. Modifications must be consistent with the long-term goals of the monitoring program. Any modification in methodology must be made accessible to participants and remain consistent with the goals of this protocol.

Literature Cited

- Ainley, D. G., C. S. Strong, T. M. Penniman, and R. J. Boekelheide. 1990. The feeding ecology of Farallon seabirds. Pages 51–127 in: D. G. Ainley, editor. Seabirds of the Farallon Islands: ecology, dynamics, and structure of an upwelling-system community by. Stanford University Press, Stanford, California.
- Beard, K. H., N. Hengartner, and D. K. Skelly. 1999. Effectiveness of predicting breeding bird distributions using probabilistic models. *Conservation Biology* 13(5):1108–1116.
- Bennetts, R. E., J. E. Gross, K. Cahill, C. McIntyre, B. B. Bingham, A. Hubbard, L. Cameron, and S. L. Carter. 2007. Linking monitoring to management and planning: Assessment points as a generalized approach. *George Wright Forum* 24(2):59–77.
- Browder, J. A., R. A. Alleman, S. Markley, P. Ortnier, and P.A. Pitts. 2005. Biscayne Bay conceptual ecological model. *Wetlands*. 25(4):854–869.
- Brugger, K. E. 1995. Double-crested Cormorants and Fisheries in Florida. *Colonial Waterbirds* 18 (1):110–117.
- Cook, M., N. Dorn, R. Shuford, and R. M. Kobza. 2010. Wildlife Ecology. 2010 South Florida Environmental Report. South Florida Water Management District, West Palm Beach, Florida.
- Cook, M., editor. 2013. South Florida Wading Bird Report. Volume 19. South Florida Water Management District, West Palm Beach, Florida. Available at: http://www.sfwmd.gov/portal/page/portal/xrepository/sfwmd_repository_pdf/wadingbirdreport_2013.pdf (accessed July 2015).
- Crozier, G.E., and D.E. Gawlik. 2003. Wading bird nesting effort as an index to wetland ecosystem integrity. *Waterbirds: The International Journal of Waterbird Biology* 26(3):303–324.
- Cummings, M. V. 1987. The Feeding Energetics of the Double-crested Cormorant in Biscayne Bay, Florida. Dissertation. University of Miami, Coral Gables, Florida.
- Custer, T. W., and C. Bunk, 1992. Feeding flights of breeding Double-crested Cormorants at two Wisconsin colonies. *Journal of Field Ornithology* 63:203–211.
- Danchin, E., and R. H. Wagner. 1997. The evolution of coloniality: the emergence of new perspectives. *Trends in Ecology and Evolution* 12(2):342–347.
- Dolbeer, R. A. 1991. Migration patterns of Double-crested Cormorants east of the Rocky Mountains (Patron migratorio de *Phalacrocorax auritus* al este de las Rocallosas). *Journal of Field Ornithology* 62(1):83–93.
- Duffy, D. C. 1995. Why is the Double-crested Cormorant a problem? Insights from cormorant ecology and human sociology. *Colonial Waterbirds* 1995:25–32.

- Erwin, R. M., G. M. Haramis, D. G. Krementz, and S. L. Funderburk. 1993. Resource protection for waterbirds in Chesapeake Bay. *Environmental Management* 17:613–619.
- Federal Register. 2014. Endangered and Threatened Wildlife and Plants; Reclassification of the U.S. Breeding Population of the Wood Stork from Endangered to Threatened; Final Rule, Federal Register 79(125):37078–37103. 30 June 2014. Available at: <http://www.gpo.gov/fdsys/pkg/FR-2014-06-30/pdf/2014-14761.pdf> (accessed July 2015).
- Floyd, T. 2008. *Smithsonian Field Guide to the Birds of North America*. HarperCollins, New York, New York.
- Fourqurean, J. W., Zieman, J. C., and Powell, G. V. N. 1992. Relationships between porewater nutrients and seagrasses in a subtropical carbonate environment. *Marine Biology* 114(1):57–65.
- Frederick, P., and J. C. Ogden. 2003. Monitoring wetland ecosystems using avian populations: seventy years of surveys in the Everglades. Pages 321–350 *in*: D. Bush and J. Trexler, editors. *Monitoring ecosystems: interdisciplinary approaches for evaluating ecoregional initiatives*. Island Press, Washington, D.C.
- Frohring, P. C., D. P. Voorhees, and J. A. Kushlan. 1988. History of wading bird populations in the Florida Everglades: A lesson in the use of historical information. *Colonial Waterbirds* 1988:328–335.
- FWC (Florida Fish and Wildlife Conservation Commission). 2003. Florida's breeding bird atlas: A collaborative study of Florida's birdlife. Available at: <http://www.myfwc.com/bba/> (accessed July 2015).
- FWC (Florida Fish and Wildlife Conservation Commission). 2013. Listed Birds. Available at: <http://myfwc.com/wildlifehabitats/imperiled/profiles/birds/> (accessed July 2015).
- Gibbs, J. P. 1991. Spatial Relationships between nesting colonies and foraging areas of Great Blue Herons. *The Auk* 108(4):764–770.
- Gibbs, J. P., H. L. Snell, and C. E. Causton. 1999. Effective monitoring for adaptive wildlife management: Lessons from the Galapagos Islands. *Journal of Wildlife Management* 63(4):1055–1065.
- Hutchinson, A. E. 1979. Estimating Numbers of Colonial Nesting Seabirds: A Comparison of Techniques. *Proceedings of the Colonial Waterbird Group* 3:235–244. Maine Department of Inland Fisheries and Wildlife, Orono, Maine.
- Johnson, D. H. 2008. In defense of indices: The case of bird surveys. *Journal of Wildlife Management* 72(4):857–868.
- Kushlan, J. A. 1978. Effect of helicopter censuses on wading bird colonies. *Journal of Wildlife Management* 43:756–760.

- Kushlan, J. A. 1993. Colonial waterbirds as bioindicators of environmental change. *Colonial Waterbirds* 16:223–251.
- Montgomery, D. C. 2001. *Introduction to Statistical Quality Control*, 4th Edition. John Wiley & Sons, Inc., New York, New York.
- Nellis, D. W. 2001. *Common coastal birds of Florida and the Caribbean*. Pineapple Press, Sarasota, Florida.
- Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. *Wildlife Society Bulletin* 31(4):1000–1003.
- Ogden, J. C., J. D. Baldwin, O. L. Bass, J. A. Browder, M. I. Cook, P. C. Frederick, P. E. Frezza, R. A. Galvez, A. B. Hodgson, K. D. Meyer, L. D. Oberhofer, A. F. Paul, P. J. Fletcher, S. M. Davis, and J. J. Lorenz. 2014. Waterbirds as indicators of ecosystem health in the coastal marine habitats of Southern Florida: 2. Conceptual ecological models. *Ecological Indicators* 44:128–147.
- Parrish, J. D., D. P. Braun, and R. S. Unnasch. 2003. Are we conserving what we say we are? Measuring ecological integrity within protected areas. *BioScience* 53(9):851–860.
- Patterson, M. E., A. J. Atkinson, B. D. Witcher, K. R. T. Whelan, W. J. Miller, R. J. Waara, J. M. Patterson, B. I. Ruttenberg, A. D. Davis, R. Urgelles, and R. B. Shamblin. 2008. South Florida/Caribbean Network Vital signs monitoring plan. Natural Resource Report NPS/SFCN/NRR—2008/063. National Park Service, Fort Collins, Colorado.
- Peterson, R. T. 2010. *Peterson field guide to birds of eastern and central North America*. Vol. 6. Houghton Mifflin Harcourt, Boston, Massachusetts.
- Powell, G. V., R. D. Bjork, J. C. Ogden, R. T. Paul, A. H. Powell, and W. B. Robertson, Jr. 1989. Population trends in some Florida Bay wading birds. *The Wilson Bulletin* 101(3):436–457.
- RECOVER (Restoration Coordination and Verification). 2014a. Comprehensive Everglades Restoration Plan (CERP) 2014 System Status Report – Chapter 7: Southern Coastal Systems. Available at: http://141.232.10.32/pm/ssr_2014/Docs/area_fb_lower_2014.pdf. (accessed July 2015).
- RECOVER (Restoration Coordination and Verification). 2014b. Comprehensive Everglades Restoration Plan (CERP) 2014 System Status Report – Chapter 3: Systemwide Science. Available at: http://141.232.10.32/pm/ssr_2014/Docs/mod_sw_2014.pdf. (accessed July 2015).
- Sadoul, N. 1997. The importance of spatial scales in long-term monitoring of colonial Charadriiformes in southern France. *Colonial Waterbirds* 20(2):330–338.
- Sullivan, K. L., P. D. Curtis, R. B. Chipman, and R. D. McCullough. 2006. *The Double-crested Cormorant: Issues and Management*. Department of Natural Resources, Cornell University,

Ithaca, New York. Available at:

<http://wildlifecontrol.info/pubs/Documents/Cormorant/Cormorant.pdf> (accessed July 2015).

Thompson, W. L., G. C. White, C. Gowan. 1998. *Monitoring Vertebrate Populations*. Academic Press, San Diego, California.

Whelan, K. R. T., P. L. Ruiz, R. B. Shamblin, P. A. Houle, M. S. Ross, A. J. Atkinson, J. M. Patterson, and J. Alonso. 2013. *Biscayne National Park Vegetation Map Project*. Natural Resource Technical Report. NPS/SFCN/NRTR—2013/774. National Park Service, Fort Collins, Colorado.

Witcher, B. 2008. *South Florida / Caribbean Network Data Management Plan*. Natural Resource Report NPS/SER/SFCN/NRR—2008/064. National Park Service, Fort Collins, Colorado.

Standard Operating Procedure A: Personnel Training

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

A.1 Purpose

This SOP describes basic training of staff performing the Biscayne National Park Colonial Nesting Bird Monitoring Program. Training for the bird monitoring program can be divided into three sections, an office portion, a flight preparedness portion, and a field portion.

A.2 Office Training

The office portion of the training will be provided by SFCN staff on site and covers:

- A) Bird identification, characteristics, and nesting habits. Field guides and pertinent publications are excellent sources of information coupled with field trips in the area. Personnel should be able to identify both adult and juvenile versions of
 - Double-crested Cormorant (DCCO)
 - Anhinga (ANHI)
 - Cattle Egret (CAEG)
 - Great White Heron (GWHE)
 - Great Blue Heron (GBHE)
 - Great Egret (GREG)
 - Little Blue Heron (LBHE)
 - Reddish Egret (REEG)
 - Snowy Egret (SNEG)
 - Tricolored Heron (TRHE)
 - Roseate Spoonbill (ROSP)
 - White Ibis (WHIB)
 - Bald Eagle (BAEA)
 - Osprey (OSPR)
- B) Location of colony sites and general park information.
- C) Overview of field and data sheets used.
- D) Analyzing and processing of data. We use specific photos located at:
(Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\Training\Training_photos) for training new personnel in the analysis portion of gathering data from photos. Using training photographs allows us to check for consistency between personnel analyzing photographs.
- E) Familiarity using the camera for bird flights. Instruction from a prior mission photographer and practice using the camera before flying is recommended. The project leader and the SFCN Community Ecologist will determine when new personnel have acquired proficient abilities to participate on flight missions.
- F) Following procedures for data entry and quality assurance and quality control.

A.3 Flight Preparedness

Since safety is the top priority, all SFCN personnel participating on bird monitoring flights are required to take the following flight preparedness courses every three years:

- A-107, Aviation Policy and Regulations I (online)
- A-100, Basic Aviation Safety
- S-271, Helicopter Crewmember
- A-110, Aviation Transport of Hazardous Material (if applicable and online)
- A-200, Aviation Mishap Review
- A-312, Water Ditching and Survival

A.4 Field Training

The field portion of training takes place in flight, on-the-job. Using the training as mentioned previously, the new crew member has to apply lessons learned. It is important for the two SFCN crew members to communicate during flight to collect the best data possible. Prior to the flight, the SFCN flight crew will determine their assignments on board the helicopter; this may be based on an individual's preference or abilities. It is recommended that all flight personnel become familiar performing both roles (observer and photographer) thus providing the greatest flexibility of flight crews.

When bringing a new technician into the project, it is necessary to perform several hours of on-the-job training. It is beneficial for the new technician to have familiarity with photo analysis and processing before going on a flight. Knowing how the data is utilized will aid in the data collection. Reviewing previously processed data sheets and photographs with new personnel will provide guidance for the monitoring process. Step-by-step instructions for processing photos are covered in the following SOPs.

Standard Operating Procedure B: Safety Requirements and Procedures to Fly in a Helicopter for Colonial Bird Monitoring in Biscayne National Park

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

B.1 Introduction

After reading this SOP, one should be familiar with the requirements needed in order to be eligible to fly in the helicopter for the colonial bird monitoring flights over Biscayne National Park, know the basic safety measures, and be familiar with specific procedures that need to be performed prior and during helicopter monitoring flights.

The monitoring of colonial nesting birds in Biscayne National Park requires access to remote sites across the waters of Biscayne Bay. Ninety-five percent of Biscayne National Park is comprised of submerged marine environments. There are approximately 42 islands protected within the park boundary consequently drawing birds to the bay year-round. Large colonies of Double-crested Cormorants and several species of egrets and herons nest seasonally in the protected refuge of the park keys. A helicopter is an efficient method to fly SFCN personnel and their field equipment (PPEs, camera, GPS, locator beacon, and radio) over the sites being monitored in a systematic way without the need to land. Helicopters offer the most practical and efficient means of sampling these monitoring sites as opposed to flying in a fixed-wing airplane. Helicopters also provide the best visual access of bird colonies on Biscayne National Park islands, as well as the ability to fly at a slower speed and hover when needed. The ability to vary the altitude of the aircraft allows for better pictures to be taken. Fixed-wing aircraft do not provide the precision available from a helicopter. A contracted or park owned and operated aircraft will be used whenever suitable for these missions. At the start of each field season, responsibilities for helicopter flying, sampling, and data collection will be delegated among the participating individuals.

B.2 Helicopter Procedures

Prior to any helicopter flight the required certifications must be obtained (see Personnel Requirements and Training section). NPS procedures for flight operations are described in more detail in the Interagency Helicopter Operations Guide (IHOG), the Park Aviation Plan (to be replaced by the South Florida Aviation Management Plan), NPS RM-60, and DM 350-3534. Refer to these publications for more information on helicopter operations and procedures. Additionally there is a Job Hazard Analysis pertaining to this monitoring effort (Appendix 6) which should be reviewed and signed by any SFCN team member flying in a helicopter for the colonial nesting bird monitoring.

In order to schedule a helicopter mission, an Aircraft Flight Request/Schedule form (Appendix 7) is filled out, and a copy is e-mailed to dispatch at Everglades National Park (EVER) for flight following. Prior to departure, a Field Safety Sign-out sheet is filled out and left at the office

(Appendix 7). Prior to loading the aircraft, SFCN personnel and their equipment are weighed in the office or at the airport. The pilot and crew are responsible for decisions related to storage of gear on board, as well as decisions to proceed or cancel the mission based on aircraft, weather, or other considerations. The Aviation Risk Assessment (352 DM 2.2 A) will be used to document this decision (Appendix 7). SFCN personnel have GPS coordinates for locations of colonies to be surveyed, as well as pre-determined flight paths, which can aid the pilot in navigation.

Weather conditions are an important consideration when deciding if to proceed with a flight. Factors such as wind speed, wind gusts, temperature, visibility, precipitation, and local weather anomalies are all part of determining whether or not to proceed with a mission. Mission participants, ground support crew and pilot are all responsible for flight safety. The mission participants will decide if the weather will permit safely accomplishing the mission and obtaining good data. We have determined that maximum wind speed (including gusts) of up to 15 miles per hour is acceptable for gathering data. We have also determined a wind gust variance of no more than 8 miles per hour is an acceptable limit to accomplish the mission successfully (these parameters are within NPS safety guidelines).

Once a flight is initiated, flight following is maintained between the pilot and flight following personnel at EVER dispatch, in accordance with Department of Interior (DOI) and NPS South Florida Aviation Program (SFLAP) or EVER guidelines. Flight following communication entails a verbal check-in to include position and status update by the pilot, and verbal acknowledgment by EVER dispatch, to occur every 15 minutes. The SFCN crew carries a portable digital park radio for use when the helicopter has shut down or landed.

Helicopter altitude is maintained above 300 feet except when photographing a bird colony. Once at a location, the aircraft will hover/circle at approximately 150 feet. This allows SFCN personnel to make correct visual identifications, get accurate counts and estimates, and take photographs.

Biscayne National Park is adjacent to the Florida Power & Light Turkey Point Nuclear Power Plant, thus part of our pre-flight safety protocol is to notify the power plant security of scheduled flights near their airspace. Up to a week in advance we send security personnel an email with the flight time, date, and a description of the helicopter including color and tail number. The contact information for the helicopter contractor and pilot's name are included. Prior to take-off an SFCN crew member calls security personnel at the power plant to remind them of the mission. An SFCN crew member also calls the office to confirm that the mission will be taking place.

B.3 Safety: Special Equipment and Certified Operators

This plan is an extension of the general philosophy that safety comes first in the work place. While helicopters have inherent risks, the proper use of personal protective equipment (Figure SOP B-1), proper planning for the transportation of personnel and gear, and the proper use of entry and exit techniques are all designed to minimize this risk. As mentioned above, NPS procedures for flight operations are described in more detail in the IHOG, SFLAP or EVER Aviation Plan (Appendix 5), NPS RM-60, and DM 350-3534. The IHOG comprehensively covers required clothing and equipment (personal protective equipment and aviation live support system), training (A-100, A-110,

A-200, S-271, and A-312), loading and unloading both passengers and cargo, flight routing, flight following, communications, landing zones, landing area safety, fueling and special considerations for hazardous material transportation. Please refer to the IHOG and the EVER Park Aviation Plan or SFLAP for further information on helicopter safety and special equipment requirements.

All considerations of aircraft performance with regard to load capacity, fitness for flight, flight duration, and ability to operate in current weather conditions are the primary responsibility of the pilot and flight crew. Any member of the crew has the ability to postpone a flight if conditions are not satisfactory (e.g., weather, gear, pilot, flight crew). An operational risk assessment analysis, hazardous materials checklist, and the SFCN Go/No-Go list (Appendix 7) will be used for each flight.

The pilot and certified helicopter crew members are responsible for completion of load calculations prior to the flight. The Flight Supervisor is responsible for passenger and load manifests.

Since flight operations take place over water, floats (pontoons) are required on the aircraft, and FAA-approved Personal Flotation Devices (PFDs) are required for all crewmembers. The port side doors of the aircraft are removed to facilitate observations and photography of nesting colonies. Additional consideration will be given to the safe loading and unloading of equipment to reduce the risk of losing gear during flight. If the aircraft is not outfitted as required, the flight will be postponed or cancelled until appropriate arrangements can be made.

In all cases, the pilot and crew will be thoroughly familiar with the hazards within Biscayne National Park and along flight routes. Flight following is conducted by Everglades National Park dispatch in accordance with DOI and EVER guidelines. Although this mission should not require landing, the SFCN crew carries a portable digital park radio for use when the helicopter has shut down or landed.

All aircraft incidents or accidents will be reported in accordance with DOI, NPS, and FAA regulations.



Figure SOP B-1. This photo shows the required personal protective equipment (PPE): approved helmet, Nomex flight suit, Nomex gloves, and over-the-ankle all-leather boots. Natural fibers such as cotton pants and shirt underneath the flight suit, and long cotton socks are recommended. The photo shows a locator beacon, two-way radio, Interagency Aviation User Pocket Guide, and a Helicopter Passenger Briefing Card [OAS-84 (06/06)]. A manually deployed, FAA-approved personal flotation device (not shown) is required when flying over water.

B.4 Locating and Assessing the Sample Sites

Presently there are six colony sites monitored on a monthly basis. Following the annual complete park survey, SFCN personnel will decide if new sites need to be added or if previous sites need to be deleted. Colony locations and flight plans are pre-determined before the start of the mission. The annual complete surveys for new colonies include the monthly survey to maximize efficiency.

A GPS plotter or handheld GPS unit (Garmin 640, 478, 60CSx, or 62s) with colony locations and pre-loaded flight tracks is available to aid in navigation during the flight. When possible, sites are approached in a manner that minimizes disturbance to birds, but wind speed and direction must be considered. Ultimately, the pilot will decide the safest approach. Upon arrival at the sites, the photographer begins capturing images to visually document the entire colony. The observer conducts a visual census of the site and records observed data. Colony sites may be flown from one end to the other, circled, or flown over in a transect pattern. Each flight path is specific to the site, planned in advance, and is conducted at an approximate altitude of 300 feet (Appendix 1). The exact flight path depends on weather conditions and is the pilot's decision.

B.5 Field Forms

Field Safety Sign-out Information Sheet

This form serves as a record for office personnel listing which crew members are conducting a field mission, the location and time of the mission, and other pertinent information.

This form can be found in z:\Safety\ 20120914_SFCN_Float_Plan.doc

A printable version of this form is included in Appendix 7.

Communications Center Aircraft Request Form (ENP Form 9400)

This form serves to request and schedule colonial bird monitoring flight with the flight agency or EVER, depending who is providing flight services for that particular date. This form must be completed and submitted to flight agency contracted for flight and EVER flight following prior to departure.

This form can be found in z:\Helicopter\Forms\ENP_Form_9400_blank.doc

A printable version of this form is included in Appendix 7.

Biscayne National Park – Colonial Bird Survey – Helicopter Field Data Sheet

This form (Figure SOP B-2) is intended to aid in keeping a record of the species of birds observed at each location, approximate quantities of active nests, and conditions encountered while conducting the flight. The “observed data” side of the data sheet is completed by the SFCN crew member in the front seat (see Roles and Responsibilities under Personnel Requirements and Training). There is a specific data sheet for each of the colonies (each island) visited during the flight. Please note the exact number of active nests is obtained later, from the photographs taken at each active colony. This form is printed back to back with the photo processing data sheet (SOP D). The “photo processing” side of the data sheet is completed after the photo analysis has occurred in the office. Keeping the data sheets together provides for more convenient and accurate data entry.

These forms can be found in:

Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\BISC\Data_sheets\20130213_data_sheet_BISC.xlsx

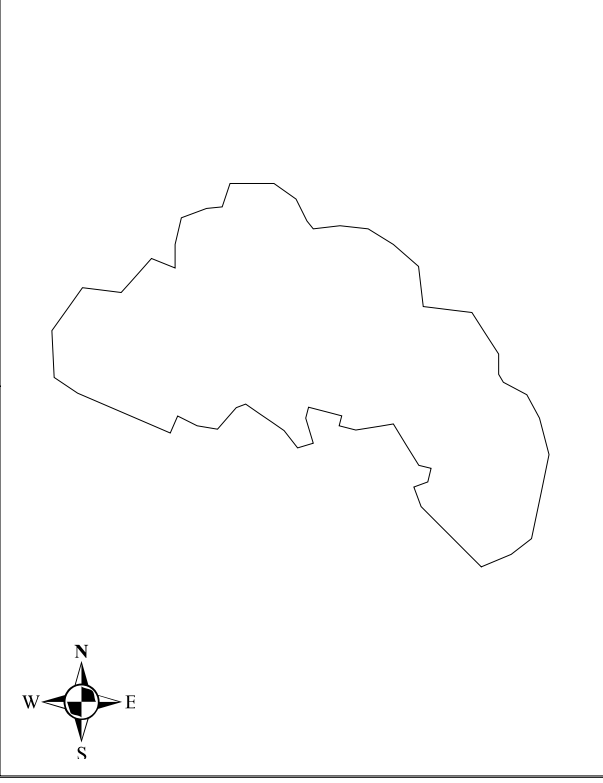
Biscayne National Park - Colonial Bird Survey		For Qty. Obs. Box, specify number of individuals. For all other boxes, specify "Yes" or "No".				
Helicopter Field Data Sheet		Species Code	Qty. Obs.	Visible nests?	Visible chicks?	Visible eggs?
Mangrove Key Colony		DCCO				
Easting: 568810.602918233 Northing: 2808792.87449692		ANHI				
Date: _____ Time: _____		CAEG				
Mark start position on map below		GWHE				
		GBHE				
		GREG				
		LBHE				
		REEG				
		SNEG				
		TRHE				
		ROSP				
		WHIB				
		BAEA				
		OSPR				
Other (specify)						
Other (specify)						

Figure SOP B-2. The above is an example of a Field Data Sheet for a known colony. This sheet is filled out by the SFCN observer during the flight when surveying an island.

Colonial Bird Vital Sign Helicopter Survey Field Data Sheet-New Colony

This form is used once a year when we search for new colonies within Biscayne National Park. Each winter and spring, flights are conducted to look for new nesting bird colonies in Biscayne National Park. The observed data recorded includes: active nests, their locations, visible chicks, visible eggs, species, their quantities, observers, and flight date and time.

B.6 Helicopter Associated Costs

The SFCN has contracted a local helicopter charter operator to perform monthly flights over the island bird colonies in Biscayne National Park. This has proven to be the best method of gathering data on nesting birds. Detailed costs and charges are listed in the Startup Costs and Budget Considerations under the Operational Requirements section of the protocol.

Standard Operating Procedure C: Camera Use and Setup, Geotagger Use and Setup, and Photography from a Helicopter

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

C.1 Introduction

Photographs are the raw data used for documenting active nests in Biscayne National Park. Using these photographs, SFCN staff will be able to count the quantity of active nests and identify various stages of occupancy of nests within the rookeries of Biscayne National Park. With the use of photography SFCN will document the location and the size of the rookery by counting active occupied and non-occupied nests.

C.2 Camera Use and Set Up

The camera is the essential tool that will be used to obtain the data; therefore, proper settings and use of the camera are vital to the success of a field mission. Currently, SFCN uses a Nikon D300s, 12.3-megapixel digital camera with a 70mm to 300mm Vibration Reduction lens. SFCN personnel going out to the field must focus on properly setting the camera's shooting options. The preferred option is to set the camera on A: Aperture-Priority Auto. In this setting the aperture is chosen by SFCN personnel (already set at f/6.3) while the camera automatically selects the shutter speed that will produce the optimal exposure. Small apertures (high f/numbers) increase depth of field, bringing both the main subject and the background into focus. Large apertures (low f/numbers) soften background details and let more light into the camera.

For more detailed and specific information on the camera's functions please refer to the *Nikon Guide to Digital Photography with the D300s Digital Camera*.

C.3 Geotagger Use and Set Up

Although geotagging photos is not necessary for analysis of photos, it provides a nice enhancement to the process. Thus, an additional tool now in use is the Solmeta Geotagger Pro. This device allows real time spatial location data to be embedded into digital photos. This technology has the capability to provide the location (relative to the island) where photographs are taken, along with GPS coordinates, altitude, compass heading, and time the photographs are taken. When used in combination with ArcGIS, Google Earth, or GPS-Photo Link, the Geotagger information may provide more accurate processing of colony photos. The Geotagger is mounted using the flash hot shoe on the Nikon camera and a supplied cable connects the two pieces of equipment.

The following steps outline how to use the Solmeta Geotagger Pro:

- 1) Connecting the Solmeta Geotagger Pro to the Nikon D300s camera:
 - a) Connect the Solmeta Geotagger Pro's coiled ten-pin data cable (cable A) to the ten-pin terminal on the Nikon D300s. If you are looking into the camera lens, the ten-pin terminal is on the camera's front right side, just below the flash sync terminal. Open the flap of the ten-pin terminal and align the arrow on the data cable to the white dot on the camera – this will align all of the pins – and push the head of the data cable in. Screw the head of the ten-pin cable onto the camera until it is tight.
 - b) Insert USB end of the coiled data cable into the Solmeta Geotagger Pro unit.
 - c) Mount Solmeta Geotagger Pro onto the Nikon D300s by sliding the front of its base into the back of the flash hot shoe on top of the camera (Figure SOP C-1).



Figure SOP C-1. Shown is the Nikon D300s camera with the vibration-reducing lens and the Solmeta Geotagger attached.

- 2) Using the Solmeta Geotagger Pro with the Nikon D300s camera:
 - a) Turn the camera on.
 - b) Turn on the Solmeta Geotagger Pro unit using the power button on its side.

