



Florida Beach-nesting Bird Plan

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1. Conservation Need

1.1 Background

Beach-nesting birds are naturally constrained to a narrow slice of habitat at the interface between saltwater and upland habitat. As such, they are adapted to deal with a range of natural forces, including major storms, predators, and an ever-shifting coastal landscape. Layered on top of these natural challenges are the major disruptions to coastal ecosystems caused by human activity, as well as the longer-term threats associated with climate change. In Florida, least terns (*Sternula antillarum*), and to a much lesser extent, black skimmers (*Rynchops niger*) and American oystercatchers (*Haematopus palliatus*) have altered their behavior to include the use of flat gravel rooftops for nesting. Habitat loss, predators, disturbance, and conflicting natural resource management priorities are all significant factors contributing to the decline of beach-nesting birds in Florida and elsewhere along the coasts of the North Atlantic Ocean and Gulf of Mexico.

The [Atlantic Flyway Shorebird Initiative \(AFSI\) Business Strategy](#) (Winn et al 2013) and the subsequent [Atlantic Flyway Shorebird Initiative Business Plan](#) (NFWF 2015) address shorebird conservation at a hemispheric scale. Developed by partners from North, South, and Central America and the Caribbean, the AFSI Business Plan is a comprehensive assessment and roadmap for shorebird conservation. This plan also calls for the development and implementation of regional or state-level business plans focused on specific aspects or focal species within the larger plan. This plan addresses the conservation of five species of beach-nesting birds in Florida. Four, including the American oystercatcher, snowy plover (*Charadrius nivosus*), least tern, and black skimmer are state-listed as “Threatened” in Florida. The Wilson’s plover (*Charadrius wilsonia*) is not state-listed in Florida, but like the American oystercatcher and snowy plover, it is a species of high concern in the [U.S. Shorebird Conservation Plan](#) (Brown et al 2001) and a priority species in the AFSI Business Plan. The Florida Fish and Wildlife Conservation Commission (FWC) and their partners within the Florida Shorebird Alliance (FSA) have produced a comprehensive [Species Action Plan for Four Imperiled Beach-Nesting Birds](#) (FWC 2013) for the four state-listed species. The Florida Beach-nesting Bird Plan is not intended to replace FWC’s earlier plan, but to build on it by including specific population goals, metrics, timelines, funding needs, and a conceptual framework consistent with the AFSI and national American oystercatcher business plans.

1.2 Focal Species

The Florida Beach-nesting Bird Plan focuses on five beach-nesting species: American oystercatcher, snowy plover, Wilson’s plover, least tern, and black skimmer. These species cross taxonomic groups, but they overlap significantly in specific locations, habitat requirements, current threats, and conservation status and thus the actions and strategies developed within this plan will benefit these species. Further, although the plan is focused on the five species listed above, this plan will benefit a suite of beach-nesting birds in Florida, as well as nesting sea turtles, beach mice and other native species in the coastal ecosystem.

With the exception of the least tern, all of the focal species overwinter in Florida. These species are long-lived birds, and their population trajectories are particularly sensitive to adult survival rates, which may be affected by winter habitat suitability (American oystercatcher Working Group et al. 2012; Hitchcock and Gratto-Trevor 1997; Yasue 2006). In winter, avian survival depends on availability of food, refuge from predation and disturbance, and local weather events (Placyk and Harrington 2004; Sherry and Holmes 1996). Although foraging is critical for survival, roosting and its associated activities such as rest, digestion, and maintenance are also important (Conklin et al. 2008).