- i) If the Solmeta Geotagger Pro is properly connected, a blinking **GPS** icon will be displayed both in the camera's control panel and the Solmeta Geotagger Pro LCD display screen.
 - ii) The **GPS** icon will blink both on the camera and the Geotagger until a GPS signal is fixed.
 - iii) When the GPS signal is fixed, the **GPS** icon will stop blinking and instead be displayed as a solid icon. The LCD display screen on the Solmeta Geotagger Pro will now display pertinent information, including latitude, longitude, altitude, time, and compass heading. As each new photograph is taken, this information becomes embedded in the photograph's metadata.
- 3) Things to keep in mind when using the Solmeta Geotagger Pro:
- a) Throughout the flight, ensure the USB end of the coiled data cable does not disconnect from the Solmeta Geotagger Pro unit. Since this connection easily comes loose, it is advisable to constantly tighten it. Be careful not to cover the top of the unit which receives the satellite signal.
 - b) Ensure the Solmeta Geotagger Pro unit always has a clear view of the sky, and that you do not place your hand or any other object on top of it throughout the flight. Otherwise, the unit will not get a good GPS signal.
 - c) Keep an eye on the **GPS** icon on the camera's control panel and on the Solmeta Geotagger Pro LCD display screen. So long as this icon is solid, you have a fixed GPS signal.
- 4) For more detailed instruction regarding the Geotagger functions and usage please refer to the *Geotagger Pro User Manual (V2.0)*.

Prior to the Solmeta Geotagger, we used a handheld GPS unit and the GeoSetter software to geotag photos (Figure SOP C-2). This process requires synchronizing the time of the camera to the official U.S. time (via www.time.gov) in order to accurately match the photo timestamp with a GPS position near an island. Once GPS tracklines were downloaded for a helicopter flight, GeoSetter was used to determine where each photo was taken. GeoSetter matches up the GPS trackline time to the photograph's timestamp from the camera. The locations where the pictures were taken could then be displayed in Google Earth and used as an aid in photo analysis. This method does not provide a compass heading for the photographs, which was a shortcoming in the photo analysis phase.



Figure SOP C-2. This image shows a flight path around Arsenicker Key with the geotagged photos. Yellow arrows show direction camera was aimed.

C.4 Photography from a Helicopter

The number of nests will be recorded from the photographs taken in the field. It is important to take as many photographs and make as many observations in an area as necessary. A photo of each island is taken upon approach of the colony. Some of these islands are not very big so this is easily achievable from the helicopter. Photos should maintain a certain chronological, sequential, and spatial order. While visiting bird colonies, multiple photographs are taken. The sequential photographs must encompass as much of the nesting colony as possible. The helicopter is positioned approximately 150 feet in altitude and near enough to the colonies so that nests are clear in the photos. As the helicopter passes the nesting colony, the photographer must document as much of the colony as possible. The end result of a helicopter pass must be a sufficient quantity of photos to create a photo mosaic the whole colony, piece by piece. Sometimes it takes more than one helicopter pass to achieve this. Once the observer and photographer are satisfied the colony has been entirely documented, they proceed to the next site. This said, it is also important to go for photos spaced

properly and in focus. Too many pictures and blurry pictures make analyzing the photos very difficult.

It does not matter if photos show the same nesting area more than once as long as each pass over the colony can be differentiated. This can be done by taking a picture of the water or the sky before beginning a new pass. This will be dealt with when the pictures are analyzed in the office so as not to count the same nests more than once.

Standard Operating Procedure D: GPS Track Downloading, Photo Downloading and Archiving, Photo Geotagging, Photo Renaming, and Photo Tagging in ThumbsPlus

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

D.1 Introduction

Photographs are essential for obtaining data to document colonial nesting bird activities at Biscayne National Park (BISC). With the use of photography and field observations, SFCN will document the size of the rookery by counting as many nests and observing as many species as possible.

The series of steps below are to be followed immediately by field personnel upon return to ensure all photographs are properly processed.

D.2 GPS Track Downloading Using DNR Garmin:

- 1) Connect GPS unit to computer via USB cable and turn GPS device on.
- 2) Open DNR Garmin program (version 5.4.1).
- 3) DNR Garmin should automatically detect the GPS device (if device is on). DNR Garmin window should show **Connected** in the lower left-hand corner. If GPS device is not automatically detected, select **GPS** from the menu bar, then select **Set Port**, and then **USB**.
- 4) The projection should read NAD83 – UTM zone 17N. If this projection is correct, skip to step 6.
- 5) The projection may need to be set the first time a GPS unit is connected to the computer. A prompt will appear and provide the user with a projection. If the initial projection is not NAD83 – UTM zone 17N, then select **No** and click on **ESRI** to select the correct projection. Click **Project** and then load the correct projection from your program files. The file path is: C:\Program Files\ArcGIS\Desktop10.1\Coordinate Systems\Projected Coordinate Systems\UTM\NAD 1983\NAD 1983 UTM Zone 17N.prj. Once this is done you may proceed.
- 6) If downloading tracks, select **Track** from the menu bar and then select **Download** from that menu.
- 7) If you have a Garmin 60CSx GPS receiver, once the track records are successfully downloaded, a dialog window will appear informing how many records were collected. You will need to select **OK** in the window.
- 8) Select **File** from the menu bar, then select **Save To**, and then **File...**.
- 9) Navigate to Z:\GIS\GPS\Garmin (model)\ (appropriate unit # as written on side of unit).
- 10) From the **Save as type:** drop-down menu, select “ArcView Shapefile (Projected)”.
- 11) In the **File name:** box, name file according to convention. Example:
Garmin60Unit2_20110119_Tracklines.
 - (1) Note: the date in the convention above is the date the data is being downloaded (usually the flight date).
- 12) Click **Save**.
- 13) DNR Garmin will ask for an output shape: Point, Line, or Polygon. Tracks can be saved as either lines or points. Saving a track output as points will allow GeoSetter to match the photos taken to the corresponding points along the track. **This type of track output (points) is necessary when**

- a gpx file is not available.** However, saving a track file as lines is a faster process than saving it as points. Select **Line** and click **OK**.
- 14) A window should appear indicating that the file was written successfully, and where the file was written to. Click **OK**.
 - 15) If using a Garmin 60CSx (if using a Garmin 62S, skip to step 17) and you want to download waypoints, select **Waypoint** from the menu bar and then select **Download** from that menu. Repeat steps 8 – 10 for the waypoints.
 - 16) A window should appear indicating that the file was written successfully, and where the file was written to. Click **OK**.
 - 17) If using a Garmin 62s and you want to download waypoints, select **File**, **Load From >** and **File...** and then navigate to **J:\Garmin\GPX** (J varies depending on the port you connected the unit to). From the **Files of Type:** drop-down menu select **GPS eXchange Format (*.gpx)**
 - a) You then need to select the appropriate file to load, the name of which should begin with the word “Waypoints” and have the date the data was collected. Click on **Open**.
 - b) A box will pop up asking you to define the feature type. Click on **Waypoint** and **Ok**.
 - c) A dialog window will appear informing you if the file loaded successfully. Click **Ok**.
 - d) To save the file, follow steps 7 – 10 above.
 - e) A window should pop up indicating that the file was written successfully, and where the file was written to. Click **OK**.
 - 18) If downloading from a Garmin 60CSx or 62S, download the gpx file next. Turn off the DNR Garmin software either by clicking on the **X** on the top right of the screen or selecting **File** and **Exit**. Next, proceed as follows, depending on the GPS model:
 - a) If using a Garmin 60CSx (if using a Garmin 62S, skip to step c) press the **Menu** key on the GPS unit twice, select the **Setup** icon, and press **Enter** key. Next, select the **Interface** icon and press **Enter** key. Next, select the **USB Mass Storage** option at bottom of the screen and press **Enter** key.
 - b) Your GPS device will now function as a removable USB Mass Storage drive. A new window should appear with all the GPX files on the unit. Select and **Copy** the desired GPX files and **Paste** into the appropriate folder, such as: Z:\GIS\GPS\Garmin_60CSx\2\GPX
 - c) If using a Garmin 62S, navigate from **My Computer** to **Garmin GPSMAP 62s** and then to **J:\Garmin\GPX** (J varies depending on the port you connected the unit to).
 - d) **Copy** the file or files with the appropriate date (when the data was collected) and **Paste** it into the appropriate folder, such as Z:\GIS\GPS\Garmin_62s\6\GPX and then rename it according to the date the information was collected, using the YYYYMMDD convention.
 - e) When finished, safely remove hardware from computer.
 - 19) Now make a copy of all the files you just downloaded to your working folder in spatial info. Example: Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\spatial_info\BISC\2014.
 - a) First, the shapefiles need to be cleaned up to remove data from other projects not related to the Birds protocol. Open up ArcMap and drag in the tracklines shapefile or the waypoints shapefile.
 - b) Right-click on the shapefile you are editing and select Open Attribute Table.
 - c) Select/Highlight all the records by the date you flew, using the TIME field.
 - d) Right-click on the shapefile, select **Data**, then **Export Data**.
 - e) When the window pops up, navigate to your spatial_info folder. Example: Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\spatial_info\BISC\2014.
 - f) Name your file by using the Garmin unit name and the field date. Example: Garmin60Unit3_20140827_Tracklines. Select Save. Click OK.

- g) When a window pops up prompting you to “add the exported data to the map as a layer?” select yes and inspect your new shapefile.
- h) Do the same for the waypoints shapefile if applicable.
- i) Make a copy of the GPX file to your GPX folder inside spatial_info by copying and pasting it to: Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\spatial_info\BISC\2014\gpx.

D.3 Photo Downloading and Archiving Using Adobe Bridge CS4:

- 1) Connect Nikon D300s digital SLR camera to computer via USB cable and turn camera on.
- 2) Open the Adobe Bridge program.
- 3) From the **File** drop-down menu, select the **Get Photos from Camera...** option.
- 4) The “Photo Downloader” dialog box will open. From the **Get Photos from:** drop-down menu in the “Source” section (at the top of the dialog box), select the camera device which the photographs will be downloaded from. The device name (in this case, D300s) should already appear as a selection in the drop-down menu.
 - a) A smaller dialog box will appear temporarily, indicating a successful connection to the device and location of photos. This smaller box will automatically close when done.
 - b) The total number of photos, total memory, and date created will now appear underneath the drop-down menu in the “Source” section.
- 5) From the “Import Settings” section of the “Photo Downloader” dialog box, select the proper location where the photographs will be downloaded to. Use the **Browse...** button to select the proper drive/folder/subfolder.
- 6) Create subfolder by selecting the **Custom Name** option from the **Create Subfolder(s):** drop-down menu. A box will appear directly underneath the drop-down menu. Type in the subfolder name using the following convention: shot date (yyyymmdd) park code_abbreviated project description (Example: 20110119_BISC_BirdFlight). All photographs will be downloaded into this subfolder.
Important: Do not rename files at this point.
- 7) Next, click on the **Get Photos** button at the bottom of the dialog box. A smaller window showing the download progress will automatically appear and will disappear when the download is complete.
- 8) Once photographs are copied into the folder, create a DVD of the original images before proceeding to the next step. Burn images and corresponding GPX file (if available) onto a DVD+R using media software such as Windows DVD Maker.

D.4 Photo Geotagging Using GeoSetter:

(Note: Geotagging photos while a nice enhancement, is not necessary for the protocol to proceed)

- 1) Open GeoSetter and if the settings window opens, go ahead and close it.
- 2) Use the left side of the screen to navigate to the folder where your photographs are stored.
- 3) Highlight all the images that you want to geotag and go to **Images** drop-down menu and click on the **Synchronize with GPS Data Files** option (Ctrl+G).
 - a) In the **Synchronize with Data File** textbox browse for the appropriate GPX file.
 - b) Set the **Assignment of Found Positions** to **Interpolate Regarding Shoot Time With Last or Next Position**
 - c) Set the **Maximum Time Difference between Taken Dates and Trackpoints** to 30 seconds.
 - d) Assuming that the camera time was synchronized before the photographs were taken, you should not need to adjust the **Additional time Adjustment**. If synchronization was not done before photographs were taken, then determine the current offset between the camera and the official time at www.time.gov and enter the appropriate numbers.

- e) When complete, click **OK** to geotag the photographs.
- 4) A box will come up saying **Synchronize with GPS Data Files**, click **Yes**. If the number of images not paired with coordinates is significant, then either you selected the wrong GPX track file or you had an inappropriate time offset. You can try synchronizing the photographs again.
- 5) Another box will come up saying **Do you want to save the assigned track(s) in the current directory?**, click **Yes**.
- 6) Another box will come up saying **Save the directory track file name** use with the following naming convention YYYYMMDD_IslandName (Example: 20120225_MAKE) then click **OK**.
- 7) A map should show up on the right hand side of the window containing the trackline and small map markers. If you click on the map markers the corresponding picture will be highlighted with a blue outline.
- 8) At this point, you have temporarily geotagged the photographs, but this metadata has not been permanently embedded inside the image files. To do this, keep all images selected, and from the **Images** menu select **Save Changes**. This will save the metadata in the original file and create an unedited copy of the file with a “.JPG_ORIGINAL” extension. These “.JPG_ORIGINAL” files can be deleted to save space once you confirm a successful geotagging. These files can be found in the image folder that the original photos were found in.
- 9) Finally, if you want to export your geotagged trackline into Google Earth you need to select all the photographs. Click on **Images** and scroll down to **Export to Google Earth**. The option to open the KMZ file you’ve just created in Google Earth should pop up. Click **Yes**.
- 10) If you want to confirm that latitude/longitude information was indeed saved inside your image files, you can view this metadata in many programs including Adobe Bridge.
 - a) Go to the **Start** bottom at the left hand bottom of the screen. Click on **All Programs** navigate to **Adobe Bridge CS4**.
 - b) In Adobe Bridge in the upper right-hand side of the window, navigate to the file you want using the selection bar. For this tutorial you will need to navigate to: Z:/Photos/Other/GeoSetter.
 - c) Let it scan the folder of images, click on an individual image, and then scroll through the available metadata on the lower right. You should see an entry for GPS latitude and longitude with values provided by the geotagging process.

D.5 Photo Renaming Using Adobe Bridge CS4:

- 1) Now rename all of the photos, as follows:
 - a) Use the following convention (similar to the subfolder in which the photos are stored): shot date (yyyymmdd)_park code_abbreviated project description_four digit number sequence beginning with the number 1 for the first photo taken in the day (Example: **20100827_BISC_BirdFlight_0001**).
 - b) First make sure to select all photos, otherwise only the selected photo will be renamed. You can do this by clicking inside the “Content” window where all the photos are located, and then clicking **Ctrl+A**. Then, from the **Tools** drop-down menu, select the **Batch Rename...** option.
 - c) From the “Batch Rename” dialog box, select **Rename in same folder** under the “Destination Folder” section. From the “New Filenames section” select the appropriate options to rename the file the following way: YYYYMMDD_BISC_BirdFlight_0001. To do this, follow these steps:

- i) On the first row, select **Date Time** on the first drop-down menu, then **Date Created** in the drop-down menu to the right, and **YYYYMMDD** from the next drop-down menu to the right.
 - ii) On the second row, select **Text** from the first drop-down menu and on the box to the right type in **_park code** (Example: **_BISC**).
 - iii) On the third row, select **Text** from the first drop-down menu, and on the box to the right type in **_abbreviated project description_** (Example: **_BirdFlight_**).
 - iv) On the fourth row, select **Sequence Number** from the first drop-down menu, type in **1** on the box to the right, and select **Four Digits** from the drop-down menu to the right.
 - v) Note that, as you make the changes above, under the “Preview” section on the bottom of this dialog box, the sample “New filename” will change accordingly. When you are done, be sure the “New filename” displays correctly and according to convention. Ensure that it has no spaces, and the appropriate underscores.
 - vi) Click **Rename**.
- d) At this time you can add each island code to the naming convention. The nesting colonies are differentiated by the islands they inhabit. There are six islands consistently used for nesting. Listed in the order photographed, the islands and their codes are: Mangrove Key (MAKE), West Arsenicker (WEAR), Arsenicker Key (ARKE), Jones Lagoon (JOLA), Ragged Key 5 (RAKE), and Soldier Key (SOKE). Other sites monitored for potential colonies during the annual survey are: Black Point (BLPO), Mangrove Point (MAPO), Old Rhodes Key (ORKE), Elliott Key (ELKE), Sands Key (SAKE), and the western shoreline (SHOR) of Biscayne National Park. Each island is photographed in its entirety from a distance prior to any photographs taken for nest detection. This helps to identify and separate each island’s photographs from the next island. Adding the island code to the previously sequenced photos can be done the following way using Adobe Bridge:
- i) First, make sure to select photos by each island. The islands can be distinguished from each other by using the ‘entire island’ photographs as mentioned above. Photos can be selected by clicking a specific photo which will highlight it. To highlight a group of photos (e.g. a single island group) click on the first photo of the island then, hold the **Shift** key and click on the last photo of the group/ island. Then, from the **Tools** drop-down menu, select the **Batch Rename...** option.
 - ii) On the third row, select **Text** from the first drop-down menu and on the box to the right type in **_abbreviated project description and the island code_** (Example: **_BirdFlight_MAKE**). Make sure to use the appropriate island code. Remember the islands are separated by a distance photograph of the entire island. The entire island photographs provide a start and stop point for the batch renaming. A photograph of water only differentiates a new pass of photographs at the same island.
- e) With the photos labeled using the island code it is now time to create folders for the photos of each island. This can be accomplished by:
- i) Right-click on the photo of the ‘entire island’ photo and select **New Folder**. Name the folder with the following naming convention **YYYYMMDD_PARKNAME_IslandName** (Example: 20120225_BISC_MAKE).
 - ii) Next, click on the ‘entire island’ photo to highlight it. Next, press and hold the ‘Shift’ key and scroll through island photos until you reach the last photo of that island. Next, click on the last photo of the island. This will highlight the island group and then these photos can be dragged into the new folder just created.
 - iii) Use the same method to create new folders for the other island colonies and repeat the steps to put photos into the appropriate folder. A folder can be created for non-bird

related photographs that may have been taken of other park interests such as vegetation work or other resource related subject. With the photographs safely copied onto a DVD, it is now safe to clean the memory in the camera. This will help prevent future storage issues.

D.6 Photo Tagging in ThumbsPlus:

- 1) Open ThumbsPlus and navigate to the colonial bird monitoring Microsoft Access database. Do this by clicking on **File** then **Database** and then **Open Database**, and then navigate to the appropriate folder as follows:
Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\SFCN_ColonialBirds.mdb
 - a) If the file is not visible within the dialog window change the “Files name:” drop-down type to **Microsoft Access Database**.
 - b) Select the SFCN_ColonialBirds.mdb database and click **Open**.
- 2) Using the main window navigate to the folder where your photos are stored.
- 3) Allow the program a moment to scan the photos in the folder in which you are going to work.
- 4) You should now see the photos you want to tag in the large viewing window in the program.
- 5) In order to tag an individual photo, begin by clicking on the photo you want to tag.
 - a) You may also want to batch tag a group of photos all at once, if they are all to be tagged with a common user field.
 - b) Select all the photos you want to tag by clicking on the first photo, then clicking and holding the **Shift** key and clicking the last photo you want to tag.
- 6) Click **Thumbnail** menu, and then click **Assign User Fields**. You can also do this by clicking on the photo and then clicking **CTRL** + **U**.
- 7) The following fields must be completed for all photos:
 - a) Flight Date – this is the date on which the photographs were taken, format 01-16-2014.
 - b) Site Name – this is the location of the colony. Currently, acceptable values are:
Arsenicker Key, Black Point, Elliot Key, Jones Lagoon, Mangrove Key, Mangrove Point, Old Rhodes Key, Ragged Key 5, Sands Key, Soldier Key, and West Arsenicker.
 - c) In order for the data to be stored, check box beside the “Flight_Date” and “Site_Name” must be checked. If this does not happen please manually check the box. When you are done typing in the appropriate values for the field names, click **Ok**. The field names are then stored in the database. You do not have to do anything else to save the data. Repeat steps 3–7 for each island.

Standard Operating Procedure E: Collecting Data, Circling Nests, and Counting Nests

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

E.1 Introduction

Colonial nesting bird data is collected by analyzing photographs taken during monthly helicopter flights over Biscayne National Park (BISC). Data analysis consists of meticulously counting nests visible in the photographs. Care should be taken to avoid counting nests twice, because the same nest might appear in multiple photographs. The data are then entered into a database for future cataloging and reporting (SOP F).

E.2 Colonial Bird Survey-Photo Processing Data Sheet

This sheet (Figure SOP E-1) is used to record the active nest data from the photographs taken of the six colony islands. A trained technician performs the analysis of the photographs. Information recorded on the photo processing data sheet includes occupied and empty active nests, bird species, locations, flight date, observers, numbers of photos used, processing date, data entered date and, blanks to enter the initials of the people processing and entering the data. Active nests may contain eggs, juveniles, adult birds, or are non-occupied but appear maintained.

The photo processing data sheet is printed back to back with the helicopter field data sheet (SOP A). Keeping data sheets together provides for more convenient and accurate data entry. Data is entered in the SFCN Colonial Bird Monitoring database (SOP F).

These forms are available in Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\BISC\Data_sheets\data_sheet_BISC.xlsx

Biscayne National Park - Colonial Bird Survey - Photo Processing Data Sheet						Initials and Date			
Flight date	Front observer	Photographer	Processing date	Photo processor	Data entered	Data checked			
Mangrove Key Colony			Easting: 568810.602918233 Northing: 2808792.87449692						
Sequence numbers of photos used (circled): _____									
Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests	Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests
DCCO					ROSP				
ANHI					WHIB				
CAEG					BAEA				
GWHE					OSPR				
GBHE					UNWH				
GREG					UNDA				
LBHE					Other (specify)				
REEG					Other (specify)				
SNEG					Other (specify)				
TRHE					Other (specify)				
Tallies:									

Figure SOP E-1. This image shows a photo processing data sheet. Data from the photographs is entered on this sheet. The data is then entered in the SFCN Colonial Bird Monitoring database.

Collecting Data with Adobe Photoshop and Adobe Bridge Software

The computer user needs Adobe Photoshop CS3 (or CS4) and Adobe Bridge software installed. Both programs must be running at the same time for data processing.

- 1) First open Adobe Bridge. Navigate to the folder that contains the photos to be marked. On the left hand side there is a folder menu with a list of folders. Select the appropriate folder and the photos will appear on the main screen. You can choose how these pictures are to be displayed (i.e., filmstrip, thumbnails, or metadata focus).
- 2) Create a new folder within the photograph folder for photographs that do not get used. Photos that are not marked and/or original photos go into this folder after they are reviewed for active nests and determined not to have any. The folder can be named "Not_used." Eventually all the original copies and unmarked photos in this folder will get discarded in order to save computer memory space. **Remember all original photos were previously saved onto a DVD-R. If this task has not been completed please do so before deleting any photos.**
- 3) When you are ready to begin circling nests, double-click on the picture you want to review. This will open Adobe Photoshop. Use the 'magnifying glass' feature in the Bridge program –simply click on the selected picture and the magnifying glass will appear. You can drag the magnifying

glass all over the picture to have a magnified view of any area. This will help detect nests that might be too small to detect with the naked eye and help you decide if it needs to be moved to the Photoshop program for circling. Another option is to click and drag the picture onto the Adobe Photoshop program directly to utilize the zoom feature of the software to look for nests.

- 4) To move a picture onto Adobe Photoshop simply click and hold the selected picture in Bridge, then drag the picture onto the main view area of the Photoshop screen. Once the picture is in the Photoshop main screen you can do all the tasks necessary to locate nests, circle nests, and save the pictures.

The following steps are done In Adobe Photoshop. Once the desired photo has been dragged into the Photoshop main screen you are ready to begin data collection.

- 1) The first step that must be taken before altering the picture is to create a new layer where all the painting and circling is going to occur. Creating this layer will protect the original photo from any alteration and will facilitate deleting any markings without affecting the picture. To create a new layer where the circling is going to take place first go to the top drop-down menu and select Layer, a drop-down menu with New is going to appear. Place your cursor over New to open the following drop-down menu and choose Layer. A dialog box opens; click OK to create a new layer named “Layer 1.” You will see the new layer on the Layer tab on the lower right hand side of the screen. Make sure that “Layer 1” is highlighted so work is performed in this layer and not in the background picture. “Layer 1” is automatically highlighted once it is created.
- 2) The next step is to use the drop-down menu from the “Arrange Documents” icon  above the top of the picture. Click the “Float All in Windows” choice this will keep the picture from moving out of view on the screen as you scan the picture for nests.
- 3) On the left hand side of the screen there is a vertical tool bar with a series of icons. If you click on the magnifying glass icon  (the Zoom Tool), you will be able to zoom in and out, in order to detect nests that might not be noticeable by looking at the picture in its normal size. If you click on the hand icon  (the Hand Tool), you will be able to pan through the picture to detect nests.
- 4) Occupied and non-occupied active nests that are detected must be circled (see below for definitions of occupied and non-occupied active nests). To achieve the best results, it is recommended that nests are circled by someone with experience, or that the person circling nests is trained by someone with experience (See SOP A). There are four colors used to circle an active nest. **RGB Yellow** is used to circle nests that are occupied (bird sitting on a nest or within one meter of the nest), **RGB Cyan** is used when eggs can be detected in the nest, and **RGB Magenta** is used when chicks can be seen in the nest. Non-occupied nests without birds or eggs which show signs of recent activity are circled using **RGB Blue** and are counted as well. Nests that are not occupied and do not have a maintained appearance are not circled and not considered in this protocol. These colors are picked from the swatch table found on the right hand side of the screen. To pick a color, click on Swatches, place the cursor over the desired color and click on it. You will know that the color is chosen when in the bottom of the vertical tool bar, on the left hand side of the screen, the Set Foreground Color icon changes to the selected color.
- 5) Once a nest has been detected and the color has been determined and chosen from the swatch table, click on the brush icon  (the Brush Tool) located on the vertical tool bar on the left side of the screen. You will notice on the top menu bar the Brush Tool settings appear. The settings we use are not too specific but we found that having set the Master Diameter at “13 px,”

- Hardness** at “100%,” and **Mode** to “normal” creates a noticeable mark. To change these settings click the **Brush** drop-down menu.
- 6) With the Brush Tool activated, and “Layer 1” highlighted, move the cursor over the detected nest and draw a circle around it by clicking and holding the mouse’s left button as you drag the pointer around the nest. Release the mouse button to stop drawing. If satisfied with the circle, click on the hand icon  (the Hand Tool) to continue panning and looking for more nests. When circling birds other than DCCO, it is beneficial to identify the birds using the four letter codes for species. This process helps later when counting species for data entry.
 - 7) If a mistake is made marking, it can be erased with the  icon (the Eraser Tool) on the vertical left hand side toolbar. To change eraser settings, click on the **Brush** drop-down menu and set the **Master Diameter** to “45 px,” the **Hardness** to “100%,” and **Mode** to “brush.”
 - 8) Once you are confident that all nests within that picture have been detected and circled appropriately with the right color, the picture must be saved. To save the picture click on **File** and select **Save As...** and a dialog box opens. Navigate to the correct folder where the photo is to be saved. Select “JPEG (*.JPG;*.JPEG;*.JPE)” from the **Format** drop-down menu. Check the **As a Copy** box under **Save Options**. Follow this naming convention: YYYYMMDD_BISC_BirdFlight_00##_copy.jpg and ensure the word “copy” is in the file name. Click **Save**. A dialog box named **JPEG Options** opens. Under **Image Options** set the **Quality** to “8” and select “High” resolution from the drop-down menu. Click **OK**. The picture is saved in your folder as a copy.
 - 9) The folder you’re working in now contains the original picture and the marked copy just created. The original copy can now be moved to the “Not_used” folder previously created. To move your original picture, click on it to drag and drop it in to the “Not_used” that folder.
 - 10) Make sure to close the photos you worked on in Photoshop. The system will ask to save the photo again – disregard the message and close the photo. This prevents the accumulation of open photos in Photoshop.
 - 11) Evaluate the next photo and repeat the process.

Active Nests Definition: Occupied and Non-occupied

For this survey it is imperative to have a set of guidelines when defining active nests. Active nests can be occupied or non-occupied. Defining the criteria for the types of nests aid in consistency among people performing circling and is useful for training purposes. Figures SOP E-2 through SOP E-5 demonstrate the criteria for active nests as defined by the SFCN.