American oystercatcher

The American oystercatcher is a large, stately shorebird that inhabits coastal marshes, oyster rakes, beaches, and islands along the Atlantic and Gulf coasts of the U.S. Although American oystercatchers can be found along coastlines elsewhere in the western hemisphere, the subspecies that inhabits the eastern U.S. is distinct in its taxonomy and geographic range. Oystercatchers are a candidate species to be state-listed as “Threatened” in Florida, and a Species of High Concern in the U.S. Shorebird Conservation Plan. In recent years this species has been the focus of a sustained and successful coast-wide recovery effort mapped out in the National Fish and Wildlife Foundation’s American Oystercatcher Business Plan. The species remains at substantial risk in Florida, and statewide breeding numbers are well below FWC’s state population target for recovery. Oystercatchers nest on both the Atlantic and Gulf coasts of Florida from March to August. During the non-breeding season, Florida is home to approximately 20% of the total U.S. population of oystercatchers and has the second largest wintering concentration of the species in the U.S. (Schulte et al. 2012).

Snowy plover

Snowy plovers are state-listed as “Threatened” in Florida. On Florida’s Gulf Coast, the snowy plover breeds between February and August. Approximately 80% of the population breeds in the Panhandle, and the remaining birds form a small subpopulation on the Southwest coast. Breeding occurs on peninsular and barrier islands as well as some mainland beaches. Their nests are located on open, dry sandy areas that are sparsely vegetated, with access to the inter-dunal areas and generally within sight of salt water. Snowy plover chicks are highly mobile and may travel several kilometers (e.g., documented records up to 13 kilometers) from the nest site in search of food, often seeking low-energy foraging habitats such as ephemeral tidal pools. Snowy plovers are partial migrants and their winter and summer ranges have substantial overlap in Florida (Himes et al. 2006).

Wilson’s plover

Wilson’s plovers are found on both the Atlantic and Gulf coasts of Florida. Wilson’s plovers nest from March to September in more densely vegetated habitat, but often will also use the barren to sparsely vegetated habitat favored by most other beach-nesting species. Less is understood about their distribution and abundance in Florida compared to other species in this plan. The diverse range of nesting habitat, as well as differences in behavior when nesting make it more difficult to

accurately estimate the population and productivity of Wilson's plovers. Wilson's plover chicks share the highly mobile characteristics of snowy plover and American oystercatcher chicks and can move extensively after hatch. Wilson's plovers are winter residents as well as breeding birds in some regions of the state. In the Panhandle for example, one study found that only 5% of the breeding population are year-round local residents. The remaining 95% migrate in from other wintering sites (Pruner et al 2015). However, winter dispersal and habitat use-patterns are poorly understood. The wintering population in peninsular Florida likely includes birds migrating from the Atlantic coast and the Florida Panhandle.

Least tern

Least terns arrive from Central and South America and begin breeding by mid-April through early September. Least terns nest in colonies ranging in size from a few breeding pairs to many hundreds (Gore 1996), and are often found nesting with other seabirds such as black skimmers or roseate terns (*Sterna dougallii*) in South Florida (Gore et al. 2007, Zambrano and Warraich 2012). In Florida, large numbers of least terns nest on rooftops as well as natural beach habitat and interior nesting sites such as phosphate mines and cleared land. Rooftop nesting terns present a separate set of management challenges due to difficulties in access for management and monitoring, as well as different risks associated with predators and environmental stressors. Approximately half of the known breeding population is currently found on rooftops (Avissar et al. 2015). Least terns are migratory and are only present in Florida during the breeding season and post-breeding staging.

Black skimmer

Black skimmers nest in colonies ranging in size from a few to several hundred pairs. They begin breeding usually in May and continue until early September. Skimmers often nest in association with other nesting seabirds, and can be found nesting in both beach and to a lesser extent, on rooftop colonies. Though the state used to have large nesting colonies consisting primarily of skimmers, the species has declined and most colonies are now small and fragmented. Skimmers historically nested in large numbers on both coasts, but they are quickly disappearing from Florida's Atlantic coast.

1.3 Key Threats

Beach-nesting birds face multiple challenges throughout their annual cycle. The primary anthropogenic threats in Florida include human disturbance, habitat degradation, increased predation, and incompatible management actions. Lack of knowledge is also a current threat when it limits our ability to identify, implement, and assess the most effective management strategies. For example, a priority identified by partners and articulated in this plan is to obtain better statewide population estimates for all focal species. Investments in monitoring and research will be required to maximize the effectiveness of management actions.