Figure SOP E-2. The nest pictured above is an example of a non-occupied nest. Although the nest is empty, it appears maintained; it has a bowl shape and maintains structure. This nest is not occupied thus it is counted as an empty nest. This nest would be circled in blue.



Figure SOP E-3. The photo above shows an adult bird sitting on a nest. This nest would be circled in yellow.



Figure SOP E-4. This picture shows an adult bird with two chicks. This photo would be circled with magenta to indicate a chick in the nest. Chicks range from hatchlings to juveniles.



Figure SOP E-5. This last active nest photo shows eggs in the nest. Although no bird is present, this nest is considered active and occupied. A nest with eggs, with or without a bird is present, is circled with cyan.

Printing Photographs Using ThumbsPlus

ThumbsPlus is used to print photographs for processing. After opening the ThumbsPlus program, proceed with the following steps:

- 1) Click on the SFCN folder. Several folders will drop down.
- 2) Click on the Vital_Signs folder. Several folders will drop down.
- 3) Click on the Colonial_Nesting_Birds folder. Several folders will drop down.
- 4) Click on the Images folder. Folders documenting each year of photographs taken will drop down.
- 5) Click on the appropriate year. Folders for each month will appear. Note: the files are named using the following format: YYYYMMDD_BISC_BirdFlight (e.g. 20111220_BISC_BirdFlight).
- 6) Click on the flight desired. Folders of the specific islands will drop down.
- 7) Click on the appropriate island folder. The photos processed earlier with circled bird nests will appear on the screen.
- 8) Highlight the first photo for printing by clicking on it. Start the process to print the photo, after making sure the print settings, print setup, and printer properties are set as follows: Click on Printer, Set the Orientation to Landscape, Click Properties... then click the Paper/Output tab and set as follows:

- a) Job Type: Normal Print
 - b) Paper: Letter (8.5x 11")
 - c) 2-Sided Printing: 1-Sided Print
 - d) Stapling: None
 - e) Print Quality: High Speed
 - f) Output Destination: Center Tray
 - 9) Under the Color Option Tab:
 - a) Color Correction: Automatic Color (Recommended)
 - b) After selecting the setting, click on **OK** to exit the first window, then click on **OK** again to exit the second window. Print the photo.
 - c) Once the picture is printed, make sure the picture format and name are correct. It is good practice to print one picture first in case the print settings are wrong, this may prevent a waste of time and resources if the settings are incorrect.
 - d) After the proper settings are confirmed, the remaining pictures can be selected for printing.
- Note: printing several pictures may occupy the printer for several minutes.

Counting Occupied and Non-occupied Active Nests

As an overview, once all the nests are circled on all the photos for a single colony, the photos are printed out (with nests circled) and laid out on a large table to eliminate cases when the same nest is circled on more than one photo, and then all remaining nests are counted.

The process in greater detail is described as follows: photographs that are marked with circled occupied nests are printed for further processing. Once printed, these photographs are laid out in sequential order so total active nests (circled nests) can be counted. The photographs are processed in the order they were taken by a single technician working on an entire colony. As there is often overlap between adjacent photos, to ensure nests are not counted more than once, the circled nests that appear on multiple photos are crossed out from all additional photos in which they are repeated. It is critical to make sure nests are not counted more than once. It is beneficial to write down totals of the various circled nests in the margin of each photo so this information can be recorded on the photo processing data sheet. It is good practice to write nest counts on the bottom margin of the photo processing data sheet – this facilitates review of the work. Occasionally a nest may be categorized one way in one photo and another way in the next photo(s). It is up to the analyst to determine the best view of the nest and make a determination – asking for a second opinion can be helpful. Occasionally it is helpful to review photographs on the computer screen for additional analysis. When a nest is seen as an active empty nest in one photo, and a subsequent photo shows a bird, it is appropriate to eliminate the empty nest count and recount the nest as occupied. Looking through several photos of a nest may reveal an egg or a chick, and so the nest may be re-categorized. The active nest quantities (occupied and not) are entered on the data sheets and categorized by nests with adults, nests with chicks or juveniles, nests with eggs, and non-occupied nests. There is a prioritization to how nests are categorized: an empty nest is overridden by an occupied nest. The priority for occupied nests is as follows: a nest with egg(s) is greater than a nest with chicks which is greater than a nest with only adult(s). Remember, each nest can only be counted once. This information is then entered into the SFCN Colonial Bird Monitoring database. When entering active

nests into the database, the quantity of nests with chicks and nests with eggs are separated for data purposes, but are included in the total occupied nest count. Note that birds observed during a survey are not included in the count of active nests, but their quantities are estimated and maintained in the 'observed section' data base. These data can be used to create an Observation Report providing a more complete picture of birds using the park.

Standard Operating Procedure F: Data Entry, Data Proofing, and Reporting

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

F.1 Introduction

Both the field observation and photo processing data sheets are entered directly into a Microsoft Access database. This database is located at:

Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\SFCN_ColonialBirds.mdb

When the Access database is opened, it shows a startup form with buttons for common database tasks and a brief database summary (Figure SOP F-1). Clicking on one of these buttons allows for data entry, data viewing/editing, report viewing, and producing graphs.

SFCN Colonial Bird Monitoring Database

last modified 03/04/2013

Which task would you like to perform?

Add Survey View/Edit Survey View Reports Open Graphing Template

Database Summary:

Number of Surveys: 57 Latest Survey: 5/20/2014

	Double-crested Cormorant Observed nesting on 55 surveys High nest count: 1048 (Apr 2014)		Roseate Spoonbill Observed nesting on 26 surveys High nest count: 12 (Jan 2011)
	Great Blue Heron Observed nesting on 45 surveys High nest count: 11 (Mar 2014)		Reddish Egret Observed nesting on 10 surveys High nest count: 1 (Apr 2012)
	Great White Heron Observed nesting on 49 surveys High nest count: 25 (Jan 2011)		White Ibis Observed nesting on 25 surveys High nest count: 92 (Apr 2010)
	Tricolored Heron Observed nesting on 22 surveys High nest count: 3 (Apr 2010)		Osprey Observed nesting on 8 surveys High nest count: 2 (Mar 2010)
	Great Egret Observed nesting on 38 surveys High nest count: 21 (Mar 2010)		Bald Eagle Observed nesting on 21 surveys High nest count: 2 (Feb 2009)

Figure SOP F-1. Startup form for the SFCN Colonial Bird Monitoring Database.

Clicking the ‘Add Survey’ button will open a form where all the information for a particular bird flight can be entered. This includes flight information, photo processing information, as well as the information harvested from the actual photographs (Figure SOP F-2).

Figure SOP F-2. SFCN Colonial Bird Monitoring Data Entry form.

The data entry form is designed to flow from top to bottom. The first pieces of information entered should be the NPS park unit, flight date, any applicable weather conditions, the name of the front observer and photographer, aircraft used, the name of the pilot, the type of survey, and the survey method. The park and flight date are absolutely essential, and if they are not entered, nothing will be saved for the flight.

For a month during which a survey was missed, enter the “NPS Park Unit”, “Survey Type” as “Routine”, enter the “Flight Date” as MM/15/YYYY to give a date in the middle of the month, and click the checkbox labeled “Not Flown”.

The remainder of the form applies to a particular site during a flight. This section is filled out by first selecting a site name, which will automatically be limited to those in the current park unit. Additional details such as the processing date, name of the photo processor, and comments should also be recorded here. If no nests were observed in the photographs, the checkbox next to ‘No Nests Observed?’ should be checked. Otherwise, proceed down the form to the remaining sections. If any photographs have been tagged for this site in ThumbsPlus, they will automatically show up as hyperlinks in the Photo Filenames section. Clicking on one of these photo links will open it in your web browser. Photographs can still be tagged in ThumbsPlus after data entry, and they will automatically link to the field data.

Finally, all the bird and nest observations need to be entered in the lowest part of the form in the section that looks much like a spreadsheet. For each species, select the species name from the first box, and then proceed to enter the number of occupied nests, nests with chicks, nests with eggs, and non-occupied nests observed in photographs. The final two boxes allow for the entry of estimated bird/nest count observations from the helicopter. These are useful because sometimes a species is routinely observed such as Magnificent Frigatebird (*Fregata magnificens*) but has not yet been shown to nest in Biscayne National Park. There are also rare situations where the front observer might spot several nests from the air, but for some reason those nests could be missing from the photographs. In situations like this, the observation from the helicopter would alert us to a problem.

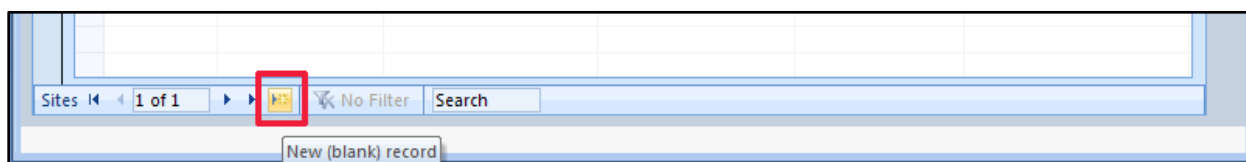


Figure SOP F-3. Clicking the arrow inside the red box allows you to proceed to the next site for data entry.

When all the data for a site has been entered, click the small arrow button near the bottom of the form (Figure SOP F-3) to advance to a blank record where an additional site can be entered. The small backward/forward arrows in this same region of the window allow for movement between the sites that were visited during a flight.

When done with data entry for the entire flight, click the ‘Close Form’ button or the X in the upper right of the form to return to the startup form. Within Microsoft Access all data is saved as it is typed into a form. Click the ‘Add Survey’ button and repeat the data entry steps for each additional new survey.

To edit a survey that has already been entered (either completely or partially), click the ‘View/Edit Survey’ button and another form will show all the flights that can be edited. Click on the small box out in front of the desired flight to select it (Figure SOP F-4). When this occurs, the button on the

lower left side of the screen will update to show the date of the flight about to be edited. Confirm this decision by clicking this button. The standard data entry form will appear on screen prefilled with any existing data for that flight. If necessary, click the small backward/forward arrows near the bottom of the form (to the left of “Sites”) to move between the various sites (i.e., bird colonies) that were visited on this flight.

View/Edit Survey

Select the flight to edit by clicking the box in front of a date. Then click the "Edit this Flight" button to make changes.

☐ limit list to current year

Survey Date	Park	Front Observer	Photographer	Sites	Photos	QAQC %
12/5/2012	BISC	Robert Muxo	Judd Patterson	7		100%
11/6/2012	BISC	Tony Pernas	Raul Urgelles	6		100%
9/26/2012	BISC	Kevin Whelan	Raul Urgelles	6		100%
7/20/2012	BISC	Raul Urgelles	Joaquin Alonso	6		100%
6/12/2012	BISC	Kevin Whelan	Raul Urgelles	6		100%
4/25/2012	BISC	Joaquin Alonso	Robert Muxo	6		100%
3/14/2012	BISC	Joaquin Alonso	Robert Muxo	6		100%
2/23/2012	BISC	Robert Muxo	Raul Urgelles	2		100%
2/16/2012	BISC	Kevin Whelan	Raul Urgelles	7	57	100%
12/20/2011	BISC	Raul Urgelles	Robert Muxo	6		100%
11/22/2011	BISC	Raul Urgelles	Robert Muxo	6		100%
10/25/2011	BISC	Joaquin Alonso	Robert Muxo	6		100%
9/23/2011	BISC	Raul Urgelles	Robert Muxo	6		100%
8/29/2011	BISC	Robert Muxo	Raul Urgelles	6		100%
7/29/2011	BISC	Robert Muxo	Raul Urgelles	6		100%
6/30/2011	BISC	Kevin Whelan	Raul Urgelles	6		100%
5/24/2011	BISC	Joaquin Alonso	Raul Urgelles	6		100%
4/19/2011	BISC		Raul Urgelles	6		100%
3/23/2011	BISC	Raul Urgelles	Joaquin Alonso	6		100%
2/17/2011	BISC	Raul Urgelles	Joaquin Alonso	7		100%
1/19/2011	BISC	Raul Urgelles	Joaquin Alonso	6		100%
12/20/2010	BISC	Kevin Whelan		6		100%
12/17/2010	BISC	Kevin Whelan	Joaquin Alonso	6	44	100%

Edit this flight

Figure SOP F-4. This page is used to edit flights previously entered by selecting the appropriate date. Note the 'Survey Date' of 2/16/12, shows 57 'Photos' linked from ThumbsPlus.

F.3 Data Proofing

Once all data has been processed and entered, the SFCN data management plan requires 100% verification of the data entry. This is completed by first printing out a report of the data and manually comparing the printout to the original datasheets. To print this report, click the “View Reports”

button on the startup form and click the “Data Verification: QA/QC Report” button. This automatically generates a report for all flight/colony combinations that are not already set as verified. This report (Figure SOP F-5) can then be printed and any discrepancies with the original datasheets are marked in red so the project leader can review and correct them in the database. The project leader initials and dates the printouts when the corrections have been entered into the database.

QA/QC Report

SFCN Colonial Birds - QA/QC Report

6/12/2012

Ragged Key 5

Species	Occupied	Chicks	Eggs	Empty
DCCO	74	1		67

Mangrove Key

Species	Occupied	Chicks	Eggs	Empty
DCCO	26	2		

Arsenicker Key

Species	Occupied	Chicks	Eggs	Empty
DCCO	178	7	3	1
GREG	1			
WHIB	28		1	0
GWHE	2	1		

West Arsenicker

Species	Occupied	Chicks	Eggs	Empty
GBHE	3	2		
GWHE	2			

Figure SOP F-5. QA/QC report used for 100% data verification.

The second stage of verification is to make sure that the photographs are linked with ThumbsPlus. This is done by viewing each colony in the Microsoft Access Colonial nesting Bird database and confirming that hyperlinked filenames appear in the “Photo Filenames” section of the data viewing form. If photographs are not visible, they can quickly be added using the steps in SOP C.

When data verification has been completed for each site, the “Checked?” checkbox in the middle-right of the form should be clicked and the name of the person who did the verification should be

selected from the drop-down menu that appears. This provides an easy way to follow the progress of data verification.

Additionally, the SFCN data management plan requires a 10% check of the verified data as an additional safeguard against data errors. This 10% check starts by running a query that randomly selects 10% of the flight date/colony pairs between two given dates. To locate this query, click the “View Reports” button on the startup form and click the “Data Check: 10% Random” button. Follow the on-screen prompts to set a start and end date for the random draw, and a query will be displayed with a random selection of flight/colonies pairs. Each chosen flight date and colony should be viewed within the database and the data checked against the original datasheets. If any errors are found, that particular flight must go through 100% verification again.

F.4 Quick Reports

To generate and view/export/print quick data reports, click the ‘View Reports’ button on the startup form. The form that appears (Figure SOP F-6) accepts user input of several options before a data summary query is displayed on screen. This query can be copied and pasted into another program or exported by clicking the “External Data” tab and choosing “Excel” from the Export section.

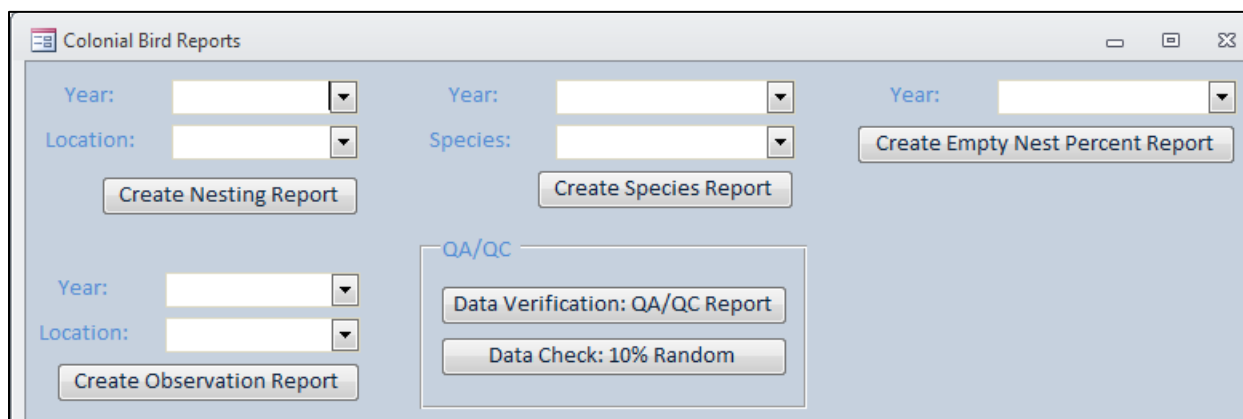
The screenshot shows a software window titled "Colonial Bird Reports". Inside, there are three main sections for generating reports. The top section has three columns: the first with "Year:" and "Location:" dropdowns and a "Create Nesting Report" button; the second with "Year:" and "Species:" dropdowns and a "Create Species Report" button; and the third with a "Year:" dropdown and a "Create Empty Nest Percent Report" button. The bottom left section has "Year:" and "Location:" dropdowns with a "Create Observation Report" button. The bottom right section is titled "QA/QC" and contains two buttons: "Data Verification: QA/QC Report" and "Data Check: 10% Random".

Figure SOP F-6. Several basic data summarizes are available after clicking the “View Report” button.

F.5 Data Sheet Storage and Photograph Storage

The colonial nesting bird monitoring effort produces printed photographs, field data sheets, photo processing data sheets, and print outs of entered data for quality assurance/ quality control. The data sheets and processed photographs are placed in binders segregated by year, month, and island colony (in alphabetical order). The DVDs containing photographs and GPS data are also stored in the same binders. These binders are stored in the SFCN office, available for reference and review.

F.6 Data Summary Report

For the first year, a sample data summary report has been included in this document and can be used as a template for creating the first data summary report for BISC (Appendix 4). In subsequent years, the easiest approach will be to simply edit the previous year’s data summary report and update the tables and graphs as it will have received formatting review from the WASO office and any problems

will have been fixed. The wording of the introduction and methods section require only changes to meet the specific monitoring of that year. However if a new Natural Resource Data Series (NRDS) template has been released from the WASO office, then the contents of the most recent data summary will need to be cut and pasted into the new template and updated.

- 1) Check to make sure no new data summary templates (NRDS) have been released by checking <http://www.nature.nps.gov/publications/nrpm/nrrntr.cfm>

If the date on the latest template is after the publication date of the previous version of the data summary, then the contents will need to be shifted to the new format. This helps ensure the report meets all NPS requirements.

- 2) If there is no new template, then simply save last year's report with a new name and update the report methods with specific flight dates, any specific changes in implementation of the protocol, etc. from that year.
- 3) Work with the Data Outreach Technician or the GIS specialist to update Figure 1 as necessary.
- 4) Note: For graphs to display correctly, missing months when flights did not occur must be entered into the database as described in section F.2 Data Entry above.
- 5) Open the colonial nesting birds database (SFCN_ColonialBirds.mdb) and click the "Open Graphing Template" button (See Figure SOP F-1).

The database exports the photograph analysis data and field observation data from the park-wide census and the routine monthly colonial nesting birds surveys into the graphing template:

..\Colonial_Nesting_Birds\data\BISC\Graphs\Colonial_Birds_Graphing_Template.xlsx

The file will open automatically. SAVE IT TO A NEW FILE NAME BEFORE MAKING ANY CHANGES SO YOU DO NOT OVERWRITE THE TEMPLATE.

- 6) Click the "Data" worksheet tab at the bottom and verify that data has exported into the template as anticipated (Figure SOP F-7).

	Start Date	Loc Name	Species Code	Common Name	Family	Order	Photo Occupied Nests	Photo Nests With Chicks	Photo Number
4	4/19/2011	Soldier Key	GWHE	Great White Heron	Ardeidae	Ciconiiformes	1		
5	4/19/2011	Soldier Key	DCCO	Double-crested Cormorant	Phalacrocoracidae	Pelecaniformes	140	6	
6	4/19/2011	Ragged Key 5	DCCO	Double-crested Cormorant	Phalacrocoracidae	Pelecaniformes	296	33	
7	4/19/2011	West Arsenicker	BAEA	Bald Eagle	Accipitridae	Falconiformes	1	1	
8	4/19/2011	West Arsenicker	GREG	Great Egret	Ardeidae	Ciconiiformes	8	2	
9	4/19/2011	West Arsenicker	UNID	Unidentified					
10	4/19/2011	West Arsenicker	GBHE	Great Blue Heron	Ardeidae	Ciconiiformes	2	2	
11	4/19/2011	West Arsenicker	GWHE	Great White Heron	Ardeidae	Ciconiiformes	4	2	
				Threskiornith					

Figure SOP F-7. After the graphing template opens click on the "Data" worksheet (circled).

- 7) To update the species list (Table Appendix 4-1), click on "SpeciesList_tbl" worksheet. Change the SampleYear (highlighted in yellow) to the current year.
- 8) Review the list of species' for any that are important to highlight in the written text. For example, if Brown Pelicans or Magnificent Frigatebirds were detected nesting in the park, this would be important news to highlight in the written summary and the following graphs may need to have their species list adjusted.

	A	B	C	D	E	F
1	SampleYear	2013				
2						
3			Values			
4	CommonName	SpeciesCode	Photographed nests	Field Observed Birds		
5	Anhinga	ANHI	4	9		
6	Bald Eagle	BAEA	1	2		
7	Black-crowned Night-Heron	BCNH		5		
8	Brown Pelican	BRPE		73		
9	Double-crested Cormorant	DCCO	4260	3686		
10	Great Blue Heron	GBHE	25	36		
11	Great Egret	GREG	72	99		
12	Great White Heron	GWHE	74	125		
13	Laridae family gull	LARI		3		
14	Laughing Gull	LAGU		10		
15	Little Blue Heron	LBHE	1	24		
16	Osprey	OSPR		4		
17	Roseate Spoonbill	ROSP	8	34		
18	Royal Tern	ROYT		2		
19	Snowy Egret	SNEG	1	21		
20	Tricolored Heron	TRHE	1	144		
21	Turkey Vulture	TUVU	1	35		
22	Unidentified	UNID	30	5		
23	Unidentified Dark Bird	UNDA	3			
24	Unidentified White Bird	UNWH	29	64		
25	White Ibis	WHIB	131	170		
26	White-crowned Pigeon	WCPI		4		
27	Grand Total		4641	4555		

Range
to copy

Figure SOP F-8. Screenshot showing SpeciesList_tbl worksheet with the year to be adjusted in yellow and range to copy into report highlighted.

- 9) Highlight the table from Row 4 to the end, right-click and select “Copy”.
- 10) Switch to or open the data summary report. Delete Table 1 by clicking on the “+” in the upper left hand corner of the table, right-click, and select “Delete Table”.

↓

Table 1. List of species detected in 2013. Numbers in this table should not be used as true abundance estimates as nests and birds were likely observed during more than one sample period.

CommonName	SpeciesCode	Total Photographed Nests	Total Field Observed Birds
Anhinga	ANHI	4	9
Bald Eagle	BAEA	1	2

Figure SOP F-9. Screenshot showing point to click on a table that selects the entire table for easy deletion.

- 11) Right-click to insert the new table and select “Paste” then “Keep Source Formatting”. This pastes the table in as a MS Table but formatted like it is in Microsoft Excel. Reformat the table as desired.

Table 1. List of species detected in 2013. Numbers in this table should not be used as true abundance estimates as nests and birds were likely observed during more than one sample period.

CommonName	SpeciesCode	Photographed nests	Field Observed Birds
Anhinga	ANHI	4	9
Bald	EA	1	2
Bald	NH		5
Brown	PE		73
Double-crested Cormorant	DCCO	4260	3686
Great	GBHE	25	36

Figure SOP F-10. Screenshot showing the “Keep Source Formatting” button. This should be used for pasting already formatted tables from Microsoft Excel.

- 12) For percent nesting by month (Table Appendix 4-2), switch to “PctNestByMonth_tbl” worksheet. Adjust years displayed as necessary by first clicking on a year to activate that field, then clicking on the “filter” symbol  and selecting the years to display. In the example below, 2009 is not included as half the year is missing, and 2014 should be unclicked as this sampling year is not yet complete. Currently the table used “Conditional Formatting” to highlight months with >0% nests and highlight in dark blue months with $\geq 20\%$ nests recorded (these can be changed). Delete Table 2 in the report and copy and paste the table as described above. The “Grand Total” column is not needed nor is the first row with “Sum of TotalActiveNests”. Delete the 0% in cells for which there was no flight. Reformat table within MSWord if desired.

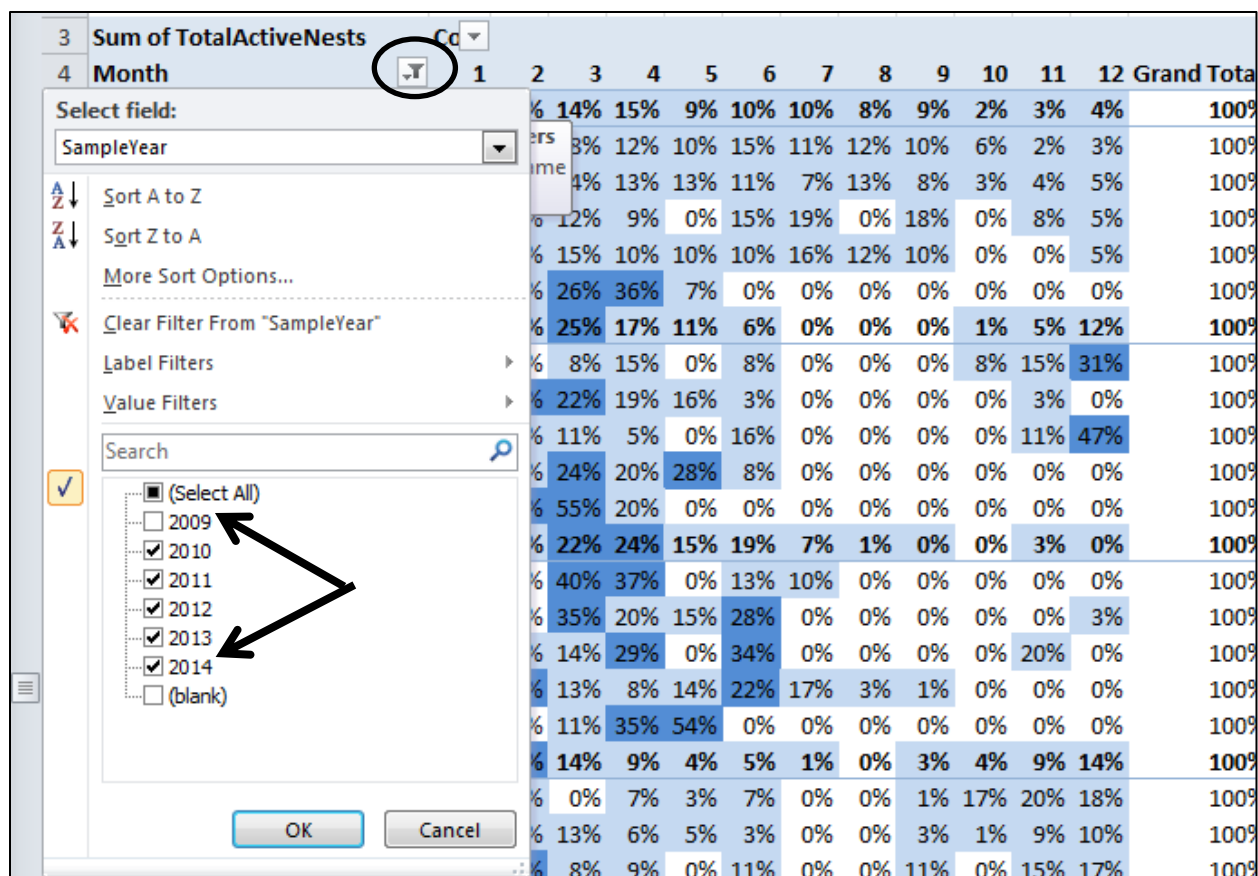


Figure SOP F-11. Screenshot showing the filter icon and where to update the years in PctNestingbyMonth_tbl worksheet.