1.3.1 Disturbance

Beach-nesting birds in Florida experience human disturbance throughout their life cycle. Disturbance events have serious impacts during the nesting season when they result in the loss of nests and chicks, or even colony abandonment. The negative effects of human disturbance on shorebirds and seabirds are well documented (Gochfeld and Burger 1994, USFWS 1996, Brown et al. 2001, USFWS 2009, Colwell et al. 2010, Niles et al. 2010). Birds reacting to disturbance by pedestrians, vehicles, and dogs may leave their eggs and young vulnerable to environmental conditions and opportunistic predators. In addition, beach driving, roadways adjacent to nesting areas, and mechanical beach cleaning can result in direct loss of eggs, chicks and adults. Disturbance events are not limited to the breeding season. Repeated disturbance of foraging and roosting birds creates stress and potential loss of fitness over time (Schlacher et al 2013). Sites that are otherwise of high-quality may be abandoned if disturbance levels grow too high (Koch and Paton 2014, Brown et al 2001, Burger 1986).

1.3.2 Habitat loss and degradation

Coastal habitats in Florida that are important for beach-nesting birds include peninsular, island and mainland beaches, mud flats, sand flats, spoil islands, oyster reefs, emergent marshes, barrens, and lagoons as well as ephemeral shoals formed within larger inlets. These dynamic coastal habitats are threatened by widespread habitat loss, increased anthropogenic pressure, and climate change. In addition to habitat loss, these coastal habitats are greatly impacted by the presence of non-native or overgrown vegetation, domestic and non-native animals, pollution, anthropogenic activities, and coastal habitat management activities (i.e. mechanical beach cleaning and beach driving). Gravel rooftops are also decreasing in quantity and quality in Florida. Gore et al. (2007) reported a total of 287 rooftop nesting sites during rooftop surveys from 1998-2000. Ten years later, Zambrano and Warraich (2010) reported 32% (n=92) of these rooftops were reroofed, demolished, or rebuilt with alternate roof materials and were no longer suitable for nesting.

Nationally, human population density in coastal counties is more than six times greater than in corresponding inland counties (NOAA 2013). The scale of threats to Florida's coastal ecosystems will increase as the number of people living in coastal counties increases (predicted to double from 12.3 million to more than 26 million by 2060; FWC 2008). Coastal engineering projects designed to halt the natural processes of erosion, sand transport, and accretion may impact beach-nesting bird habitat and food availability. The scope and frequency of these projects is predicted to increase with an increasing human presence in the coastal zone. For example, along the Florida Atlantic Coast 19 of 21 (90%) inlets have some form of sediment retaining structure. Along the Gulf coast, 20 of 48 (42%) inlets have structures within them and 50% (24 of 48) of the Gulf inlets are dredged, mined or artificially opened and one is artificially closed. Of the 809 miles of beach shoreline in Florida, only 37% (298 miles) reside in public ownership or are protected by conservation organizations (Rice 2012).

The effects of climate change (e.g., sea level rise, stronger weather events, disruption of weather and ocean patterns) are likely to amplify the habitat loss from anthropogenic factors. This plan

does not attempt to address the causes of climate change, but improving the resiliency of habitats and populations to the likely effects of climate change will be important in the coming years.

1.3.3 Predation

Native and introduced predator populations may artificially increase in association with high numbers of people along coastal areas. Overabundant predators associated with humans such as raccoons (*Procyon lotor*), foxes (*Vulpes vulpes*), coyotes (*Canis latrans*), crows (*Corvus spp*), gulls (*Larus argentatus*, *Leucophaeus atricilla*), rats (*Rattus spp*), feral cats (*Felis catus*), dogs (*Canis lupus familiaris*), Burmese pythons (*Python molurus bivittatus*), and tegus (*Salvator merianae*) prey on beach-nesting bird eggs, chicks, and even adult birds. These artificially abundant predators can have major impacts on beach-nesting bird reproductive success and viability of breeding populations. As human use of prime nesting habitat forces beach nesters to nest in less desirable areas, even native co-evolved predators, such as ghost crabs (*Ocypode quadrata*) and gull-billed terns (*Gelochelidon nilotica*), can have substantial impacts on reproductive success. As available habitat shrinks, beach-nesting species are constrained in their ability to move between sites and predators may be able to find nests more efficiently. In Florida, predators represent a significant threat to the viability of the focal species.