- 13) For the table printout of all the routine and census data (Table Appendix 4-3), switch to “BigTable_tbl” worksheet in Microsoft Excel. Repeat steps above to replace Table 3. Highlight the whole table. Select “Table Tools” at the top of the screen, then the “Layout” menu, then the “Cell Margins” button. Change the Left and Right Margins to 0.02”. Then Right-Click and under “Table Properties” set “Preferred Width” to 7.5”. This should cause the table to resize to fit on one page. See how to appropriately format tables on multiple pages in the NRDS template guidance. Otherwise reformat the table as desired, e.g. add lines between years, etc. Add “NF” to the year lines to designate months with “No Flight”

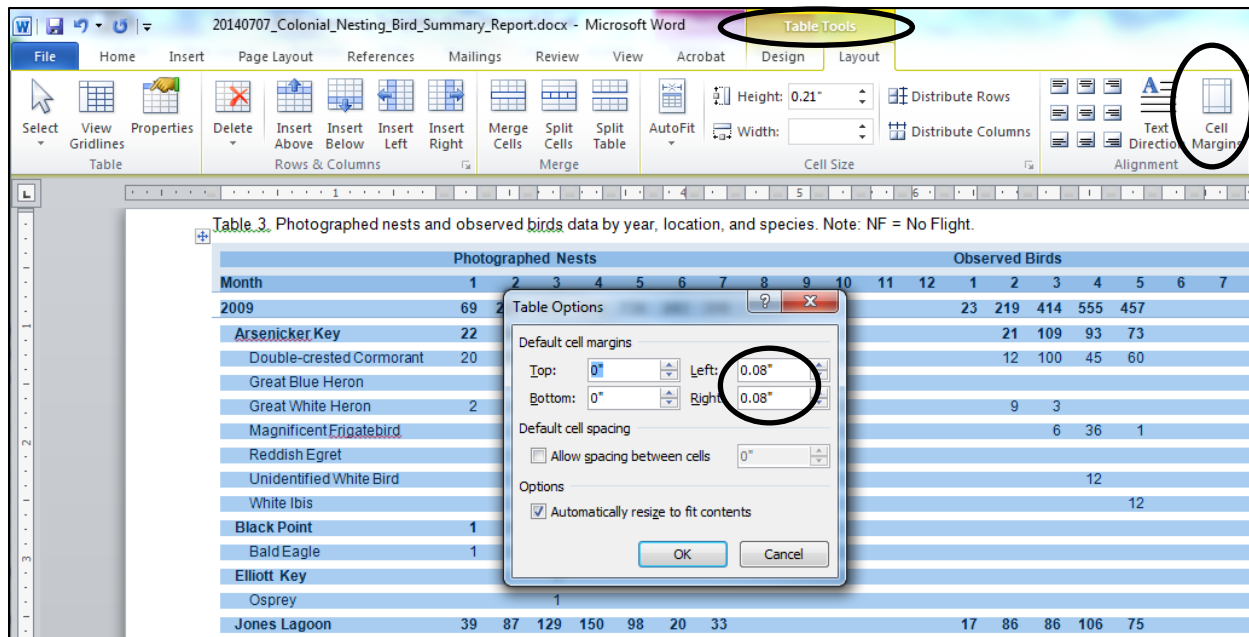


Figure SOP F-12. Screenshot showing location of the “Table Tools” menu, the “Cell Margins” button, and where to change the cell margins to help the table fit onto the page.

- 14) For the graphs showing the number of nests detected each month by species (Figures Appendix 4-2 thru 4), switch to SpeciesBySamplingPeriod_gr worksheet. To trim the graphs to show only to the end of the calendar year, click on a year in each table and then click on the filter button to select/unselect years as appropriate. Click on the Double-crested Cormorants figure. Right-click and select “Copy”. Switch to the MSWord Document. Delete the old graph. Insert the new graph by right-clicking and selecting “Paste” and then “Picture”. Resize as appropriate. Repeat for other two graphs.
- 15) For the graph showing the number of colony locations by species (Figure Appendix 4-5), click on “NumColonies_gr” worksheet. Scroll to right to see the graph. Update the years, species, and locations on the pivot table above the graph if necessary. For example, if brown pelicans are found nesting in the park, this species will need to be selected and added to the table for it to appear in the graph. Likewise if new colonies are found in the park, their locations will need to be added to the Loc_Name checkoff list. Copy and paste the graph into the MSWord document as a picture as described above in step 13.

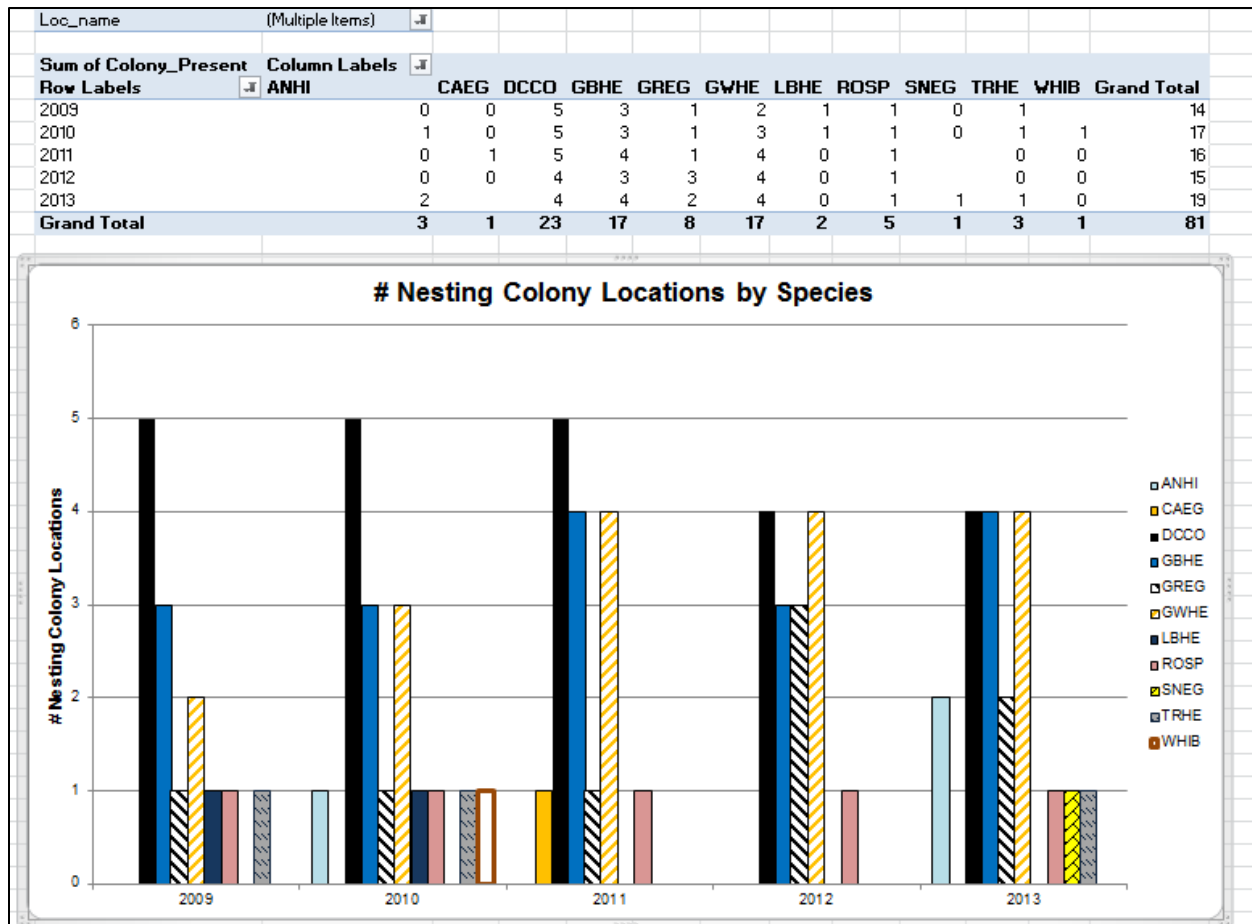


Figure SOP F-13. Screenshot showing graph of number of nesting colony locations by species with the pivot table that creates it above. The years should be adjusted in the pivot table. New colony locations should be added under “Loc_Name” and new colonial nesting bird species observed nesting under “Column Labels” as appropriate.

- 16) For the graphs of the number of species detected nesting in each colony (Figure Appendix 4-6), click on the SpRich_gr worksheet. Scroll to the right to see the graph. Update the table below the figure for years, nesting species codes, and add any new colony locations as appropriate using the various filters. Copy and paste the figure into the MSWord document as a “Picture” as described above in step 13.

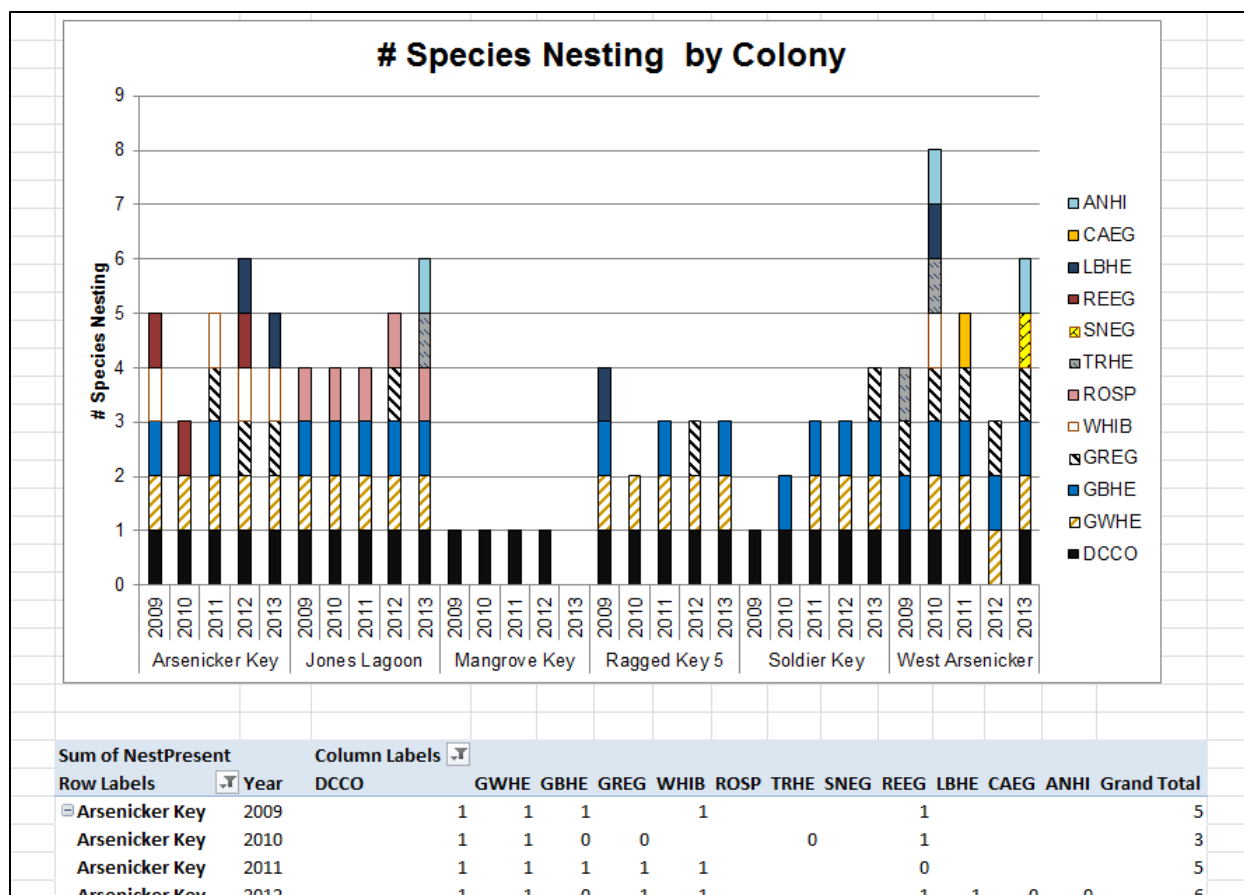


Figure SOP F-14. Screenshot showing number of species nesting by colony with related pivot table below from worksheet SpRich_gr. The years should be adjusted in the pivot table. New colony locations should be added by clicking on a location like “Arsenicker Key” and clicking the filter button and new colonial nesting bird species observed nesting by clicking the filter button to the right of “Column Labels”.

- 17) For the graphs of the total peak nest counts across all colonies (Figure Appendix 4-7) and then within each colony (Figure Appendix 4-9), click “PeakNest_gr” worksheet. Scroll to the right and update years on the pivot tables above each of the graphs. Delete the previous graphs but not the legend for Figure 8. Follow steps above for copying and pasting graphs into the report. Resize the six colony peak nest count graphs so that six can fit on one page. If new colonies are located, a new colony specific graph will need to be added to the graphing template.
- 18) Repeat step 17 for nesting index graphs (Figure Appendix 4-8 and 4-10) using graphs on the “NestingIndex_gr” worksheet

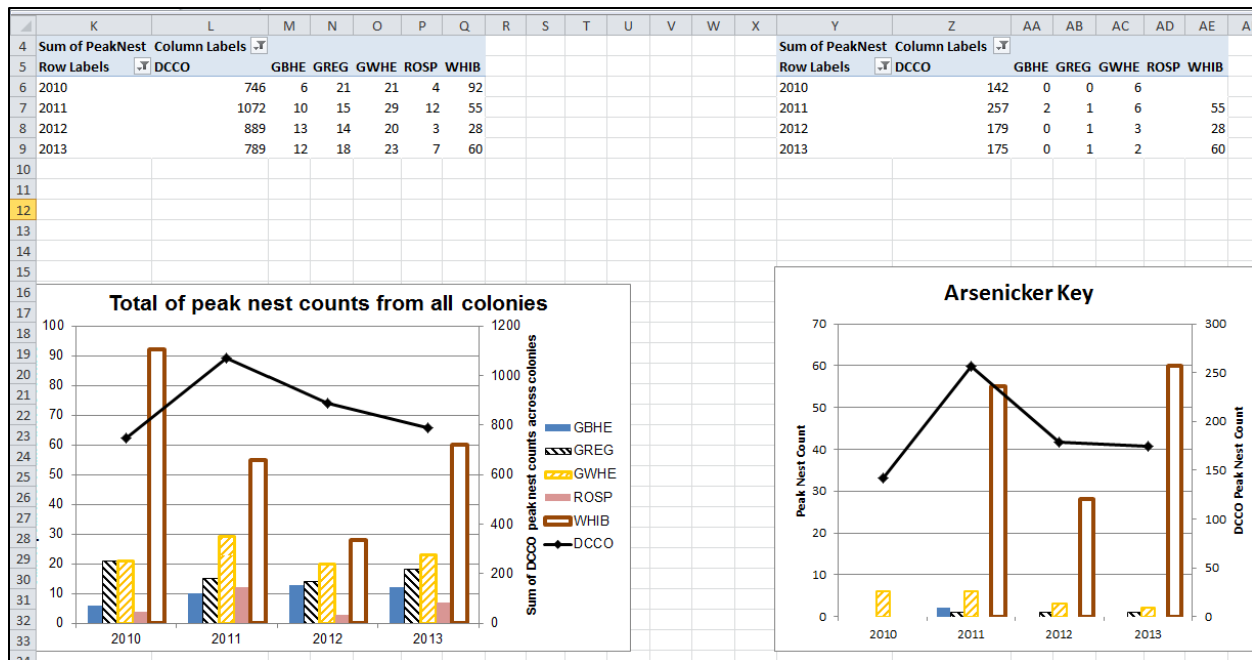


Figure SOP F-15. Screenshot showing number peak nesting across all colonies and also for Arsenicker Key from worksheet PeakNest_gr. Years should be updated on these graphs.

- 19) Make sure the publication meets 508 Compliance requirements. Using the latest NRDS template and following the self-contained instructions will meet most of these requirements. In addition:
- Tables must be in MS Word table format. They cannot be images of a table, or still in MS Excel or SigmaPlot, or set up using "typewriter techniques," e.g., using spaces and tabs on a regular line of text to create "columns."
 - Tables cannot be wider than the page margins.
 - Images must have alternate text.
 - Images, text boxes, etc. must also stay within the existing page margins.

For additional details on adding alternate text or formatting tables, etc., please see the guidance in:

Z:\SFCN_Publications\ReportGuidelines\508_Compliance\IM_PDF_Accessibility_Using_MSWord.pdf

Or any more recent guidance on <http://www.nature.nps.gov/publications/nrpn/nrrntr.cfm>

F.7 Data Analysis

Presently there is not enough data to determine the natural range of variability that should be expected within BISC in numbers of colonies, locations of colonies, peak nests and peak nesting periods. These are expected to vary with annual rainfall, amount and timing of freshwater flows into the bay, and how they in turn affect food availability within and outside the park. Separating natural background variability from actual trends will be difficult at first and will be approached cautiously and with common sense. Initially data analysis for change will consist of:

- Comparison with baseline maximum and minimum numbers of colonies, peak nesting periods, annual nesting index, and peak nesting months to see if a current year is within the range of the baseline data.
- Determination if new colonies are established or are being abandoned.
- Using a regression analysis to see if a trend is occurring in peak nesting.

An initial baseline range of the maximum and minimum number of colonies, peak nest counts, colony locations, and peak nesting months is given in Table SOP F-1. As this is a new program, an initial analysis simply involves looking for obvious changes from the baseline years and then stating as such.

Number of Colonies

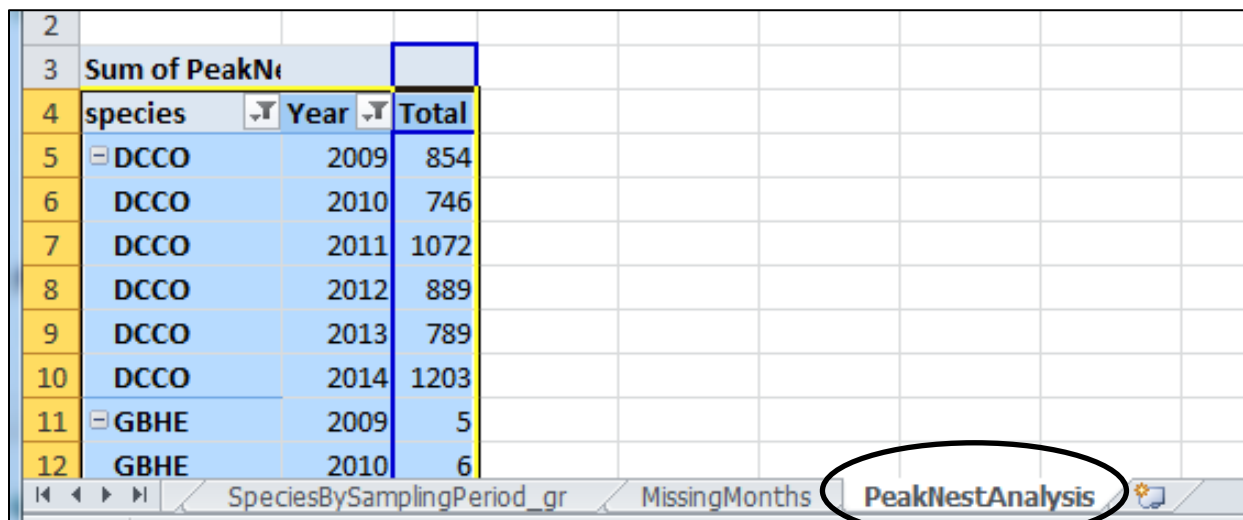
- 1) Any change in the number of colonies for top-canopy nesters is considered a difference as the monitoring completes a census for the park. White Ibis is similarly considered a census as it is a highly-visible bird even in the sub- canopy, and typically nests in large groups. The simplest approach at this time is to note whether a current year's number of colonies is outside the range seen from years 2010–2013 and whether new colonies have developed or colonies have been abandoned as the locations of colonies has been fairly stable through the development phase of this protocol.

Table SOP F-1. Initial baseline ranges from 2010–2013 of number of colonies, peak nest counts, and annual nesting index for focal species. New data outside this range may be noted as worth watching as a trend may be developing.

	Species=	DCCO	GBHE	GREG	GWHE	ROSP	WHIB
Colonies	Colonies nested at least once	All	All except Mangrove Key	All except Mangrove Key	All except Mangrove Key	Jones Lagoon	Arsenicker, West Arsenicker
	Maximum # Colonies	6	5	4	5	1	1
	Minimum # Colonies	5	3	1	4	1	1
Peak Nest Counts	Maximum Peak Nest Count	1072	13	21	29	12	92
	Minimum Peak Nest Count	746	6	14	20	3	28
	Average Annual Peak Nest Count	874	10.3	17	23.3	6.5	58.8
	Std. Deviation	145	3.1	3.2	4.0	4.0	26.2
	Peak Nesting Months	Mar–Sep	Dec–Jun	Nov–Jul	Sep–Apr	Nov–Feb	Apr–Jul
Nesting Index	Maximum Nesting Index	5880	32	81	104	21	150
	Minimum Nesting Index	4309	13	40	76	7	69
	Average Nesting Index	5196	25	56	87	13	110
	Std. Deviation	653	9	18	12	6	37
	Months Any Nesting Detected	All	Oct–Jun	All except Oct	All except Aug	Oct–Apr	Apr–Aug

Peak Nesting

- 2) For focal species, trends in peak nesting are determined by colony and then across all colonies to provide a park-wide estimate. Similar to the colony count, peak nest numbers can be compared to the range detected in 2010–2013. In addition, once five or more complete years of data have been gathered, a regression analysis may be used to evaluate trend. For species with small whole numbers (i.e., all species except cormorants) which may violate the assumption of normally distributed data, a Poisson regression analysis may be used.
 - a. To conduct the regression analysis, first copy the table in worksheet PeakNestAnalysis of the graphing template to a new Microsoft Excel file and save it as Excel 97–2003 Workbook (*.xls):
Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\exports\PeakNest.xls



species	Year	Total
DCCO	2009	854
DCCO	2010	746
DCCO	2011	1072
DCCO	2012	889
DCCO	2013	789
DCCO	2014	1203
GBHE	2009	5
GBHE	2010	6

Figure SOP F-16. Screenshot showing worksheet and table to highlight for SAS regression analysis.

- b. From a computer with SAS statistical program loaded (currently on the Quantitative Ecologist's computer), double-click the SAS program script

Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\analysis\Annual\Scripts\ColonialBirdsRegression.sas

This loads the program below into SAS 9.2.

```

* This program analyzes colonial nesting bird peak nest counts using first a
* Poisson regression (appropriate for most species) and then a regression
* assuming a normal distribution (appropriate for DCCO);

proc import
datafile="Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\data\BISC\exports\PeakN
est.xls"
out=peaknestdata replace; * reads in data file;
quit;
Data peaknestworking;
  set peaknestdata;
  if year=2009 then delete; * deletes 2009 as an incomplete year;
  if year=2014 then delete; * deletes 2014 as an incomplete year;
run;
Proc sort;
  by species year;
run;
Proc print; * prints out data to allow checking that is read in correctly;
run;
title; footnote; options pageno=1;
*** Poisson Regression Analysis ***;
proc glimmix ;
  Title "poisson distribution";
  by species;
  model Total = Year/ dist=poisson solution;
  Output pred=predglx resid=residglx;
run;
Proc plot; * plots predicted values versus residuals for poisson regression
analysis;
  By species;
  Plot residglx*predglx;
Run;
*** Regression Analysis with Normal Distribution ***;
proc glimmix ;
  Title "normal distribution";
  by species;
  model Total = Year/ dist=normal solution;
  Output pred=predglx2 resid=residglx2;
run;
Proc plot; * plots predicted values versus residuals for normal regression
analysis;
  By species;
  Plot residglx2*predglx2;
Run; quit;

```

Box F-1. SAS program script for conduction Poisson regression analysis and normal parametric regression analysis.

c. Then click the submit button

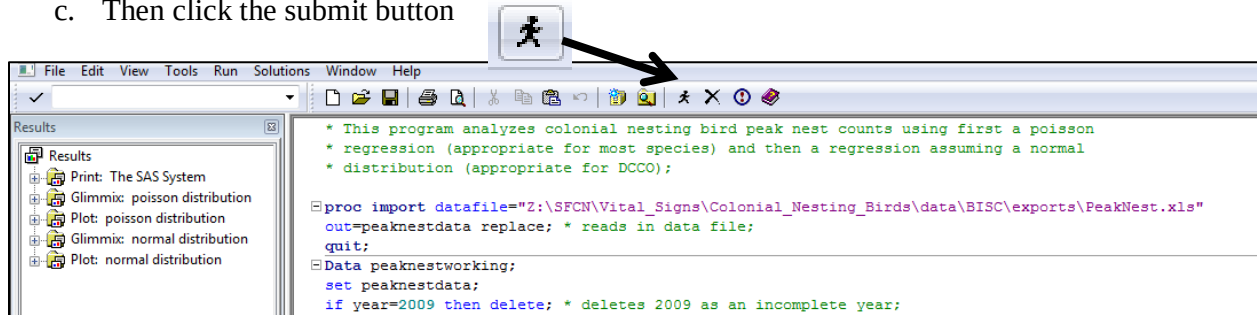


Figure SOP F-17. Screenshot showing “submit” button used to run programs.

d. Click the “Output” window to see the results and scroll to the top of the output.

e. Check that the data printed out as expected.

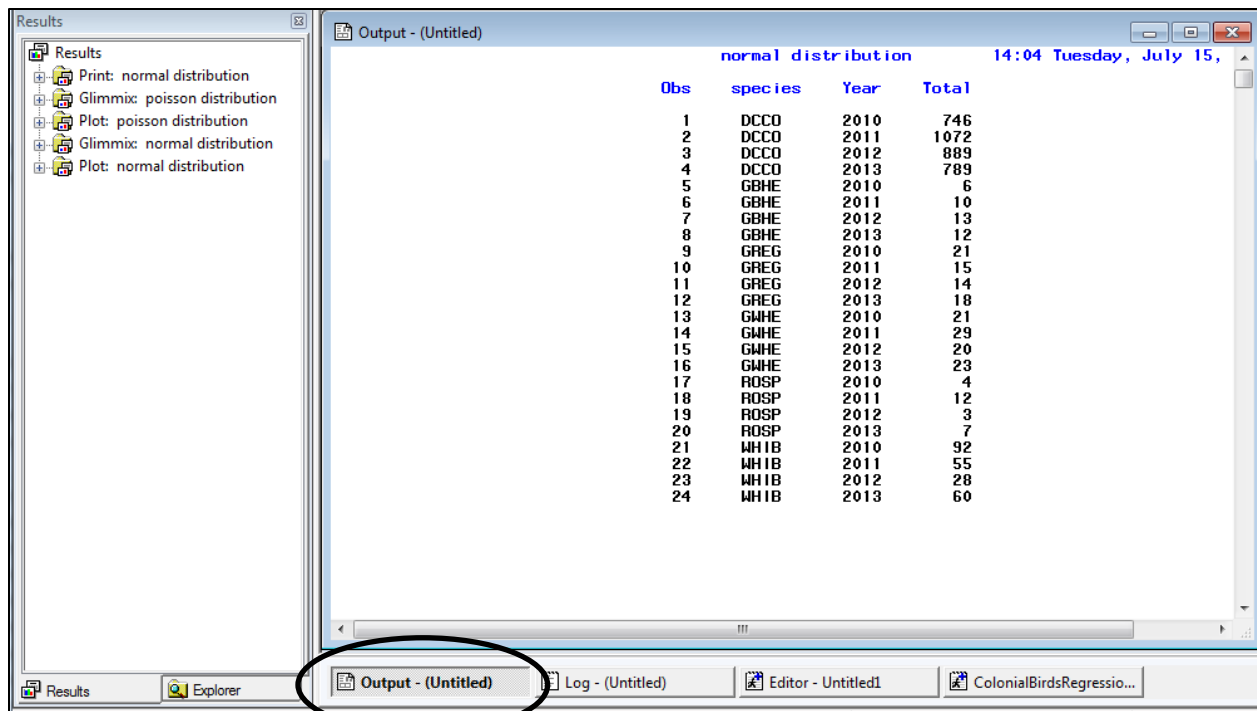


Figure SOP F-18. Screenshot showing “Output” window and initial printout of data that should be checked to make sure results were read into program correctly.

f. For GBHE, GWHE, GREG, ROSP, WHIB, scroll down to the first analysis and check that the response distribution is Poisson.

- j. Click on the Output window and select “File” and “Save As” and save the file to Z:\SFCN\Vital_Signs\Colonial_Nesting_Birds\analysis\Annual\YYYY\YYYYMMDD_ColonialNestingBirds_PeakNestRegression_2013.lst where YYYY is the last data year for the report and YYYYMMDD is the analysis date.
- k. Early trends should be interpreted cautiously as the true range of natural variability is still unknown, e.g., natural variability due to differences in annual rainfall

Annual Nesting Index

- 3) The annual nesting index is calculated as the sum of nests counted during all 12 months. The Excel graphing template will automatically interpolate values for 1–2 missing months using the averages number of nests counted in the month before and month after the missing month(s). It is important to note that the “annual nesting index” is different from the total number of nests as the same nest may be counted in more than one month. Similar statistical analyses are conducted for “annual nesting index” as for “Peak Nesting” described above.

Timing of Peak Nesting

- 4) Timing of peak nesting will need a longer baseline before it can be evaluated adequately for change. Initial results show some variability in timing of nesting within some species whereas cormorants nest year-round with possibly multiple peak nesting periods.

If No Trend is Detected Update the Control Limits

- 5) After implementation of five or more complete years of data collection, a regression analysis will be run. If no trend is detected, the maximum and minimum of the data can be updated to include 2014 as initial “Control Limits”. As more data is collected the range can be replaced with 90% and 95% calculated “Control Limits” (Montgomery 2001) which provide a quick way of evaluating whether a current year of data is outside what is expected given the initial baseline data. This process can be repeated as time moves forward, perhaps every five years.

F.8 Archiving

Secure data archiving is essential for protecting data from loss. Several different types of archiving are involved with this protocol. The types of data that are archived include:

- Field datasheets
- Photographs
- GPS trackline files
- Databases
- Scanned data sheets
- Exported flat files
- Protocol, graphing template, and analysis scripts
- Data summary reports

Annual archiving for these files starts once the designated project lead has affirmed that the appropriate QA/QC procedures for a calendar year’s data are complete and has notified the Network Data Manager that the database is ready for archiving. This should typically occur in February as the target date for the 10% QA/QC check is January.

- 1) The following are stored in SFCN Colonial Nesting Birds binders in the SFCN conference room segregated by year, month, and island colony in alphabetical order:
 - Printed photographs, field data sheets, photo processing data sheets, printouts of entered data for QA/QC.
 - DVDs and/or Blu-ray disks of photographs and GPS data.This occurs once photo analysis is complete.
- 2) The database metadata is updated including updating any new fields descriptions, table descriptions, query descriptions, form descriptions, etc. At this point the Network Data Manager places a copy of the database into the folder within the archive directory on the network server in Z:\SFCN_Archive\Vital_Signs\Colonial_Nesting_Birds\BISC\YYYY and the year _YYYY is appended to the database name. A copy of the database is also uploaded to [http:// Irma.nps.gov](http://irma.nps.gov) and stored as “NPS ONLY”. For details of uploading files to IRMA, please see <https://irma.nps.gov/content/help/datastore/index.aspx>. Once the data are archived, any changes made to the database in the archive folder must be documented in an edit log and an electronic version the database is maintained in a read-only format on the program server.
- 3) The export used for the “Data” worksheet in the graphing template should also be saved as a *.csv file with associated metadata. The metadata file and flat file are stored together in a zip file ColonialBirds_BISC_YYYY.zip. This is a format that can easily be sent in response to data requests. A copy of the flat file zip folders is also uploaded to [http:// Irma.nps.gov](http://irma.nps.gov) and stored as “NPS ONLY”. For details of uploading files to IRMA, please see <https://irma.nps.gov/content/help/datastore/index.aspx>.
- 4) The scanned datasheets for that year are likewise stored in same archive folder in a zip file called YYYY_BISC_DataSheets.zip.
- 5) GPS tracklines will be added into a cumulative shapefile and stored as YYYY_ColonialBirds_BISC.shp.
- 6) The version of the protocol used that year, even if changes are still in draft form and not formally published, is archived in the same folder. If there are changes to the protocol that were made that year but not yet included in the formal document, these should be described in a Colonial_Birds_Protocol_Readme_YYYY.docx . This document does not need to be formal but should be read by someone else in the office to make sure it is understandable and contains no obvious errors. The graphing template and any SAS and/or R analysis scripts used during the year should also be copied to the folder.
- 7) Data summary reports are archived once they are published in the Natural Resource Report Series and their report numbers received. PDF versions of data summary reports are copied to the same archive folder described above and loaded to IRMA and made available to “PUBLIC” upon publication. The SFCN product tracking database is updated:
Z:\SFCN_Archive\SFCNProductTracking_20130725.mdb

Backup copies of the folders containing data and archives on the SFCN server are maintained at the South Florida office and at the Washington Office located at Fort Collins, Colorado.

Standard Operating Procedure G: Revising the Protocol

(Version 1.0)

Version #	Date	Revised by	Changes	Justification

G.1 Purpose

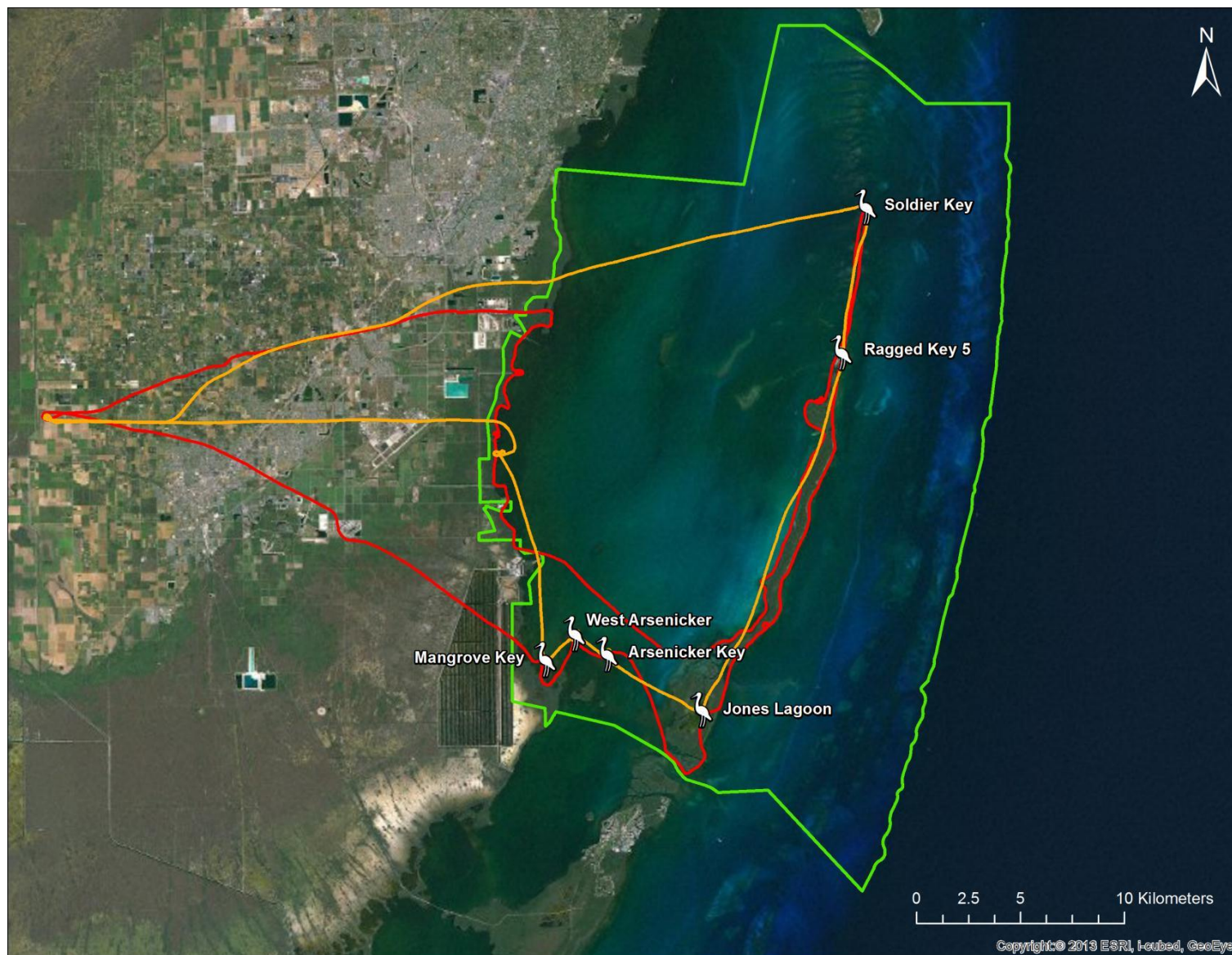
Define how changes in the protocol will occur and how they will be tracked. Changes can be suggested at any time following the procedures outline below.

G.2 Procedures

Once published in the Natural Resource Report Series, the protocol “Biscayne National Park Colonial Nesting Bird Monitoring Protocol” can only be modified through the use of a versioning system with the following guidance.

- 1) Protocols edits and versioning are tracked in the Revision History Log attached to the entire protocol and each SOP. Major changes results in an update by whole numbers (i.e., version 1.0, version 2.0, etc.) and minor changes by hundredths (e.g., version 1.01, version 1.02, etc.) Record the new version number, date of revision, author of the revision, describe the change, and provide a rationale for the change. *IMPORTANT:* Any changes to an individual SOP must also be tracked in the protocol’s Revision History Log and the version number of the protocol **MUST** be updated, even if the change is editorial and only to one SOP.
- 2) All changes must first be reviewed within the network and then sent to the Regional Network Coordinator and associated parks with a summary of changes and recommendation for whether additional scientific review is recommended. The Regional Protocol Review Coordinator will determine if additional external scientific review is necessary. In general, minor changes to the protocol will only require in-house review by network staff (e.g., editing, formatting, and switching to new software or comparable technology changes that do not fundamentally affect sampling design or data interpretation). Major changes in the protocol may require external review by subject-matter experts (e.g., fundamental changes in sampling design, field methods).
- 3) Once approved for publication, the revised protocol is submitted to WASO for formatting review and a new report number.
- 4) The data manager is informed about the changes to the protocol so the new version number can be incorporated in the project database metadata, reports, etc. The data manager may need to edit the database if the changes affect the database structure.
- 5) The new protocol version is posted on the SFCN website and <http://irma.nps.gov>, the National Inventory and Monitoring Program protocol database is updated, and copies are forwarded to all people/organizations known to be working with the previous version of the protocol.

Appendix 1 – Annual and Monthly Survey Flight Paths



Appendix 2 – Flight Information, Field Observation, and Photo Processing Data Sheets

<u>Pre- and Post-Flight Information</u>						
Date: _____						
Project Name: _____						
Observer/ Photo: _____/ _____						
Pilot Name: _____						
Aircraft make/model: _____						
Beginning/ Ending Hobbs: _____/ _____						
Fuel amount: _____						
Weather conditions: _____						
Temperature: _____						
Wind direction/speed: _____						
Cruising speed/altitude: _____						
GPS Unit: _____						

Biscayne National Park - Colonial Bird Survey
Helicopter Field Data Sheet - Mangrove Key Colony
Easting: 568810.602918233 Northing: 2808792.87449692

Date: _____ Time: _____

Mark start position on map below

Photo number sequence: _____



Species Code	Qty. Obs.	No. of nests	No. of chicks	No. of eggs
D-C Cormorant				
Magnificent Frigatebird				
Brown Pelican				
Turkey Vulture				
Great White Heron				
Great Blue Heron				
Great Egret				
Tricolored Heron				
Small White Heron				
Small Dark Heron				
Roseate Spoonbill				
White Ibis				
Bald Eagle				
Osprey				
Other (specify)				
Other (specify)				

Biscayne National Park - Colonial Bird Survey - Photo Processing Data Sheet						Initials and Date			
Flight date	Front observer	Photographer	Processing date	Photo processor	Data entered	Data checked			
Mangrove Key Colony				Easting: 568810.602918233		Northing: 2808792.87449692			
Sequence numbers of photos used (circled): _____									
Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests	Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests
DCCO					ROSP				
ANHI					WHIB				
CAEG					BAEA				
GWHE					OSPR				
GBHE					UNWH				
GREG					UNDA				
LBHE					Other (specify)				
REEG					Other (specify)				
SNEG					Other (specify)				
TRHE					Other (specify)				
Tallies:									

Biscayne National Park - Colonial Bird Survey - Photo Processing Data Sheet	Initials and Date
--	--------------------------

Initials and Date

Flight date

Front observer

Photographer

Processing date	
-----------------	--

Photo processor	
------------------------	--

Data entered

Data checked

New Colony

Easting: 00000000.00000000 Northing: 00000000.00000000

Sequence numbers of photos used (circled): _____

Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests	Species codes	Total no. of occupied nests	No. of nests with chicks (from total)	No. of nests with eggs (from total)	No. of empty nests
DCCO					ROSP				
ANHI					WHIB				
CAEG					BAEA				
GWHE					OSPR				
GBHE					UNWH				
GREG					UNDA				
LBHE					Other (specify)				
REEG					Other (specify)				
SNEG					Other (specify)				
TRHE					Other (specify)				

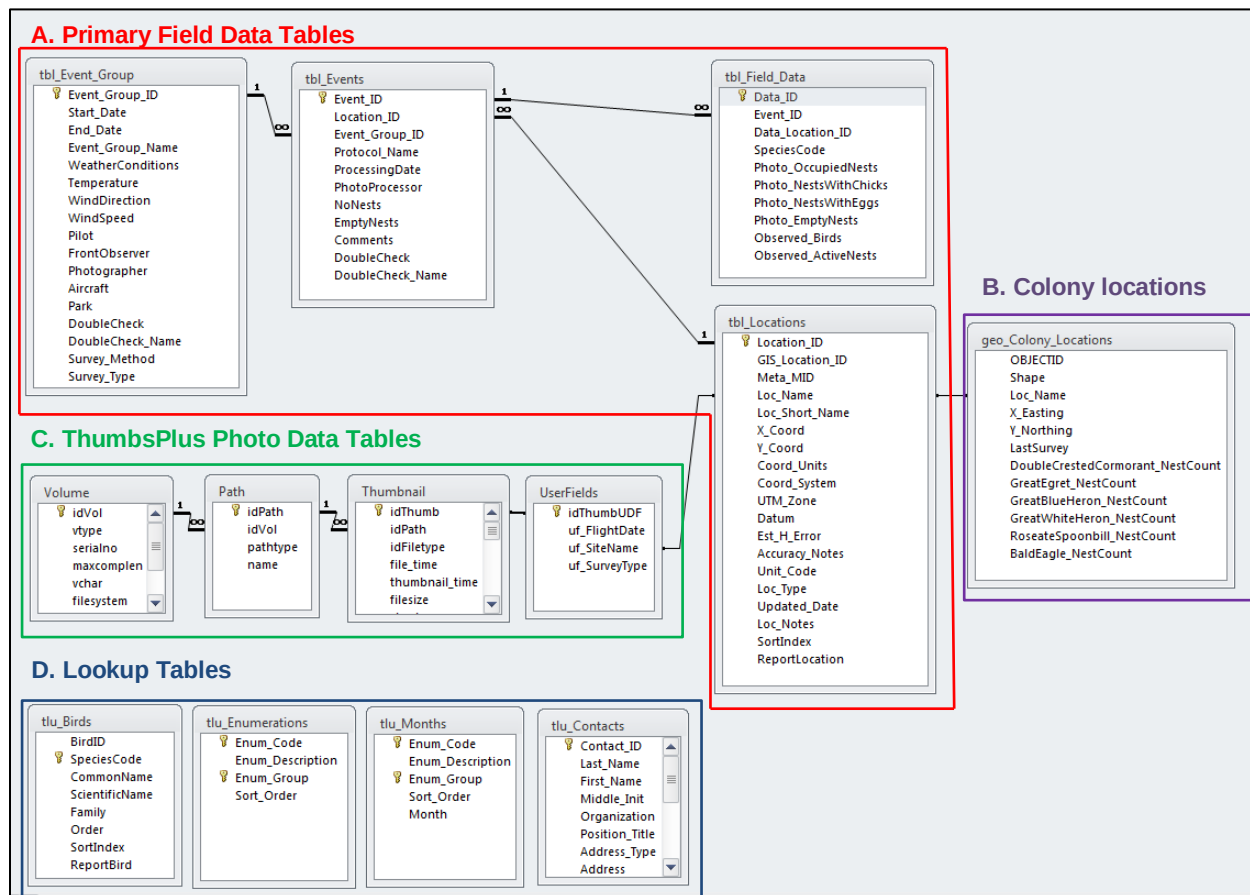
Appendix 3 – Database Descriptions and Definitions

Colonial Nesting Birds Database

Database name: SFCN_ColonialBirds.mdb

Description: Microsoft Access 2010 database that contains

- A) Primary field/photo processing data;
- B) Colony locations featureclass controlled by ArcGIS;
- C) Photo data entered via ThumbsPlus; and
- D) Lookup tables with commonly referenced values.



Database Table Descriptions and Field Definitions

Table: geo_Colony_Locations

Description: ArcGIS geodatabase feature class indicating the approximate spatial position of each bird colony.

Field Name	Type	Size	Description
OBJECTID	Number (Long Integer)	4	ESRI feature autonumber
Shape	OLE Object	0	ESRI feature geometry
Loc_Name	Text	50	Name of the bird colony
X_Easting	Text	254	Easting coordinate value in meters (UTM coordinate system)
Y_Northing	Text	254	Northing coordinate value in meters (UTM coordinate system)

Table: tbl_Db_Revisions

Description: Database revision history data.

Field Name	Type	Size	Description
Revision_ID	Text	50	M. Database revision (version) number or code (Rev_ID)
Revision_Contact_ID	Number (Replication ID)	16	MA. Link to tlu_Contacts (Rev_Cnt_ID)
Db_Meta_ID	Number (Replication ID)	16	M. Link to tbl_DB_Meta (Db_Meta_ID)
Revision_Date	Date/Time	8	M. Database revision date (Rev_Date)
Revision_Reason	Memo	0	M. Reason for the database revision (Rev_Reason)
Revision_Desc	Memo	0	M. Revision description (Rev_Desc)

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by Natural Resource Data Template (NRDT)

Table: tbl_Event_Group

Description: Event aggregations. In this case these represent individual flights with flight details.

Field Name	Type	Size	Description
Event_Group_ID	Number (Replication ID)	16	M. An identifier for the event group (Ev_Gp_ID)
Start_Date	Date/Time	8	M. Starting date of the event group (Start_Date) - date that the bird colony monitoring flight occurred
End_Date	Date/Time	8	M. Ending date of the event group (End_Date) - not used since all flights currently occur on a single day
Event_Group_Name	Text	100	MA. Event group (e.g. season, trip) name (Ev_Gp_Name)
WeatherConditions	Text	255	general description of weather conditions during the flight
Temperature	Number (Single)	4	average temperature during the flight in degrees Celsius
WindDirection	Text	255	average wind direction during the flight in degrees
WindSpeed	Text	255	average wind speed during the flight in knots
Pilot	Number (Replication ID)	16	name of the person piloting the aircraft
FrontObserver	Number (Replication ID)	16	name of the person observing and taking notes in the front of the aircraft
Photographer	Number (Replication ID)	16	name of the person taking photographs in the back of the aircraft
Aircraft	Text	70	type/model of aircraft used for the monitoring
Park	Text	4	4 digit NPS park unit code where flight occurred
DoubleCheck	Yes/No	1	has this data been double-checked? yes or no
DoubleCheck_Name	Number (Replication ID)	16	name of the person who did the double-check
Survey_Method	Text	50	method of survey (helicopter, boat, canoe)
Survey_Type	Text	50	type of survey (routine or census)

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tbl_Events

Description: Details for a sampling event at a single colony including photo processing information.

Field Name	Type	Size	Description
Event_ID	Number (Replication ID)	16	M. Event identifier (Event_ID)
Location_ID	Number (Replication ID)	16	M. Link to tbl_Locations (Loc_ID)
Event_Group_ID	Number (Replication ID)	16	MA. Link to tbl_Event_Group (Ev_Gp_ID)
Protocol_Name	Text	100	M. The name or code of the protocol governing the event (Protcl_Nam)
ProcessingDate	Date/Time	8	date that the photographs were processed
PhotoProcessor	Number (Replication ID)	16	person who processed the photographs
NoNests	Yes/No	1	checked (yes) if no nests were observed at a site
EmptyNests	Number (Long Integer)	4	number of empty nests seen in the photographs for this site - replaced by individual species level tracking in September 2012
Comments	Text	255	comments from the photo processing datasheet
DoubleCheck	Yes/No	1	has this data been double-checked? yes or no
DoubleCheck_Name	Number (Replication ID)	16	name of the person who did the double-check

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tbl_Field_Data

Description: Photograph nest counts and observer bird observations.

Field Name	Type	Size	Description
Data_ID	Number (Replication ID)	16	MA. Field data table row identifier (Data_ID)
Event_ID	Number (Replication ID)	16	M. Link to tbl_Events (Event_ID)
Data_Location_ID	Number (Replication ID)	16	MA. Optional link to tbl_Data_Locations (Data_Loc_ID)
SpeciesCode	Text	4	4-letter USGS bird banding code for the bird species observed/nesting
Photo_OccupiedNests	Number (Long Integer)	4	number of occupied nests counted from the photographs for a site
Photo_NestsWithChicks	Number (Long Integer)	4	number of nests with chicks counted from the photographs for a site
Photo_NestsWithEggs	Number (Long Integer)	4	number of nests with eggs counted from the photographs for a site
Photo_EmptyNests	Number (Long Integer)	4	number of empty nests counted from the photographs for a site
Observed_Birds	Number (Long Integer)	4	number of birds observed from the helicopter (estimate)
Observed_ActiveNests	Number (Long Integer)	4	number of active nests observed from the helicopter (estimate)

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tbl_Locations

Description: Location of bird colonies.

Field Name	Type	Size	Description
Location_ID	Number (Replication ID)	16	M. Location identifier (Loc_ID)
GIS_Location_ID	Text	50	MA. Link to GIS feature, equivalent to NPS_Location_ID (GIS_Loc_ID)
Meta_MID	Text	50	MA. Link to NR-GIS Metadata Database (Meta_MID)
Loc_Name	Text	100	M. Name of the location (Loc_Name)
Loc_Short_Name	Text	10	Added by SFCN. Abbreviated name for location
X_Coord	Number (Double)	8	M. X coordinate (X_Coord)
Y_Coord	Number (Double)	8	M. Y coordinate (Y_Coord)
Coord_Units	Text	50	M. Coordinate distance units (Coord_Unit)
Coord_System	Text	50	M. Coordinate system (Coord_Syst)
UTM_Zone	Text	50	MA. UTM Zone (UTM_Zone)
Datum	Text	50	M. Datum of mapping ellipsoid (Datum)
Est_H_Error	Number (Single)	4	MA. Estimated horizontal accuracy (Est_H_Error)
Accuracy_Notes	Text	255	MA. Positional accuracy notes (Acc_Notes)
Unit_Code	Text	12	M. Park, Monument or Network code (Unit_Code)
Loc_Type	Text	25	MA. Location type category (Loc_Type)
Updated_Date	Date/Time	8	MA. Date of entry or last change (Upd_Date)
Loc_Notes	Memo	0	MA. General notes on the location (Loc_Notes)
SortIndex	Number (Long Integer)	4	order of sorting for these locations
ReportLocation	Yes/No	1	show this location on reports?

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tlu_Birds

Description: Lookup table of birds that might be observed during this project.

Field Name	Type	Size	Description
BirdID	Number (Long Integer)	4	Bird species identifier number
SpeciesCode	Text	4	4 letter shorthand code
CommonName	Text	255	Common name or code for unidentified birds
ScientificName	Text	255	Scientific name
Family	Text	255	Scientific family
Order	Text	255	Scientific order
SortIndex	Number (Long Integer)	4	preferred sort order of the bird species
ReportBird	Yes/No	1	show this bird species on reports?

Table: tlu_Enumerations

Description: Enumerated lookup table.

Field Name	Type	Size	Description
Enum_Code	Text	50	M. Code for lookup values (Enum_Code)
Enum_Description	Memo	0	M. Lookup value description (Enum_Desc)
Enum_Group	Text	50	M. Category for lookup value (Enum_Group)
Sort_Order	Number (Integer)	2	O. Order in which to sort lookup values (Sort_Order)

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tlu_Months

Description: Enumerated lookup table.

Field Name	Type	Size	Description
Enum_Code	Number (Long Integer)	4	M. Code for lookup values (Enum_Code)
Enum_Description	Memo	0	M. Lookup value description (Enum_Desc)
Enum_Group	Text	50	M. Category for lookup value (Enum_Group)
Sort_Order	Number (Integer)	2	O. Order in which to sort lookup values (Sort_Order)
Month	Text	255	Month as a 2 digit text field = 01, 02, ...,12

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: tlu_Contacts

Description: Contact data for project-related personnel.

Field Name	Type	Size	Description
Contact_ID	Number (Replication ID)	16	M. Contact identifier (Contact_ID)
Last_Name	Text	50	M. Last name (Cnt_Last)
First_Name	Text	50	M. First name (Cnt_First)
Middle_Init	Text	4	M. Middle initial (Cnt_MI)
Organization	Text	50	M. Organization or employer (cntorg)
Position_Title	Memo	0	M. Title or position description (cntpos)
Address_Type	Text	50	M. Address (mailing, physical, both) type (addrtype)
Address	Text	50	M. Street address (cntaddr)
Address2	Text	50	MA. Address line 2, suite, apartment number (Cnt_Addr2)
City	Text	50	M. City or town (city)
State_Code	Text	8	M. State or province (state)
Zip_Code	Text	50	M. Zip code (postal)
Country	Text	50	M. Country (country)
Email_Address	Text	50	MA. Email address (cntemail)
Work_Phone	Text	50	MA. Phone number (cntvoice)
Work_Extension	Text	50	MA. Phone extension (Work_Ext)
Contact_Notes	Memo	0	MA. Contact notes (Cnt_Notes)

M=Mandatory; O=Optional; MA= Mandatory if applicable. These fields are required by the Natural Resource Data Template (NRDT)

Table: Userfields

Description: ThumbsPlus 7.0 generated database table for linking photo into database.

Field Name	Type	Size	Description
idThumbUDF	Number (Long Integer)	4	Unique ID
uf_FlightDate	Date/Time	8	Flight Date
uf_SiteName	Text	25	Colony site name
uf_SurveyType	Text	25	type of survey (routine or census)

Table: Path

Description: ThumbsPlus 7.0 generated database table for linking photo into database.

Field Name	Type	Size	Description
idPath	Number (Long Integer)	4	Path ID
idVol	Number (Long Integer)	4	Volume id of path
pathtype	Number (Long Integer)	4	Type of path (invalid, dir, zip)
name	Text	255	Path

Table: Volume

Description: ThumbsPlus 7.0 generated database table with details of the photo filing.

Field Name	Type	Size	Description
idVol	Number (Long Integer)	4	Volume ID
vtype	Number (Long Integer)	4	Volume type
serialno	Number (Long Integer)	4	Volume serial number
maxcomplen	Number (Long Integer)	4	Maximum component length
vchar	Number (Long Integer)	4	Volume characteristics
filesystem	Text	32	Filesystem type
label	Text	64	Volume label
netname	Text	255	Network connection name
alias	Text	80	Volume alias

Table: Thumbnail

Description: ThumbsPlus 7.0 generated database table with details of the photo.

Field Name	Type	Size	Description
idThumb	Number (Long Integer)	4	Thumbnail ID
idPath	Number (Long Integer)	4	Path ID for file
idFiletype	Number (Long Integer)	4	File type
file_time	Number (Long Integer)	4	Date file was last written
thumbnail_time	Number (Long Integer)	4	Time thumbnail was made
filesize	Number (Long Integer)	4	File size (bytes)
checksum	Number (Long Integer)	4	Thumbnail checksum
width	Number (Long Integer)	4	Image width
height	Number (Long Integer)	4	Image height
horiz_res	Number (Long Integer)	4	Horizontal resolution (PPM)
vert_res	Number (Long Integer)	4	Vertical resolution (PPM)
colortype	Number (Integer)	2	Color type (encoded)
colordepth	Number (Integer)	2	Color depth (bits per pixel)
gamma	Number (Integer)	2	Assumed Gamma (*10)
thumbnail_width	Number (Integer)	2	Thumbnail width
thumbnail_height	Number (Integer)	2	Thumbnail height
thumbnail_type	Number (Long Integer)	4	Thumbnail type
thumbnail_size	Number (Long Integer)	4	Size of thumbnail (bytes)
name	Text	255	File name
thumbnail	OLE Object	0	Embedded thumbnail photograph
annotation	Memo	0	Memo field
metric1	Binary	255	Thumbsplus field
metric2	Binary	255	Thumbsplus field
metric3	Binary	255	Thumbsplus field

Appendix 4 – Data Summary Report

Introduction

Colonial nesting bird colonies of wading birds and seabirds serve as important indicators of wetland health as they respond to changes in food abundance and quality, contaminants, invasive species, and disturbance. The SFCN is monitoring colonial nesting birds in Biscayne National Park (BISC) and this report summarizes the results.

Methods

The specific objectives of this monitoring program are to determine status and long-term trends in:

- number and locations of active colonies of colonial nesting birds with a special focus on Double-crested Cormorants, Great Egrets, Great White Herons, Great Blue Herons, White Ibises, and Roseate Spoonbills
- annual peak active nest counts of colonial nesting birds in Biscayne National Park with a special focus on Double-crested Cormorants, Great Egrets, Great White Herons, Great Blue Herons, White Ibises, and Roseate Spoonbills
- changes in annual nesting index (sum of monthly nest counts) for the focal species
- changes in the timing of peak nest counts for the focal species

The protocol involves an annual aerial park-wide survey using a helicopter to locate nesting colonies of wading birds and seabirds within Biscayne National Park followed by monthly aerial surveys of the nesting colonies. Nesting colonies are photographed and the photographs are analyzed in the office to identify and count active nests by species. An observer also records counts of both nesting and non-nesting birds observed in the field. Peak nest counts are calculated first by colony and then summed across all colonies. The annual nesting index is calculated by summing the nests counted each month by species (note: this number is larger than the true number of nests as the same nest may be counted in multiple months). The nesting index for months with no sampling is calculated as the average of the months before and after the missing month. Complete methods are described in the protocol “Colonial Nesting Bird Monitoring Protocol in Biscayne National Park” (Muxo et al. Draft).

Colony surveys were conducted: 2/25/2013, 3/21/2013, 4/18/2013, 5/15/2013, 6/19/2013, 7/19/2013, 8/14/2013, 9/13/2013, and 12/19/2013. In 2013, the park-wide survey was not performed. Flights were not conducted during the federal government shutdown and subsequent spending restrictions. The six islands surveyed during the monthly flights included: Mangrove Key, West Arsenicker, Arsenicker Key, Jones Lagoon, Ragged Key 5, and Soldier Key. Mangrove Key was surveyed throughout the year as it had been a nesting colony in previous years despite no nests being detected.

The survey data and graphs presented in this report encompasses data collected during the pilot data collection phase through the current monitoring year: 2009 (January–July), 2010 (January–December), 2011 (January–December), 2012 (February, March, April, June, July, September, November, and December), and 2013 (February–September, and December).

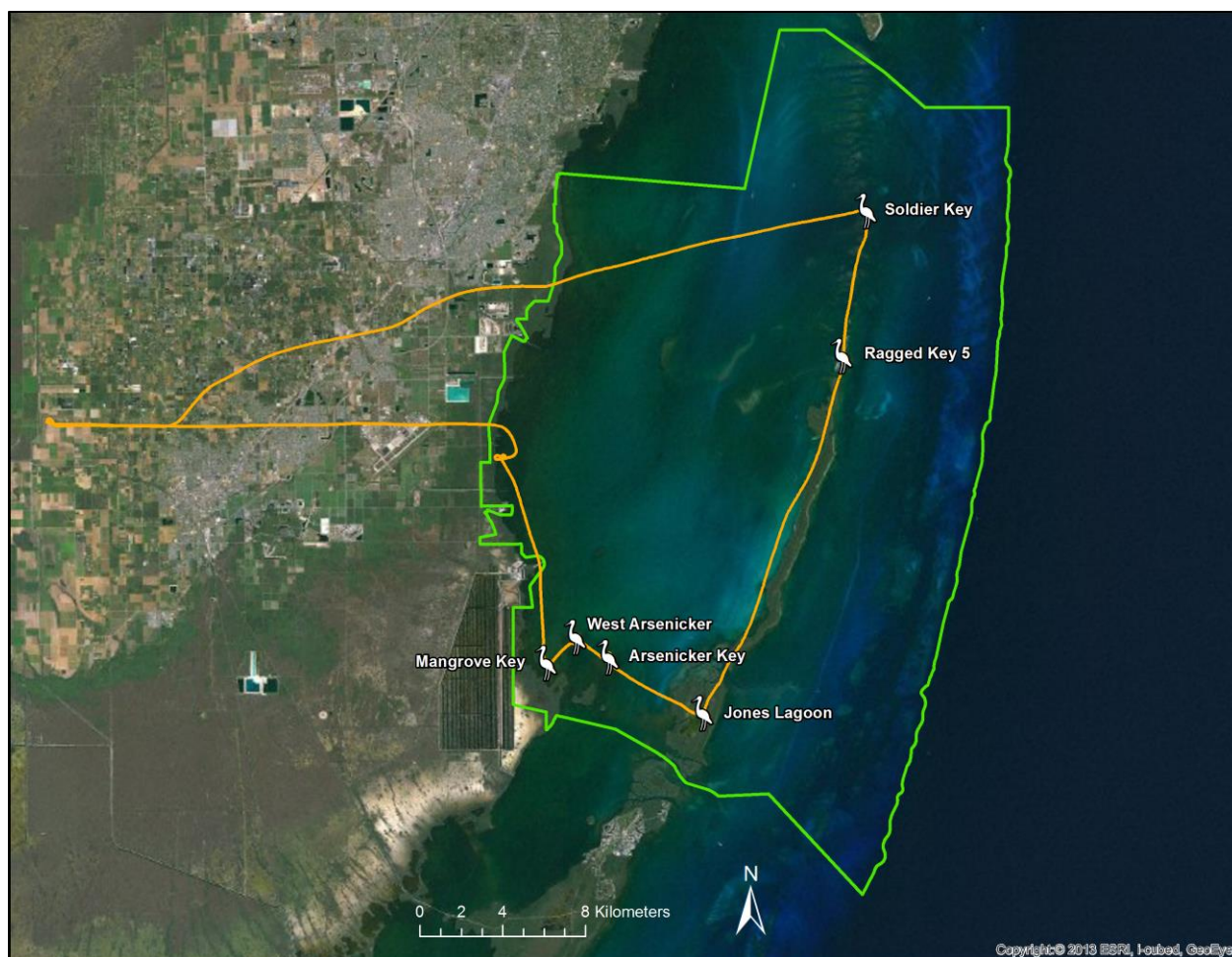


Figure Appendix 4-1. Nesting colony locations and flight path. The six nesting locations are displayed along the flight path shown in orange, and the park boundary is in green. This monitoring flight started at Homestead General Aviation Airport, west of the park. The flight paths shown were captured from an on board handheld GPS.

Results and Discussion

The standard results of the colonial nesting bird monitoring are summarized in the following tables and graphs and then discussed further below:

- Table Appendix 4-1: Species List
- Figures Appendix 4-2 thru 4: Graphs of nests photographed per month by focal species
- Figure Appendix 4-5: Number nesting colonies per species by year
- Figure Appendix 4-6: Number species nesting by colony and year
- Figure Appendix 4-7: Total of peak nest counts across colonies by focal species
- Figure Appendix 4-8: Annual nesting index across colonies by focal species
- Figure Appendix 4-9: Peak nest counts by colony by focal species
- Figure Appendix 4-10: Annual nesting index by colony by focal species
- Table Appendix 4-2: Percent nesting by month and focal species
- Table Appendix 4-3: All photographed and observed data by year, location, and species

- Table Appendix 4-4: Totals and percentages of nests occupied by birds, nests with eggs, nests with chicks, and empty nests

In 2013 the SFCN completed its fifth year of monitoring colonial nesting birds in Biscayne National Park (BISC). Table Appendix 4-1 provides a brief listing of the species detected either through field observations or photographs of nests. No new species were detected nesting in 2013. The data indicates more species are observed at the colonies than are photographed nesting. This table also provides the species codes used in subsequent tables and graphs.

The results of monitoring have yielded valuable nesting data for the observation of species-specific nesting patterns and trends. We have chosen to break down survey results by grouping bird species according to their feeding method: diver, stalk and strike, and tactile. The Double-crested Cormorant (*Phalacrocorax auritus*) dives for its prey. Nesting survey results show the Double-crested Cormorant is the most prominent bird surveyed, as its nests comprise up to 95% of all nests counted (Table Appendix 4-1, Figure Appendix 4-7, Figure Appendix 4-8). Results show a seasonal pattern with spring and summer peaks for nesting. A reduction in nesting effort, of approximately 50% from peak effort, is seen from October through February (Figure Appendix 4-2, Table Appendix 4-2). Double-crested Cormorants nest year-round in Biscayne National Park.

Stalk and strike type feeders such as the Great Blue Heron (*Ardea herodias*), Great Egret (*Ardea alba*), and Great White Heron (*Ardea herodias occidentalis*) all have similar nesting seasons (Figure Appendix 4-3 and 4, Table Appendix 4-2). The population of these charismatic birds makes up only a small fraction, when compared to cormorants, of the overall colonial nesting bird populations in Biscayne National Park. Tactile feeders include the Roseate Spoonbill (*Platalea ajaja*) and White Ibis (*Eudocimus albus*), which nest at different time periods. The White Ibis had the second highest quantity of nests counted in our survey.

The Mangrove Key colony Double-crested Cormorant nesting numbers have changed greatly over the four years surveyed. There has been a significant decline in cormorant nest counts from 2009 to 2013 with no nests detected in 2013, while the Ragged Key 5 colony has shown an increase over the same time. The Ragged Key 5 and Arsenicker Key colonies have consistently ranked high in peak nest counts (Figures Appendix 4-9 and 4-10).

West Arsenicker colony has the high species richness of observed and photographed nesting species of all the colonies (Figure Appendix 4-6, Table Appendix 4-3). Mangrove Key has the least.

Table Appendix 4-1 shows higher species richness from observed data compared to photographed nesting data, thus indicating more species are found within the park foraging or roosting compared to species nesting. Table Appendix 4-3 documents the nest counts from photographed data and bird count estimates from observed data from 2009 through 2013.

Table Appendix 4-1. List of species detected in 2013. Numbers in this table should not be used as true abundance estimates as nests and birds were likely observed during more than one sample period.

Common Name	Species Code	Photographed Nests	Field Observed Birds
Anhinga	ANHI	4	9
Bald Eagle	BAEA	1	2
Black-crowned Night-Heron	BCNH		5
Brown Pelican	BRPE		73
Double-crested Cormorant	DCCO	4260	3686
Great Blue Heron	GBHE	25	36
Great Egret	GREG	72	99
Great White Heron	GWHE	74	125
Laridae family gull	LARI		3
Laughing Gull	LAGU		10
Little Blue Heron	LBHE	1	24
Osprey	OSPR		4
Roseate Spoonbill	ROSP	8	34
Royal Tern	ROYT		2
Snowy Egret	SNEG	1	21
Tricolored Heron	TRHE	1	144
Turkey Vulture	TUVU	1	35
Unidentified	UNID	30	5
Unidentified Dark Bird	UNDA	3	
Unidentified White Bird	UNWH	29	64
White Ibis	WHIB	131	170
White-crowned Pigeon	WCPI		4
Grand Total		4641	4555

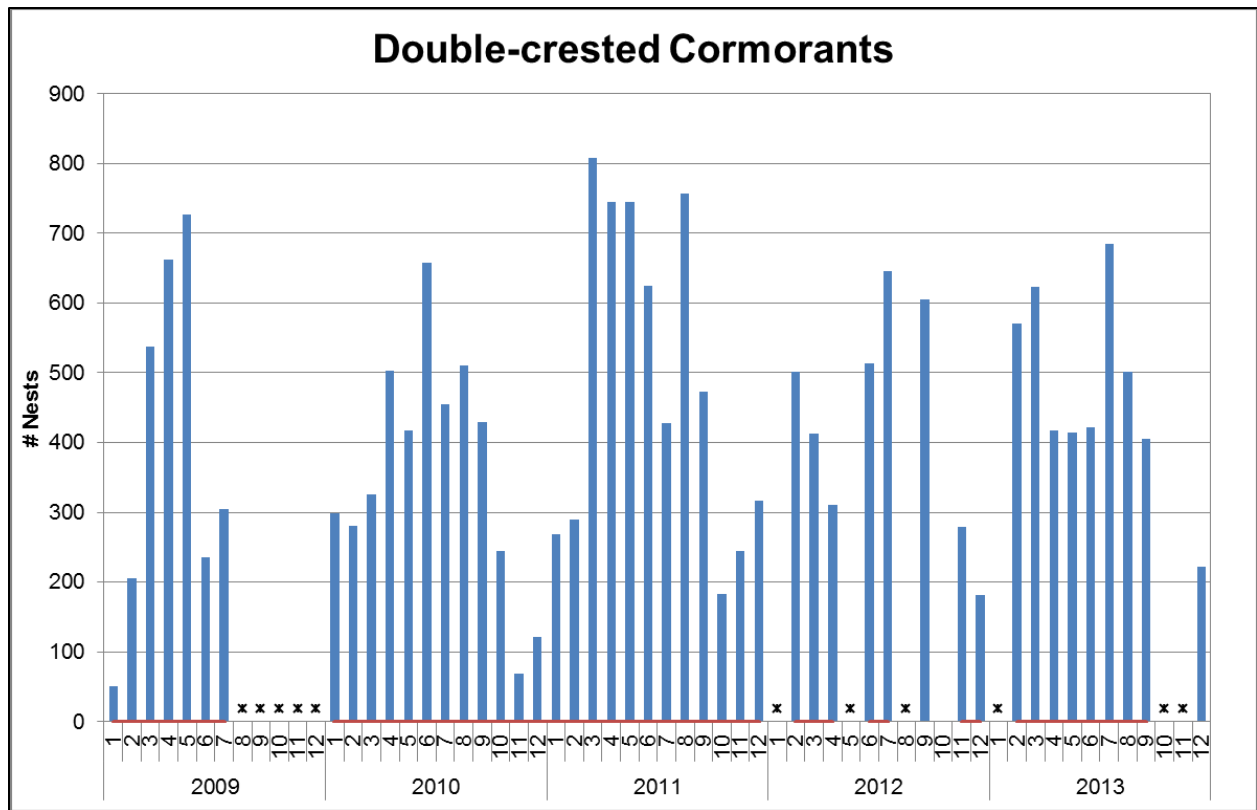


Figure Appendix 4-2. Number of Double-crested Cormorant nests per month and peak nesting periods.
 * = Months not sampled.

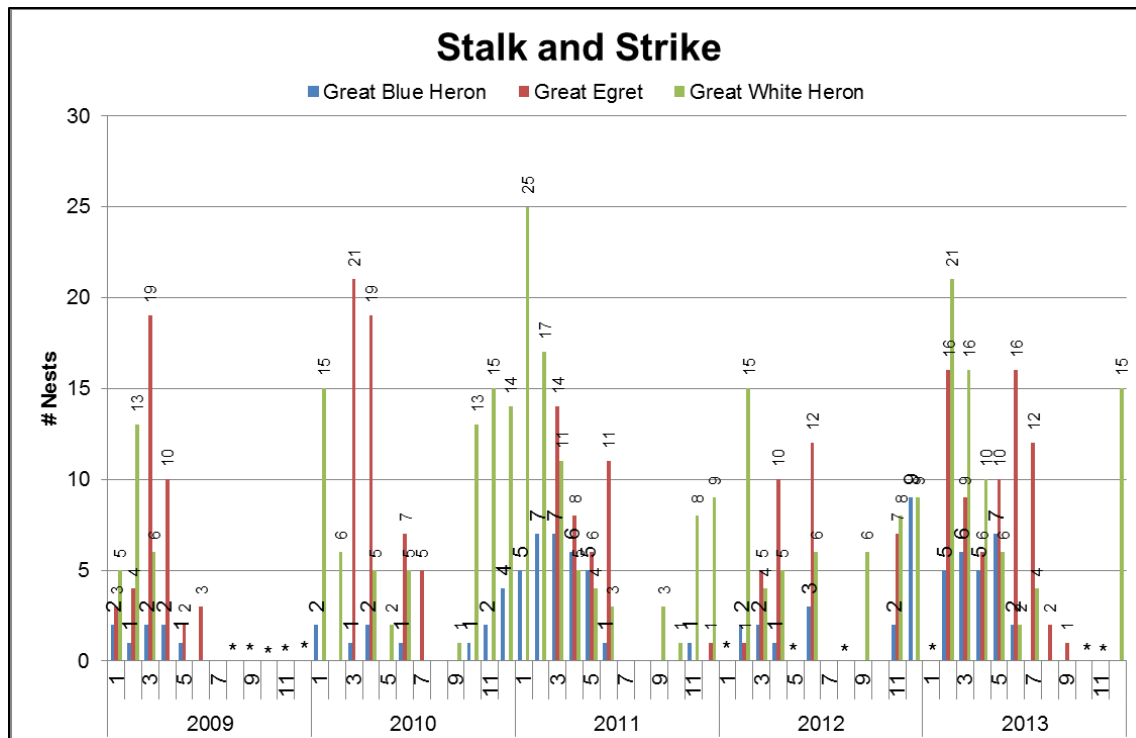


Figure Appendix 4-3. The number of nests and peak nesting periods by month for selected stalk and strike species: Great Blue Heron, Great Egret, and Great White Heron. * = Months not sampled.

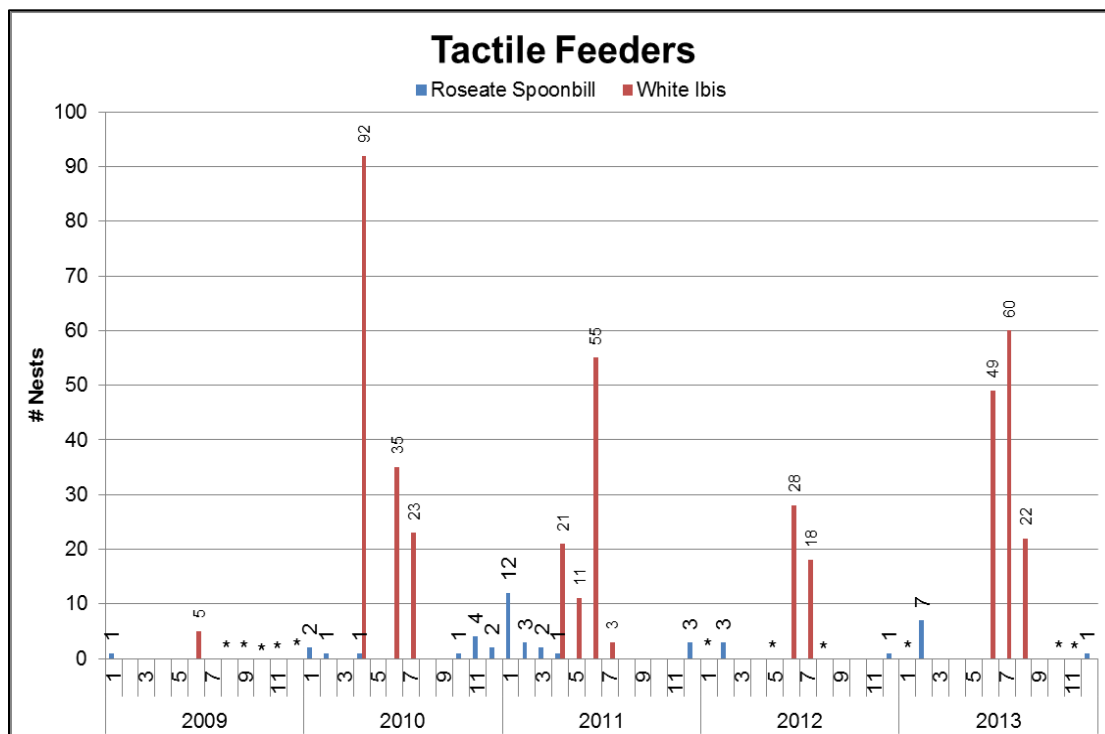


Figure Appendix 4-4. The number of nests and peak nesting periods by month for selected for two tactile feeder species: Roseate Spoonbills and White Ibises. This graph shows Roseate Spoonbills nest in the dry season and White Ibises nest in the wet season. * = Months not sampled.

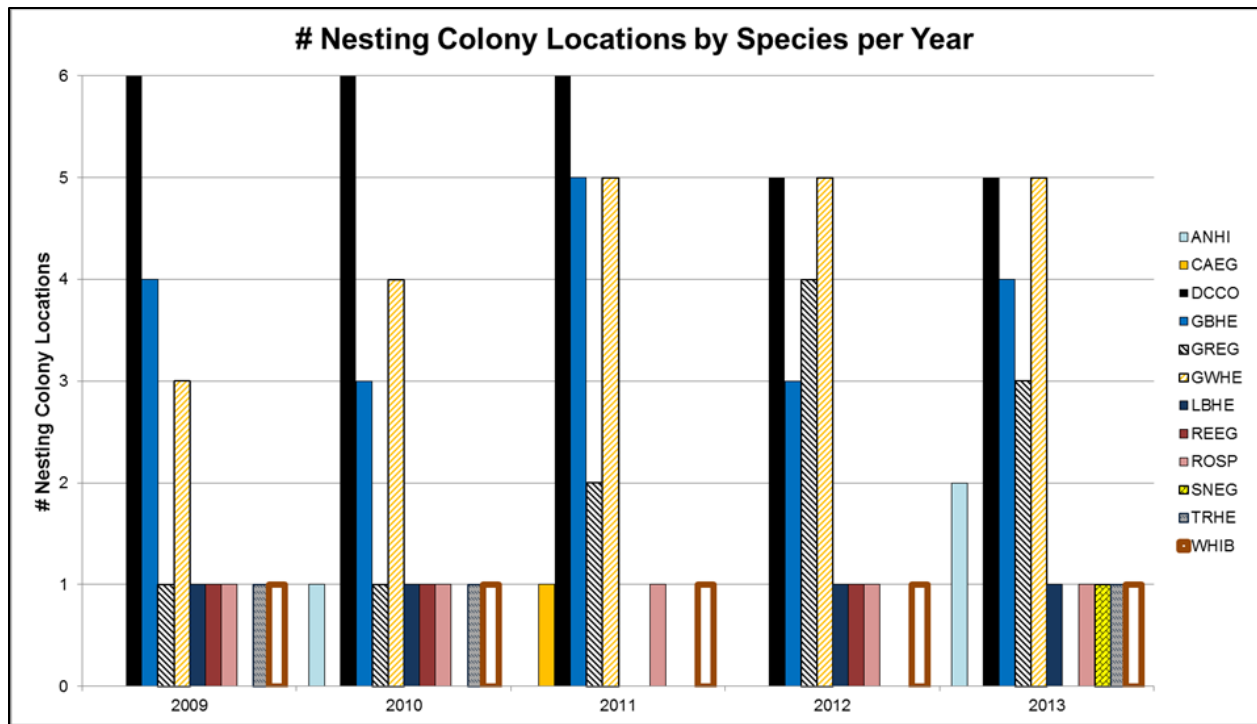


Figure Appendix 4-5. Number of nesting colonies per species by year. Includes all egrets, ibis, and herons.

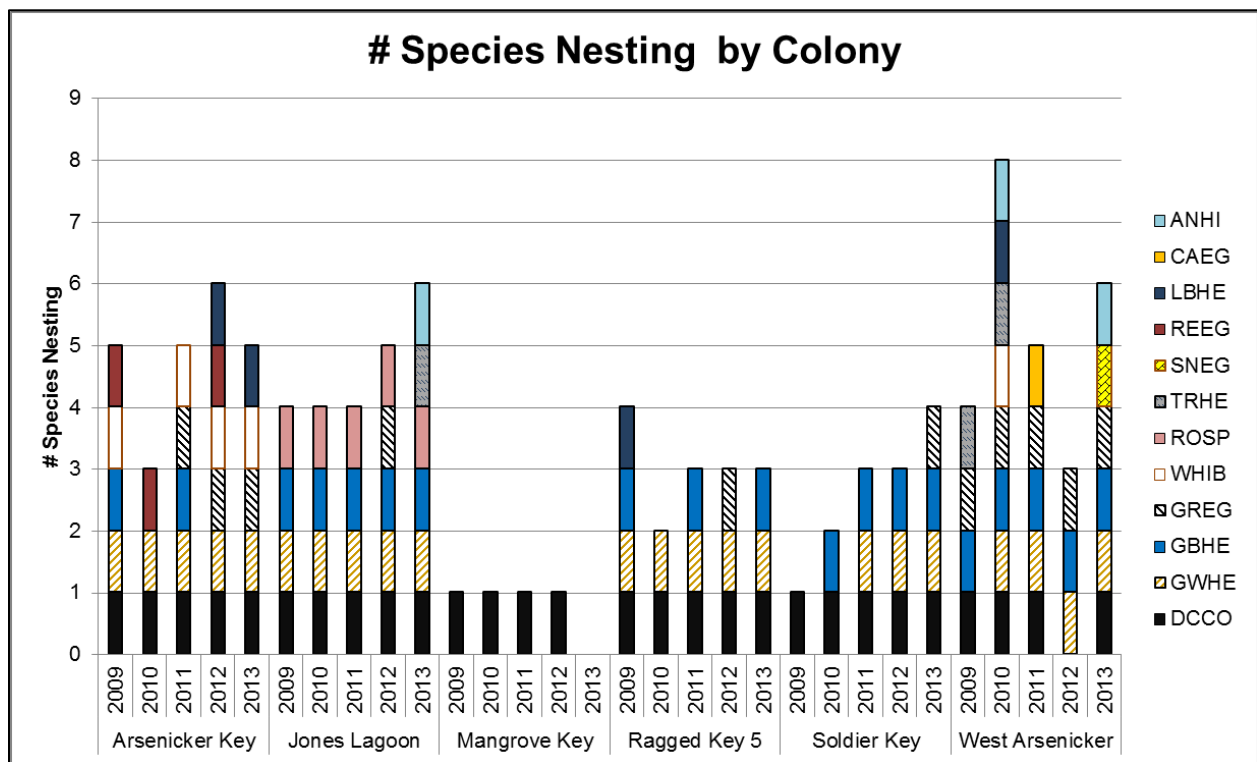


Figure Appendix 4-6. Number of species detected nesting by colony and year. Includes all egrets, ibis, and herons.

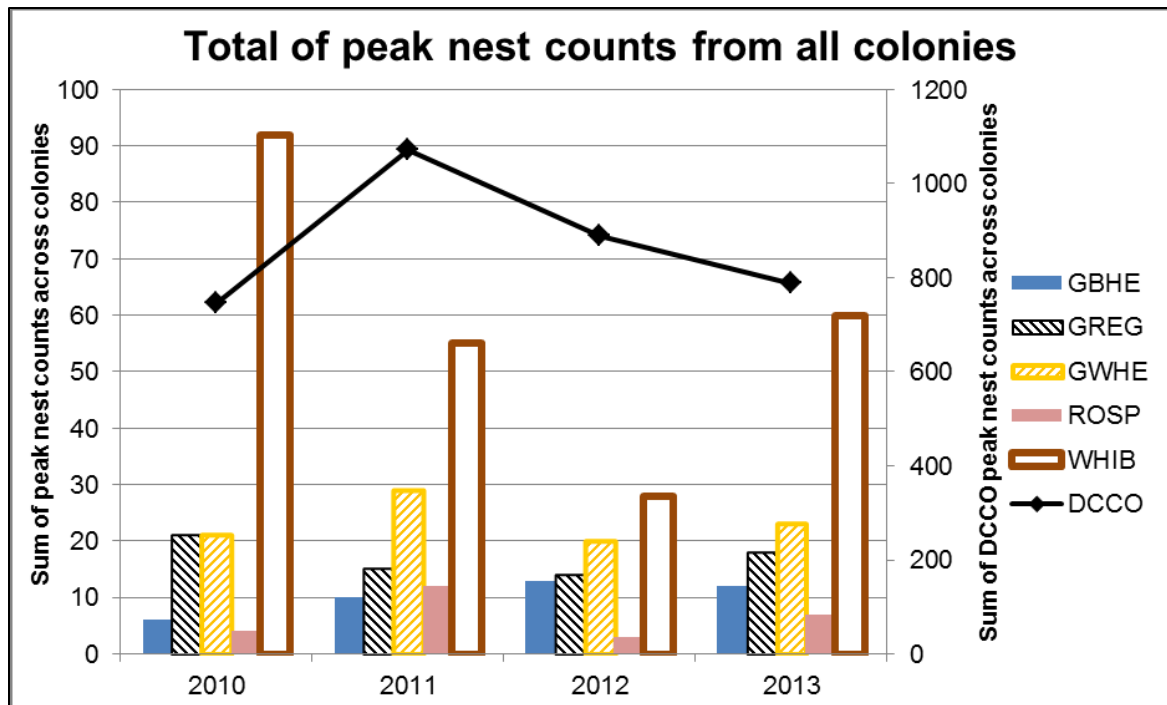


Figure Appendix 4-7. The maximum number of nests detected per colony were summed to create a total of peak nest counts across all colonies for the six focal species.

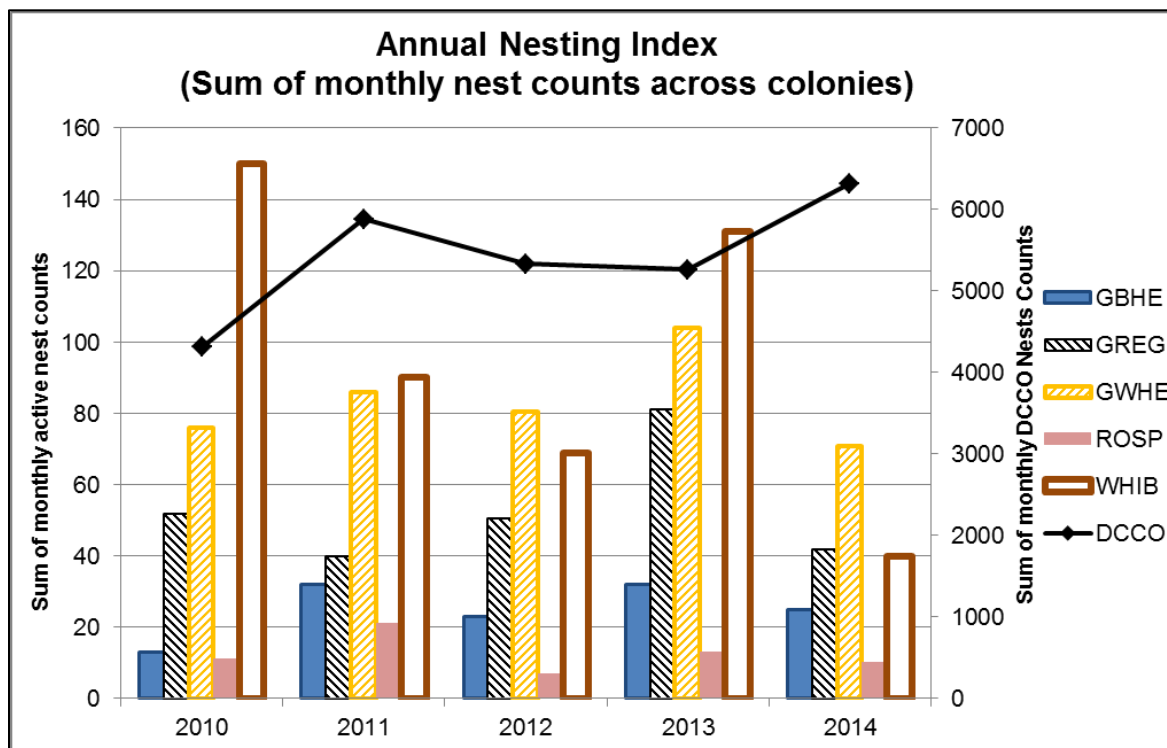


Figure Appendix 4-8. Annual nesting index across colonies by focal species. The number of nests counted at each colony during each month were summed to create an annual nesting index across all colonies for the six focal species. This number exceeds the actual number of nest starts as a single nest could be counted during two or more monthly visits.

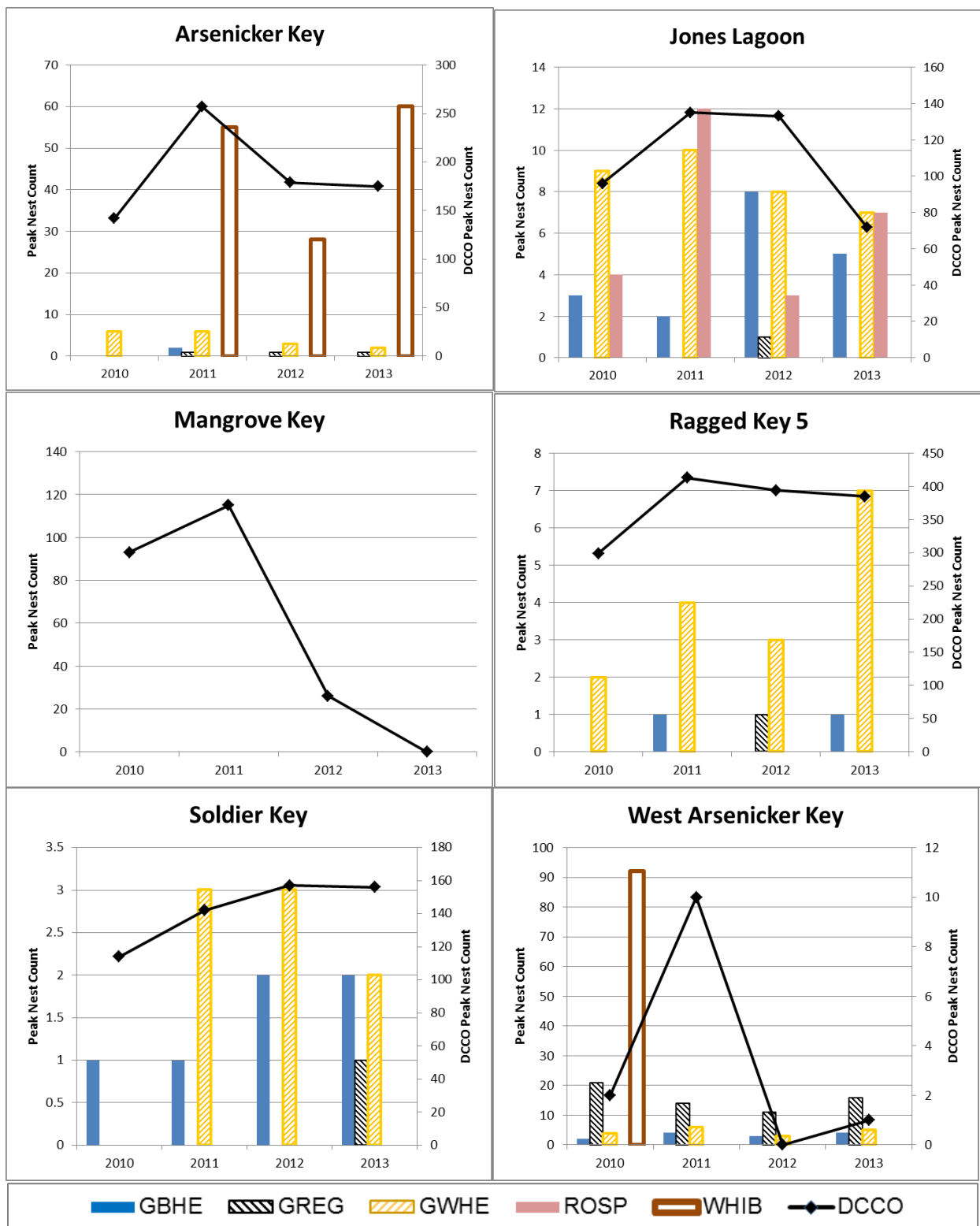


Figure Appendix 4-9. Peak nest counts by colony for the six focal species.

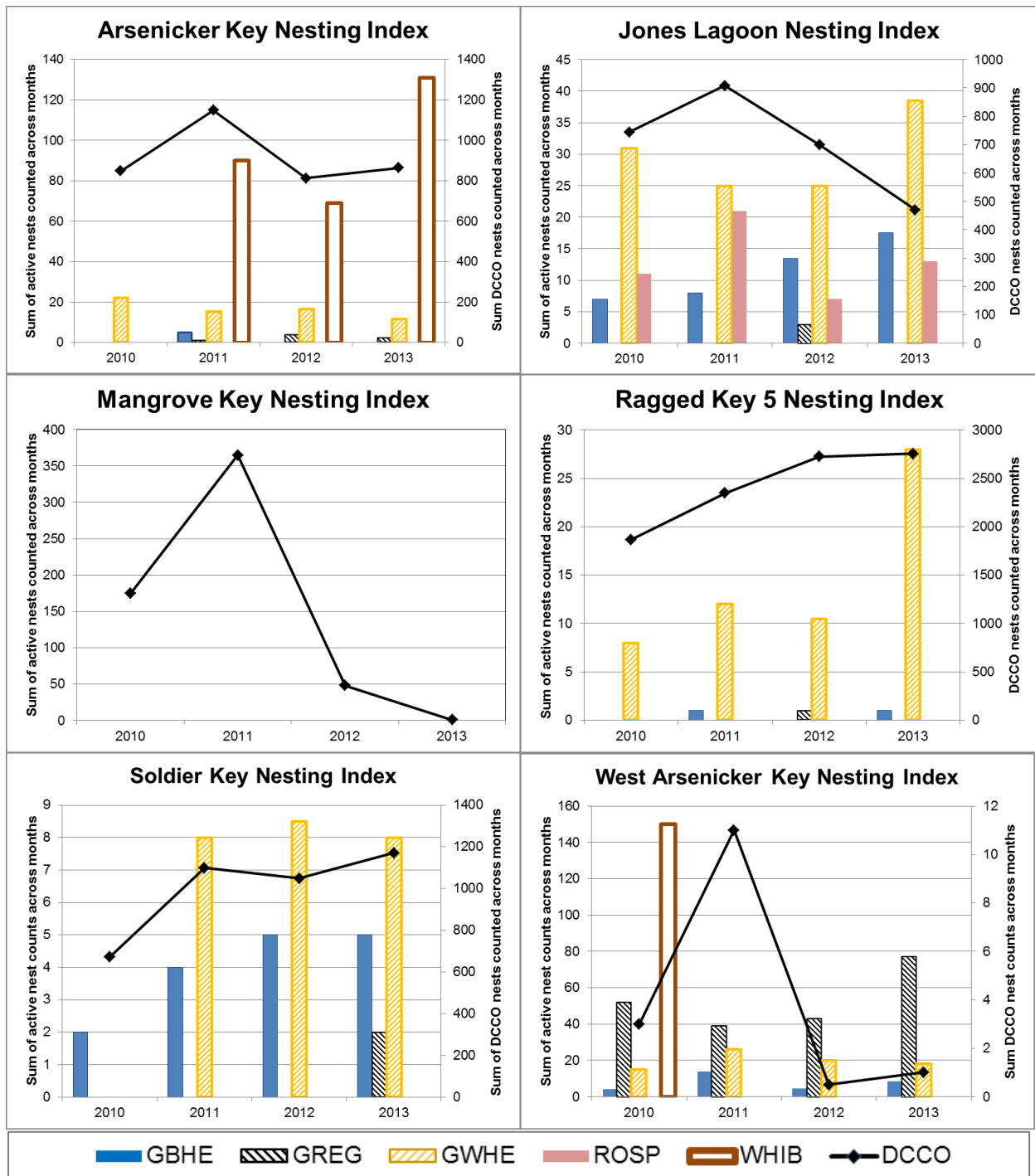


Figure Appendix 4-10. Annual nesting index across colonies by focal species. The annual nesting index is defined as total nests counted across all months and colonies.

Table Appendix 4-2. Percent nesting by month and species. Months with any photographed nests are highlighted. Months with greater than 20% nesting are highlighted as dark blue. Blank cells had no flight.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Double-crested Cormorant	3%	9%	12%	11%	9%	12%	12%	10%	11%	2%	3%	5%
2010	7%	6%	8%	12%	10%	15%	11%	12%	10%	6%	2%	3%
2011	5%	5%	14%	13%	13%	11%	7%	13%	8%	3%	4%	5%
2012		15%	12%	9%		15%	19%		18%	0%	8%	5%
2013		13%	15%	10%	10%	10%	16%	12%	10%			5%
Great Blue Heron	8%	16%	18%	16%	13%	8%	0%	0%	0%	1%	6%	15%
2010	15%	0%	8%	15%	0%	8%	0%	0%	0%	8%	15%	31%
2011	16%	22%	22%	19%	16%	3%	0%	0%	0%	0%	3%	0%
2012	0%	11%	11%	5%		16%	0%		0%	0%	11%	47%
2013	0%	20%	24%	20%	28%	8%	0%	0%	0%			0%
Great Egret	0%	9%	25%	22%	8%	23%	9%	1%	1%	0%	4%	1%
2010	0%	0%	40%	37%	0%	13%	10%	0%	0%	0%	0%	0%
2011	0%	0%	35%	20%	15%	28%	0%	0%	0%	0%	0%	3%
2012		3%	14%	29%		34%	0%		0%	0%	20%	0%
2013		22%	13%	8%	14%	22%	17%	3%	1%			0%
Great White Heron	14%	20%	11%	9%	4%	6%	1%	0%	3%	5%	11%	16%
2010	20%	8%	0%	7%	3%	7%	0%	0%	1%	17%	20%	18%
2011	29%	20%	13%	6%	5%	3%	0%	0%	3%	1%	9%	10%
2012		28%	8%	9%		11%	0%		11%	0%	15%	17%
2013		28%	22%	14%	8%	3%	5%	0%	0%			20%
Roseate Spoonbill	32%	32%	5%	5%	0%	0%	0%	0%	0%	2%	9%	16%
2010	18%	9%	0%	9%	0%	0%	0%	0%	0%	9%	36%	18%
2011	57%	14%	10%	5%	0%	0%	0%	0%	0%	0%	0%	14%
2012		75%	0%	0%		0%	0%		0%	0%	0%	25%
2013		88%	0%	0%	0%	0%	0%	0%	0%			13%
White Ibis	0%	0%	0%	27%	3%	40%	25%	5%	0%	0%	0%	0%
2010	0%	0%	0%	61%	0%	23%	15%	0%	0%	0%	0%	0%
2011	0%	0%	0%	23%	12%	61%	3%	0%	0%	0%	0%	0%
2012		0%	0%	0%		61%	39%		0%	0%	0%	0%
2013		0%	0%	0%	0%	37%	46%	17%	0%			0%

Table Appendix 4-3. Photographed nests and observed bird data by year, location, and species. Note: NF = No Flight.

Month	Photographed Nests												Observed Birds											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
2009	69	229	571	678	736	243	310	NF	NF	NF	NF	NF	23	219	414	555	457			NF	NF	NF	NF	NF
Arsenicker Key	22	34	169	75	118	60	72							21	109	93	73							
Double-crested Cormorant	20	30	167	74	114	55	67							12	100	45	60							
Great Blue Heron			1																					
Great White Heron	2	4	1											9	3									
Magnificent Frigatebird															6	36	1							
Reddish Egret				1																				
Unidentified White Bird					4		5									12								
White Ibis						5											12							
Black Point	1	1																						
Bald Eagle	1	1																						
Elliott Key			1																					
Osprey			1																					
Jones Lagoon	39	87	129	150	98	20	33						17	86	86	106	75							
Double-crested Cormorant	31	78	126	149	97	20	33						12	40	80	100	75							
Great Blue Heron	2	1	1	1										1										
Great White Heron	3	8	2										2	9	6									
Magnificent Frigatebird														12		6								
Roseate Spoonbill	1												2	24										
Unidentified					1																			
Unidentified White Bird	2												1											
Mangrove Key			53	148	217	7	25								22	80	40							
Anhinga																								
Double-crested Cormorant			53	148	217	7	25								22	80	40							
Mangrove Point	1		1												1	1								
Osprey	1		1												1	1								
Ragged Key 5		86	166	217	205	85	74							71	125	200	150							
Brown Pelican														9										
Double-crested Cormorant		84	163	215	205	85	74							60	120	200	150							

	Photographed Nests												Observed Birds											
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Great Blue Heron				1																				
Great White Heron		1	3											1	5									
Little Blue Heron		1																						
Unidentified White Bird				1										1										
Sands Key		1																						
Osprey		1																						
Soldier Key		14	29	76	90	68	103							30	50	60	101							
Double-crested Cormorant		14	29	76	90	68	103							30	50	60	100							
Great White Heron																	1							
West Arsenicker	6	6	23	12	8	3	3						6	11	21	15	18							
Bald Eagle	1	1	1										1	1	1	3								
Cattle Egret																	6							
Double-crested Cormorant					3		2																	
Great Blue Heron					1												2							
Great Egret	3	4	19	10	2	3							5	10			4							
Little Blue Heron																	1							
Snowy Egret																	1							
Tricolored Heron					1												2							
Turkey Vulture																	2							
Unidentified	2	1	3	2																				
Unidentified White Bird					1		1								20	12								
2010	318	292	352	641	423	715	485	511	431	262	91	141					998							330
Arsenicker Key	90	54	50	145	144	124	79	116	53	4	6	13					167							54
American White Pelican																								3
Brown Pelican																								2
Double-crested Cormorant	86	52	50	142	141	122	79	116	52			9					150							36
Great Blue Heron																	2							
Great Egret																								2
Great White Heron	4	2		1		2			1	2	6	4					2							6
Green Heron																	5							

[illegible]

[illegible]

[illegible]

Month	Photographed Nests												Observed Birds											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Mangrove Key			2	42	69	115	32	46	44	2	9	5			1	24	36	4	14	10	6		1	6
Brown Pelican																							1	
Double-crested Cormorant			2	42	69	115	32	46	44	2	8	5			1	24	36	4	12	10	6			6
Great Blue Heron																			1					
Great White Heron																			1					
Unidentified Dark Bird											1													
Ragged Key 5	34	135	415	309	275	198	138	188	237	120	158	154	292	204	251	36	100	67	7	112	41	4	114	94
Brown Pelican													40								1	4	12	24
Double-crested Cormorant	29	133	413	309	275	198	138	188	237	120	157	151	250	200	250	36	100	67	6	110	40		100	65
Great Blue Heron	1																		1					
Great White Heron	4	2	2								1	3	2	4	1					2			2	4
Ring-billed Gull																								1
Soldier Key	84	57	139	142	136	107	96	142	101	53	17	39	203	154	246	29	152	133	40	50	56		124	88
Brown Pelican																		1						
Cattle Egret															12									
Double-crested Cormorant	78	53	137	140	136	107	96	142	101	53	17	39	200	150	200	24	150	125	40	50	55		120	85
Great Blue Heron	1	1	1	1										2	2		1	1					1	1
Great White Heron	3	3	1	1									3	2	12	5	1	6			1		3	
Ring-billed Gull																								2
Unidentified	1																							
Unidentified White Bird	1																							
White Ibis															20									
West Arsenicker	4	9	21	27	17	14	8		3		4	4	7	12	10	5	23	168	15	90	42	2	17	13
American White Pelican																								1
Anhinga																		3						
Bald Eagle			1	1											2								2	1
Black Vulture																				12				
Brown Pelican																								2
Cattle Egret							8												15					
Double-crested Cormorant				10								1					1	30		10	36			3

[illegible]

	Photographed Nests												Observed Birds											
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Osprey																								1
Jones Lagoon	60	25	18			48	133		64		75	47	51	6	30		2	36		25		8	18	
Anhinga																								2
Brown Pelican													1											
Double-crested Cormorant	43	23	16			47	133		63		72	33	32		26			35		23				4
Great Blue Heron	2	1	1									8	1	1	1							3	3	
Great Egret	1										1						1							
Great White Heron	8	1	1			1					2	4	8	5	1		1					5	6	
Little Blue Heron																		1		1				
Magnificent Frigatebird													1											
Roseate Spoonbill	3											1	8							1			3	
Unidentified												1												
Unidentified White Bird	3								1															
White Ibis															2									
Mangrove Key						26			2		1	1	5		3		3			6		7	4	
Belted Kingfisher																						2		
Double-crested Cormorant						26			2		1	1	5		3		1			6		2	4	
Great Blue Heron																						1		
Great White Heron																						2		
Unidentified White Bird																	2							
Ragged Key 5	275	297	127			141	310		394		154	66	64	5			149	80		257		151	80	
Belted Kingfisher																				4				
Brown Pelican													14										55	
Double-crested Cormorant	272	294	127			141	310		394		151	66	39				149	80		199		150	20	
Great Blue Heron																				54		1		
Great Egret			1																					
Great White Heron	3										3		3	3									3	
Laughing Gull													8											
Ring-billed Gull																							2	
Unidentified White Bird			2												2									

Month	Photographed Nests												Observed Birds											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Soldier Key		81	59	158		122	102		94		44	39		103	9	91		84	121		136		213	173
Brown Pelican																		2						8
Double-crested Cormorant		78	58	157		120	102		94		40	37		90		90		81	120		130		200	160
Great Blue Heron			1								2	1		2							2		9	1
Great Egret																					2			
Great White Heron		3		1		1						1		5	1				1		2		4	2
Herring Gull																		1						
Laughing Gull														6										
Ring-billed Gull																								2
Unidentified						1					2													
Unidentified White Bird															8	1								
West Arsenicker			5	13		27			3		13	4		29		6		110	26		45		7	11
American White Pelican																								2
Bald Eagle												1												1
Brown Pelican														1										2
Cattle Egret																			1					
Double-crested Cormorant														14				1			5			2
Great Blue Heron						3								6		3								
Great Egret			4	9		11					6			4		1		2			8			
Great White Heron			1	1		2			3		3	3		4				1			2		6	3
Little Blue Heron																								
Osprey																								1
Tricolored Heron																2		77	12		5			
Turkey Vulture																		4	1		25			
Unidentified																		15					1	
Unidentified White Bird				3		11					4													
White Ibis																		2	6					
White-crowned Pigeon																		7	6					
Yellow-crowned Night-Heron																		1						
2013	NF	628	667	444	443	500	770	534	406	NF	NF	249	NF	339	529	711	536	515	629	572	340	NF	NF	384

[illegible]

Month	Photographed Nests												Observed Birds											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Roseate Spoonbill		7										1		8	15	4			1					6
Tricolored Heron							1																	
Unidentified		3	1									2												
Unidentified White Bird		2		1	2		1					4			6									
White Ibis																								10
Mangrove Key															1	1	1	13	26	2	4			5
Anhinga																					1			
Double-crested Cormorant																		12	25	1	2			5
Great White Heron															1	1	1			1				
Turkey Vulture																		1	1					
Unidentified White Bird																					1			
Ragged Key 5		356	394	214	165	181	347	194	227			136		118	171	225	153	110	184	150	61			127
Anhinga																			1					
Brown Pelican														6			3							20
Double-crested Cormorant		350	385	211	165	180	347	194	227			131		100	170	220	150	110	182	150	60			100
Great Blue Heron				1																				
Great Egret																2								
Great White Heron		6	7	2								5		10	1	3			1		1			6
Laridae family gull														1										
Royal Tern																								1
Unidentified			1																					
Unidentified White Bird			1			1								1										
Soldier Key		121	122	132	158	88	124	94	60			78		82	168	205	121	102	190	184	110			155
Brown Pelican														5					1					2
Double-crested Cormorant		119	120	129	156	87	122	92	60			74		65	160	203	120	100	180	180	100			150
Great Blue Heron		1	1		2									5		1								1
Great Egret			1				1												1					
Great White Heron		1		2		1	1					1		6	8	1	1	2	6	1	3			2
Laridae family gull																			2					
Laughing Gull														1						3	6			

Month	Photographed Nests												Observed Birds											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Royal Tern																				1				
Unidentified				1				2				3												
West Arsenicker		25	24	12	14	23	16	3				2		30	53	22	29	105	90	41	66			6
Anhinga						2													1	1	1			1
Bald Eagle			1												1									
Black-crowned Night-Heron																				2	3			
Brown Pelican														4							3			
Double-crested Cormorant							1							20	7	6	4		20					4
Great Blue Heron		1	4	3											3	3	2		3					
Great Egret		16	8	6	10	16	11	2						6	10	7	12	25	4		6			
Great White Heron		5	4	1	2							1			5			4	4	4	1			1
Little Blue Heron																2				12				
Snowy Egret							1												21					
Tricolored Heron															22	4	10	40	17	20	25			
Turkey Vulture																		6	5	2	12			
Unidentified		1	3	1	1	1	2					1												
Unidentified White Bird		2	4	1	1	4	1	1							5			30			15			
White Ibis																				12				
White-crowned Pigeon																	1		2					

Table Appendix 4-4. Totals and percentages of nests occupied by birds, nests with eggs, nests with chicks, and empty nests. Occupied nests number includes nests with chicks and nests with eggs. Total active nest is comprised of occupied nests plus empty nest. Blanks are zero.

Species Code	Sample Year	Occupied Nests	Nests With Chicks	Nests With Eggs	Empty Nests	Total Active Nests	% Occupied Nests	%Nests With Chicks	% Nests With Eggs	% Empty Nests
DCCO	2010	3995	672	118	314	4309	93%	16%	3%	7%
DCCO	2011	5274	507	159	606	5880	90%	9%	3%	10%
DCCO	2012	3030	222	79	416	3446	88%	6%	2%	12%
DCCO	2013	3950	321	108	310	4260	93%	8%	3%	7%
GBHE	2010	13				13	100%			
GBHE	2011	31	5	4	1	32	97%	16%	13%	3%
GBHE	2012	18	3	3	1	19	95%	16%	16%	5%
GBHE	2013	25	8	1		25	100%	32%	4%	
GREG	2010	52	4	3		52	100%	8%	6%	
GREG	2011	29	3	4	11	40	73%	8%	10%	28%
GREG	2012	35	3	1		35	100%	9%	3%	
GREG	2013	72	12	6		72	100%	17%	8%	
GWHE	2010	76	19	4		76	100%	25%	5%	
GWHE	2011	85	14	14	1	86	99%	16%	16%	1%
GWHE	2012	52	14	1	1	53	98%	26%	2%	2%
GWHE	2013	70	22	8	4	74	95%	30%	11%	5%
ROSP	2010	11	2			11	100%	18%		
ROSP	2011	21	6			21	100%	29%		
ROSP	2012	4				4	100%			
ROSP	2013	8	3			8	100%	38%		
WHIB	2010	149	20	3	1	150	99%	13%	2%	1%
WHIB	2011	90	6	5		90	100%	7%	6%	
WHIB	2012	46		1		46	100%		2%	
WHIB	2013	131	11	11		131	100%	8%	8%	

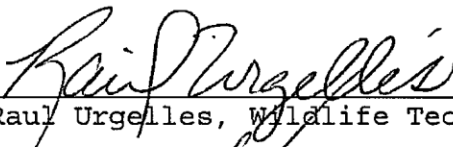
Appendix 5 – Special Use Aircraft and Safety Plan

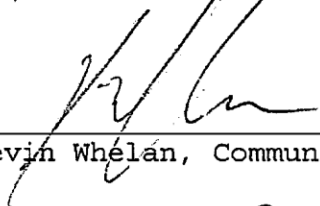
SPECIAL USE AIRCRAFT AND SAFETY PLAN EVERGLADES NATIONAL PARK

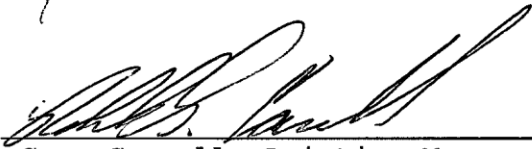
Colonial Nesting Bird and Vegetation Surveys Biscayne National Park

South Florida and Caribbean Network
National Park Service
Inventory and Monitoring

Updated July 2012

Prepared by: 
Raul Urgelles, Wildlife Technician, SFCN

Reviewed by: 
Kevin Whelan, Community Ecologist, SFCN

Approved by: 
Gary Carnall, Aviation Manager, EVER

SPECIAL USE AIRCRAFT AND SAFETY PLAN
EVERGLADES NATIONAL PARK

Colonial Nesting Bird and Vegetation Surveys
Biscayne National Park

OBJECTIVES: This plan's purpose is to provide guidance to personnel who direct, manage, and participate in helicopter-based aviation operations related to South Florida/Caribbean Network (SFCN) Vital Signs Monitoring Plan targeting the **Colonial Nesting Birds and Vegetation Communities Extent & Distribution** components of the program and conducted within Biscayne National Park (BISC).

SCHEDULE: Colonial bird surveys are conducted at least once a month at six sites: Mangrove Key, West Arsenicker, Arsenicker Key, Jones Lagoon, Ragged Key 5, and Soldier Key (see attached map). Vegetation surveys are conducted as needed (episodically) with no set schedule at this moment. Flight operations are scheduled in a manner that is appropriate to either project.

PROJECT DESCRIPTION: The monitoring of colonial nesting birds and vegetation communities in BISC requires access to remote sites across the waters of Biscayne Bay. A helicopter is needed to fly two, sometimes three, SFCN personnel and their field equipment (binoculars, cameras, and GPS) over these monitoring sites in a systematic way without the need to land. Data will be collected through visual census and photographs of colonial nesting birds and vegetation communities. Contracted park aircraft will be used whenever suitable for these missions.

JUSTIFICATION: A helicopter offers the most practical and efficient means of transportation to the monitoring sites in BISC. Motorboat transportation is the only other means of travel to these remote regions within the park. However, motorboats will disturb roosting and nesting birds and provide SFCN personnel with inaccurate counts due to restricted visual access to the colonies. Surveying vegetation communities from a motorboat will provide inaccurate land cover estimates and assessments as well as incomplete species inventory. Given the size of BISC, motorboat operations will create time limitations which will not allow for a

complete assessment of the park's land habitats. As such, travel by helicopter is the only reasonable means of surveying colonial nesting birds and vegetation communities within the required time period. Helicopter use is further justified because it provides SFCN personnel with the best visual access of bird colonies and vegetation communities in order to get accurate counts and estimates.

DESCRIPTION OF METHODS TO BE USED: SFCN personnel and their equipment will be weighed-in prior to loading the aircraft at the flight office located at Kendall-Tamiami Executive Airport (HMC Helicopters) or Homestead General Aviation Airport. The pilot is primarily responsible for decisions related to the disposition of gear stored on board and/or decisions to go/no go based on aircraft, atmospheric conditions, or other considerations. Prior to flight, SFCN personnel will provide GPS coordinates for the locations to be surveyed and will work with the pilot to determine a flight plan. Once a flight is initiated, flight following will be maintained between dispatch and the helicopter by the pilot. Between point locations, flights are performed above 500'. Once at a location, the aircraft will hover/circle below 500' (at approximately 300' for bird surveys). This will allow SFCN personnel to make correct visual identifications, get accurate counts and land-cover estimates, and take photographs.

PROCEDURES: NPS procedures for flight operations are described in the SOP for Helicopter Use and are in the Park Aviation Plan, MPS 60, and DM 350-354. The SOPs cover required clothing and equipment (Personal Protective Equipment and Aviation Live Support System), training (B3 and/or S-271), loading and unloading both passengers and cargo, flight routing, flight following, communications, landing zones, landing area safety, fueling and special considerations for hazardous material transportation.

NECESSARY SPECIAL EQUIPMENT AND CERTIFIED OPERATORS: Since flight operations will take place over water, floats (pontoons or emergency pop-out) will be required on the aircraft and PFDs will be required for all crewmembers. If the site conditions do not match the aircraft's current setup, flight will be cancelled until appropriate arrangements can be made. Additional consideration will be given to the safe loading and unloading of small equipment cases to reduce the risk of loose gear during flight.

SAFETY: This plan is an extension of the general philosophy of Safety First in the work place. While helicopter flight has inherent risks, the proper use of Personal Protective Equipment, proper planning for the transportation of personnel and gear, and the proper use of entry and exit techniques are all designed to minimize this risk.

In all cases, both the pilot and crew will be thoroughly familiar with the hazards within BISC and along flight routes. Flight following will be conducted by Everglades National Park Operations Center (dispatch) in accordance with AMD and NPS guidelines. "Everglades Flight Following" will utilize the following frequencies: 163.3875 TX (to transmit) and 169.7250 RX (to receive). The crew (SFCN personnel) will also have a portable digital park radio with spare battery pack for use when the helicopter is shut down. The pilot and certified helicopter crew member are responsible for completion of load calculations prior to flight. The Flight Supervisor is responsible for passenger and load manifests. All aircraft incidents or accidents will be reported in accordance with AMD, NPS, and FAA regulations.

CONSIDERATIONS OF AIRCRAFT PERFORMANCE CAPABILITY: All considerations of aircraft performance, be it with regard to load capacity, fitness for flight, flight duration, and ability to operate in the weather conditions at the time of flight, are the primary responsibility of the pilot.

ALTERNATIVES:

1. (PREFERRED) Continued use of helicopter for colonial nesting bird monitoring and vegetation community surveys. In this alternative, SFCN personnel will continue to be transported to remote work-related sites within BISC to collect data via helicopter. This alternative allows the efficient and timely completion of monitoring and assessment-related objectives with a minimum of loss of data within the network. This is the preferred alternative.
2. Eliminate use of helicopter operations to remote sites within BISC. In this alternative, no helicopter would be used for access to remote locations in the park. All activities would be accomplished via motorboats. Since BISC covers 181,500 acres, this would not be a practical option. This

alternative is not considered a viable option for the SFCN.

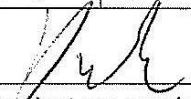
* Aviation Risk Assessment, 352 DM 2.2A (exhibit 5) will be used and addressed with each flight.

Appendix 6 – Job Hazard Analysis

NOTE: THIS JOB HAZARD ANALYSIS MAY BE UPDATED AFTER PUBLICATION AND THUS SHOULD BE SEEN ONLY AS AN EXAMPLE TO HELP PERSONNEL LOCATE THE JHA's. For the most recent version, please check:

Z:\SAFETY\SFCN Safety Program\Section 3A - SFCN Standard Operating Procedures - SOP's\Colonial_Birds\

Job Hazard Analysis (JHA)

Title of Job/Operation:		Helicopter Crew Member – Colonial Nesting Birds Protocol		Date:	March 27, 2013	No.	001
Position/Title(s) of Person(s) Who Does Job:		SFCN staff, especially Biological Science Technician				Page 1 of	2
Department:	Department of Interior – National Park Service		Employee Observed:				
Park Unit:	South Florida / Caribbean Network (SFCN)		Analysis Made By:		Robert Muxo,		
Location:	Biscayne NP, Everglades NP, Big Cypress NP		Analysis Approved By:		Kevin Whelan, Matt Patterson		
Employee Name:			Signature & Date	 9/5/2014			
Required Standards and General Notes:	All DOI personnel participating in helicopter flights for this monitoring project are required to complete the following helicopter training courses: A-107, Aviation Policy and Regulations I (on-line), A-100, Basic Aviation Safety, S-271, Helicopter Crewmember, A-110, Aviation Transport of Hazardous Material, A-200, Aviation Mishap Review, and A-312 Water Ditching and Survival. Maintain flight following with Everglades Dispatch Also required: Complete office field safety sign-out sheet; review helicopter "Go-No Go" list; complete Operational Risk Management Analysis (GAR); complete Hazardous Materials Manifest; notify FPL & office at takeoff and landing.						
Required Personal Protective Equipment:	Leather boots, Nomex flight suit, Nomex or leather gloves, non-synthetic undergarments, helmet, manual PFDs						
Tools and Equipment:	GPS, camera, field notebook, personal survival equipment, park radio, locator beacon						
Sequence of Basic Job Steps		Potential Accidents or Hazards		Recommended Safe Job Procedures			
1. Field safety briefing		1. Not knowing procedures to prevent accidents.		1. a) Brief entire crew on the use and application of the JHA and GAR model. b) Pilot/aircraft data card approved and current. c) Flight plan approved/flight following initiated. d) Personal protective equipment in use when required. e) Pilot briefed on mission and known flight hazards. f) Crew and passengers briefed on hazards and emergency procedures.			
2. Loading gear		2. Items not secured/ storage compartments not latched properly cause distraction/injury during flight.		2. Tie down cargo in cabin and gear in storage compartment. Make sure cargo latches are properly closed.			
3. Boarding the helicopter		3. Contacting moving propeller blades or falling.		3. a) Whenever possible, wait until all moving parts have stopped moving. b) Watch your step. c) Approach helicopter within view of pilot.			

Sequence of Basic Job Steps	Potential Accidents or Hazards	Recommended Safe Job Procedures
Boarding the helicopter (cont.)		d) Approach helicopter from the front of the aircraft e) Do not hold gear overhead.
4. During flight	4. a) Person or items falling out. b) Mid-air collision.	4. a) Do not remove seatbelts. b) Do not throw anything from the helicopter. c) Assist pilot by watching for other aircraft and birds.
5. Disembarking the helicopter	5. Contacting moving propeller blades or falling.	5. a) Wait for all moving parts to stop moving before releasing seatbelts and disembarking. b) Watch your step.

Appendix 7 – Examples of Flight Forms

THESE FORMS MAY BE UPDATED AFTER PUBLICATION AND THUS SHOULD BE SEEN ONLY AS EXAMPLES TO HELP PERSONNEL LOCATE THE CORRECT FORMS. The most recent version of the forms are located in

- Z:\Helicopter\Colonial_birds\Forms\

With backups in:

- Z:\SAFETY\SFCN Safety Program\Section 3A - SFCN Standard Operating Procedures - SOP's\Colonial_Birds\

Included files:

- Flight_Request_Form_9400_blank_use_this.pdf
- SFCN_Float_Plan.doc
- GAR_Risk_Assessment_Model_Birds_USE.doc
- SFCN_Helicopter_Go_No_Go_Checklist_Mod_USE.docx
- Aviation_Risk_Assessment.docx
- Hazardous_Materials_Manifest.docx
- 20140319_HMC_Bird_Aircraft_Daily_Diary_HCM-1_Use.xls

Aircraft Flight Request/Schedule Form (ENP 9400)

UNITED STATES DEPARTMENT OF THE INTERIOR										Change #		6. Aircraft Information FAA N#							
AIRCRAFT FLIGHT REQUEST/SCHEDULE																			
1. Initial request information				Cost-Account/Management Code(s)				Billee Code (OAS A/C only)				Flight Schedule No.		PAX Seats					
Initial Date/Time		To/From EVER Flight Following/		Phone Numbers						Make/Model									
										Color									
Check one: ☐ Point-to-Point Flight ☒ Mission Flight										Desired A/C Type: ☒ Helicopter ☐ Airplane				Vendor					
Mission Objective/Special Needs:														Phone No.					
														Pilot(s)					
2. Passenger/Cargo Information – Indicate Chief of Party with an asterisk (*) Please include pax cell numbers																			
NAME/TYPE OF CARGO		LBS OR CU FT	PROJECT ORDER/ REQUEST NO.		DEPT ARPT	DEST ARPT	RETURN TO	NAME/TYPE OF CARGO		LBS OR CU FT	PROJECT ORDER/ REQUEST NO.		DEPT ARPT	DEST ARPT	RETURN TO				
3. Flight Itinerary (For Mission-Type Flights, Provide Points of Departure/Arrival and Attach Map with Detailed Flight Route and Known Hazards Indicated)																			
DEPART WITH			DEPART FROM			ENROUTE	ARRIVE AT			DROP OFF		KEY POINTS				INFO RELAYED			
Date	No. Pax	Lbs.	Airport/Place		ETD	ATD	ETE	Airport/Place		ETA	ATA	No. Pax.	Lbs.	Drop-Off Points, Refueling Stops, Flight Check-Ins, Pickup Points		To/From			
4. Flight Following														5. Method of Resource Tracking:		7. Administrative		8. Review (If applicable)	
☐ FAA IFR ☐ Satellite ☐ FAA VFR With Check-In Every _____ Minutes To ☐ FAA or ☐ Agency ☒ Agency VFR With Check-In via radio Every <u>15</u> Minutes Frequency(ies):														☐ Phone ☒ Radio ☐ To Scheduling Dispatcher @ _____ (PHONE NUMBER) ☐ Prior to Takeoff ☐ Each Stop Enroute ☐ Arrival at Destination ☐ To: _____ @ _____ (Other Office) (PHONE NUMBER)		Type of Payment Document: ☒ OAS-23 or ☐ OAS 2 ☐ FS 6500-122 ☐ Other Route Document To:		☐ Hazard Analysis Performed ☐ Dispatch/Aviation Mgr. Checklist ☐ Other:	
9. Close-out														Closed by:					
														Date/Time:					

Field Safety Sign-out Sheet

Safety First!!! Field Safety Sign-out Information

Objective: To know where field personnel are, when they are overdue from returning from the field, when help should be sent, and to have enough information to give to searchers to make them easy to find.

Date(s):

List all crew members (crew leader first): _____

Time of departure:

Time expected to return:

Time to send help:

Location(s) (please attach a copy of any maps you make and give enough information to direct a search crew):

☐ BICY ☐ BISC ☐ EVER ☐ DRT0 ☐ WCA3A ☐ Other

Purpose: _____

Ramp

☐ Black Point Marina ☐ BISC Headquarters ☐ Flamingo

☐ Everglades City ☐ Other:

Contact info

Radio #:

Cell phone #:

Home phone #:

Will you be in cell phone range? Yes ☐ No ☐ Partial ☐ .

If overdue call

☐ EVERGLADES Dispatch: 305-242-7740 ☐ 911

☐ Dry Tortugas Site Manager (Acting): Glenn Simpson 305-242-7700

☐ U.S. Coast Guard: 305-535-4300, 305-535-4304, 305-535-4582

☐ EVER Flight Following: 305-242-7868

☐ BICY Mike O'leary 239-450-2278

Truck/Car

☐ Community Truck Ford F250 – 2012, green, 4x4, crew cab, long-bed, tag # I517061

☐ Community truck Ford F250 – 2008, white, 4x4, crew cab, long-bed, tag # I411795

☐ Marine truck Ford F250 – 2007, white, 4x4 crew cab, short-bed, tag # I411786

☐ EPMT Ford F250 – 2012, green, 4x4, crew cab, long-bed, tag # I517061

☐ Chrysler Grand Caravan minivan – 2005, dark blue, tag # I410018

Truck/Car (continued)

☐ Ford Expedition (XLT) – 2009, white, tag # G62-0210F-(Tony’s SUV)

☐ Ford Fusion – 2010, white, tag # I413445

☐ 16-ft Green Cargo ATV Trailer, tag # I413441

Boat

☐ TwinVee Catamaran w/NPS logo, length 29 ft, tag # I263404

☐ “Tiburon” TwinVee Catamaran, length 19 ft, tag # I413447

☐ Airboat w/NPS logo, length 14 ft, tag # I411792

☐ “Sparky” Aluminum workboat, length 20 ft, tag # I411792

☐ M/V Fort Jefferson – Satellite Ph: 808-659-5146, Cell Ph: 305-215-4767

☐ Canoe, red, Osagian “Missourian”, length 17’

☐ Other:

If staying overnight

Lodging you are staying in:

Lodging phone number:

Name of field crew’s Nightly Call-in Contact:

Expected call-in time:

If going on a helicopter

Name of the company:

Name of the pilot:

Contact info for pilot & company:

Precise take-off point:

Take-off time:

Precise landing point:

Landing time:

☒ Approval for permission to work 8 hours comp time per day.

Operational Risk Management Analysis (ORMA)

Rate 1–10 *

Any category rated > 5 should receive specific mitigation.

Supervision: These monitoring events will take place under the supervision of EVER Flight Following, the Pilot, Helicopter Manager, Flight Manager, and Helicopter Crew Member. Each person involved in the mission has the responsibility to minimize risk.			
Planning: Prior to each mission, flight requests and notifications will be sent to EVER Flight Following, HMC Helicopter, BISC management & resource personnel, and FPL Security at Turkey Point. Weather conditions are monitored prior to scheduling each flight until the time of the flight. Prior to each flight, an Aviation Risk Assessment form, Hazardous Materials Manifest, and a Go/No-Go checklist will be completed. The flight crew will brief the pilot on the mission objectives and requirements and a safety briefing will be performed by a qualified individual.			
Contingency Resources: If a member of the flight crew cannot perform their duties, another qualified person may substitute for that individual. If conditions such as weather or equipment are not satisfactory the mission may be rescheduled or cancelled. In case of an emergency, the helicopter and/or crew is equipped with a first aid kit, emergency locator beacon, and radio. Personal protective equipment will be worn by crew members including PFDs when flying over water.			
Communication: As previously stated, flight notifications and requests will be sent to the appropriate individuals. These flights will be performed using EVER Flight Following procedures (status checks performed at 15 minute intervals). It is important to maintain communications of personnel within the aircraft as well and foster good communications between everyone involved.			
Team Selection: Personnel performing the monitoring will remain current in required flight training: A-107/ Aviation Policy and Regulations, B-3/ Combination Helicopter/ Airplane Safety Certificate, S-271/ Helicopter Crewmember Certificate, and A-312 Water Ditching and Survival.			
Team Fitness: In the event a team member or the pilot is considered unfit to perform their assigned tasks, (as determined by the pilot, flight crew member, or other personnel involved with the mission) the mission can be rescheduled or cancelled. Team members' physical and mental fitness need to be considered before each mission.			
Environment: Weather conditions will be monitored before and during the mission to ensure we stay within NPS guidelines and do not exceed limits of the aircraft or personnel. Our data collection environmental limits are more stringent than IHOG guidance allows.			
Incident Complexity: Efforts should be made to minimize complexity. Planning, communication, and simplifying tasks will aid to minimize complexity. Weather considerations are another major concern to lessen complexity. Safely minimizing the mission time also reduces exposure to risk.			
Green (1–35)	Amber (36–60)	Red (61–80)	

SFCN Helicopter Go / No-Go Checklist

Items needed:

- Personal protective equipment; helmet, flight suit, gloves, leather boots. PFD's are also required when the flight track is taking you beyond gliding distance to land. ____
- GPS (handhelds, plotter), cameras, and any other electronics needed for the mission. ____
- Data sheets. ____
- Handheld communication (portable digital park radio with spare battery). ____
- Personal locator beacon (PLB) 406MHz. ____
- Safety items such as survival packs, first aid, extra food, water, etc. ____

Pre-flight procedures:

- Plan flight mission properly. Refer to the Aviation Safety Manual if necessary. ____
- Submit Aircraft Flight Request form (ENP 9400) after confirming flight availability to: Clayton Camblin (EVER aircraft dispatcher) via email; or to HMC Helicopter Services via fax to (305) 254-1407. ____
- Send emails notifying park managers & FPL of mission (dates, times, locations, etc). ____
- Prepare GPS, charge batteries, synchronize camera with *time.gov* for geosetting. ____
- Fill out SFCN office safety sheet with flight mission details. Call SFCN office (305) 252-0347 prior to take-off and after landing. ____

Flight day procedures:

- Monitor weather conditions, and make sure they are appropriate for flying mission. ____
- Arrive at airport at least 30 minutes prior to scheduled flight. ____
- Ensure that pilot and personnel have proper qualifications to fly the mission. ____
- Brief pilot and personnel of mission, routes, stopping points, specifics, etc. Make sure pilot is rested and not pre-occupied (e.g., not flown frost suppression missions the previous night). ____
- Make sure pilot goes over pre-flight briefing on aircraft features and safety components. ____
- Know where fuel gauge is located and amount of fuel needed to safely return. ____
- Ensure proper flight following/resource tracking procedures and radio frequencies. ____
- Ask the pilot to set radio so you can also hear all air traffic communications. Be aware that once 5 miles from airport range flight following takes over monitoring of the aircraft. ____
- Check with pilot to ensure that passenger-side control pedals are in the lock position. ____
- Secure all loose equipment before flight; use precaution to prevent anything from falling out. ____
- Communication is important! Ask, notify, listen, and be alert to everything that is going on. ____
- Be aware of local airports and potential emergency landing spots. ____

During flight:

- Ensure flight following is initiated and maintained throughout flight. ____

- As crew member you must keep alert for hazards (other aircrafts, birds, etc.) and notify the pilot. ____
- Check fuel gauge during flight. ____

Post-flight procedures:

- Do not remove seatbelts or exit aircraft until propellers have stopped moving. ____
- Make sure that you obtain the completed and signed copy of the AMD-23E from the contractor. ____
- Make sure to update SFCN spreadsheets with fly times, costs, and any other important information. ____

Flight Manager Signature:_____

Date:_____

AVIATION RISK ASSESSMENT

352 DM 2.2 A

Risk assessment is the subjective analysis of physical hazards and operational procedures to arrive at a Go-No-Go decision. Risk assessments support informed GO-NO-NO decisions which are the responsibility of management. The pilot retains the final authority for the NO-GO decision when safe operations of the aircraft are a factor.		
If you answer no to any of the elements, stop and re-evaluate	The following is designed to provide the aircraft user or manager a checklist to help determine a GO-NO-GO decision.	
YES	NO	GO-NO-GO CHECKLIST
		1. Aircraft data card, checked and mission approved.
		2. Pilot qualification card, checked, mission approved
		3. Pilot flight/ duty limitation checked.
		4. Official/ unofficial passengers authorized. Release form completed if needed.
		5. Manifest completed and left at departure point.
		6. Weight and balance completed by pilot.
		7. Mission approved by management. Proper PPE being worn. (Flight suit, gloves, leather boots, flight helmet.)
		8. Pilot briefed by personnel on intended missions and hazards.
		9. Aircraft safety briefing being provided to passengers.
		10. Personnel trained and qualified for mission. B3 must be current. (Within three years.)
		11. Flight plan completed, flight following procedures established and operational.
		12. Hazard map reviewed for low level flights.
		13. Weather forecast received, winds within prescribed limits.
		14. Cargo checked and secured.
		15. Survival equipment available if required.
		16. Special Use Plan current and on file (LE, SAR, Fire, Hydro, Exotics, Biological Monitoring).
Comments:		
Pilot Signature:	Chief of Party Signature:	Date:

HAZARDOUS MATERIALS MANIFEST

Date _____ A/C _____ Bureau/Agency _____

					Location In Ship*
Common Name	Hazard Class	ERG#	QTY	Weight	
Acetylene	Flammable Gas	116			
Aerosols, Nonflammable<1 Liter	Nonflammable Gas	126			
Aerosols, Flammable<1 Liter	Flammable Gas	126			
Antifreeze, ethylene glycol	none	none			
Batteries dry	Corrosive Materials	154			
Batteries Wet/ Acid	Corrosive Materials	154			
Batteries Wet w/ alkali	Corrosive Materials	154			
Batteries Wet/ Non-spillable	Corrosive Materials	154			
Bear Spray, Irritants	ORM-D	none			
Cartridges Small Arms	ORM-D	none			
Clorox, liquid bleach	Corrosive Materials	154			
CO2 cartridge (PFD or other)	Nonflammable Gas	120			
Diesel Fuel	Flammable Liquid	128			
Drip Torch Fuel	Flammable Liquid	128			
Engines, Internal Combustion	Class 9	128			
Fire Extinguisher	Nonflammable Gas	126			
Fireline Explosives FLE	Explosives	112			
Pistol Flare Shell ¾ x 3 1/2	Flammable Solid	133			
Pistol Flare Shell 2 ½ x 6	Flammable Solid	133			
Fuel Aviation Jet-A	Flammable Liquid	128			
Fuel White Gas	Flammable Liquid	128			
Fusee	Flammable Solid	133			
Gasoline	Flammable Liquid	128			
Gas Personal Flotation Device (PFD)	Class 9	138			
Lithium Battery	Class 9	138			
Mapp Gas Helitorch	Flammable Gas	116P			
Matches (book, box or strike anywhere)	Flammable Solid	133			
Medical Waste	Infectious Substance	158			
Methanol (Petro Gel)	Flammable Liquid	131			
MRE Heaters (magnesium powder)	Dangerous When Wet	138			
Nitrogen (compressed)	Nonflammable Gas	121			
Nitrogen (refrigerated)	Nonflammable Gas	120			
Oxygen (compressed)	Nonflammable Gas	122			
Paint (flammable)	Flammable	128			
Petro Gel Helitorch	Flammable	131			

					Location In Ship*
Common Name	Hazard Class	ERG#	QTY	Weight	
Petroleum Oil	Flammable	128			
PSD Spheres (Potassium Permanganate	Oxidizer	140			
Propane	Flammable Gas	115			
Saw bar and fuel mix oil	None	none			
Wood lacquer, varnish, filler, etc.	Flammable	127			
Wood Stain	Flammable	129			
		Total Weight		0	

*IC= Internal Cargo, EB= External Basket, TB= Tail Boom, LL= Long-line

Users (HMGB, HECM) Signature: _____

Pilot's Signature: _____

Remarks: _____

AMD-137 (11/08)		AIRCRAFT CONTRACT DAILY DIARY							
Contract #: D14PD00089		Item:		Page	1	Of	1	Date:	05/20/14
1. Contractor: HMC Helicopter Service				7. Designated Base: Tamiami airport					
2. A/C Make/Model & FAA #: Bell 206L1 - N5013G				8. Current Aircraft Location:					
3. Pilot(s) On Duty: Gary Freeman				9. Activity: Ferry			Training		Project
				Large Fire Support			Standby		IA
4. Mechanic(s) On Duty: NA				10. Other Aircraft On Base: NA					
5. Driver(s) On Duty: NA				11. Weather: Sunny few clouds calm winds					
6. Total # Of Contractor Personnel:				12. Local Fuel Price:					
13. Pay Items	Begin	End	Total	EXT.	14. Special Equipment	HR/Days	Cost		
Availability									
Flight Time	1461.9	1463.1	1.2						
Service Miles									
Pilot Duty									
Driver Duty									
Mechanic Duty									
15. Aircraft Status: (Maintenance performed, power trend analysis completed, reasons for any unavailability, etc.)									
16. Narrative Report: (Include problems encountered, official visits or inspections, safety issues encountered, etc.)									
No Problems encountered. - Crew arrived early and followed Go-No-Go list, Risk assessment model, SFCN Go-no-go list and performed preflight briefing, used EVER flight following, and performed post-operation paper work. Aircraft had popout Floats. 206L offered at 206B3 rate.									
17. Miscellaneous Costs: (Contractor purchased permits, fees, travel, etc; to be reimbursed by Govt.)									
None - reduction of gas charge (-100.00 see AMD-23E)									
18. Govt. Representative Name/Title (Print):				Govt. Representative Signature:			Date:		
Robert Muxo / Biological Technician							6/25/2014		
NFES #1088					HCM-1 (11/2008) REQUIRED				

Appendix 8 – Directions to Airports

Miami Executive Airport

The address of Miami Executive Airport is, 12800 SW 145 St., Miami, FL, 33186.

Driving directions to Miami Executive Airport from the SFCN office are as follows:

- From office proceed west on SW 184th St / Eureka Dr.
- 3.6 mi - Take ramp right for Florida's Turnpike (821) North toward Orlando (Toll Road)
- 4.0 mi - At exit 19, take ramp left and follow signs for SW 120th St
- 0.3 mi - Turn left onto SW 120th St
- 1.9 mi - Turn left onto SW 137th Ave / Lindgren Rd
- 0.6 mi - Turn right onto SW 128th St (Private Road, Gated Road, BP on the corner)
- 0.8 mi - Turn left onto SW 145th Ave (Private Road)
- 48 ft

Homestead General Airport

The address of Homestead Airport is, 28700 SW 217 Ave. Homestead, FL 33030.

Driving directions to Homestead General Airport from the SFCN office are as follows:

- From office proceed west on SW 184th St / Eureka Dr.
- 2.4 mi - Turn left onto US-1 S / S Dixie Hwy (Taco Bell on the corner)
- 2.8 mi- Keep left to stay on US-1 S / S Dixie Hwy / S Federal Hwy / Trooper Buck Buchanan Memorial Hwy
- Pass BP in 4.1 mi
- 6.9 mi - Bear right onto SW 296th St / Avocado Dr.
- 5.5 mi - Turn right onto SW 217th Ave
- 0.7 mi- Arrive at 28700 SW 217th Ave, Homestead, FL 33030

If you reach SW 280th St / Waldin Dr., you've gone too far.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 169/129033, July 2015

National Park Service
U.S. Department of the Interior



Natural Resource Stewardship and Science

1201 Oakridge Drive, Suite 150
Fort Collins, CO 80525

www.nature.nps.gov

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