We have some adequate management techniques, but we lack the knowledge about when and where they can be used effectively while considering interactions among the predator populations. For instance, coyotes are nest predators, but also impact raccoon abundance and behavior. Raccoons, in turn, are predators on ghost crabs, another important nest predator. In addition, predation and predator behavior can be influenced by human activity. Human disturbance can reduce the resilience of beach-nesting birds to predation pressure. For example, when a bird flushes from its nest due to human disturbance, the unguarded nest faces greater risk of predation. Comprehensive best management practices (BMPs) as well as basic research are needed to answer these critically important questions and effectively address predation issues.

1.3.4 Incompatible Management Actions

Coastal habitats and beaches in particular are subject to disparate and often conflicting management pressures. Incompatible uses permitted on many beaches include mechanical beach cleaning, overuse by humans, and presence of pets. Even conservation actions for other species can have detrimental effects on beach-nesting birds if the actions are not coordinated. For example, people surveying for sea turtle nests may disturb or accidentally destroy beach-nesting bird eggs, chicks, or even adult birds unless the surveyors are trained and surveys are coordinated with beach-nesting bird protection efforts. Planting dune vegetation to control erosion can reduce the availability and quality of open sand flats used by multiple nesting species and increase habitat for predators.

1.4 Conservation Capacity Landscape

1.4.1 Conservation capacity

Florida's beach-nesting bird conservation partnership network, the FSA, is comprised of 12 active regional partnerships that monitor and manage beach-nesting birds across Florida. FSA members include resource managers in local, state, and federal governments, non-governmental organization (NGO) representatives, and private citizens. The FSA newsletter ([The Wrack Line](#)) maintains an email distribution list of over 18,000 subscribers.

FWC's statewide shorebird partnership coordinator, assisted by other FWC staff and key partners, cultivates regional partnerships to improve cooperation between key agencies, organizations, and individuals involved with the management, monitoring, and stewardship of shorebirds and seabirds. In 2011, the FWC launched a beach-nesting bird monitoring website called the Florida Shorebird Database (FSD). Data entered into this database is collected using a statewide monitoring protocol. FWC continues to work with partners to refine and improve the database and monitoring protocol and encourage expansion of monitoring efforts. This database is the critical tool for mapping, tracking, and analyzing the data associated with the massive annual beach-nesting bird management and monitoring effort in the state. Continued development, expansion, and management of this database is crucial to the success of improved statewide monitoring programs and analysis of management efforts.

Audubon Florida maintains an active network of staff biologists and volunteer bird stewards that conduct on-the-ground education, help protect posted nesting areas, and assist with monitoring, management, and social marketing efforts. This network is expected to grow with the full implementation of this plan and include regional stewardship coordinators to fully manage the program.

The American Bird Conservancy (ABC) has considerable experience successfully designing and implementing educational programs and social marketing campaigns. ABC's engagement with the FSA partners and stakeholders in the state may materially advance the goals associated with changing public attitudes and behaviors in the state.

The U.S. Fish and Wildlife Service (USFWS) regulates protective actions via the Migratory Bird Treaty Act, coordinates or funds research and surveys, initiated the first predator control program with the U.S. Department of Agriculture and National Park Service in Northwest Florida, and coordinates an annual statewide wintering shorebird survey, as well as a plover and red knot international census every five years.

Shorebird population monitoring in the state is also conducted via the International Shorebird Surveys (ISS) which promotes a standardized methodology for gathering information on shorebirds and the habitats they use. The ISS is the longest running effort to monitor shorebirds in the Americas.

Florida partners maintain an active role in the American Oystercatcher Working Group, the Snowy Plover Working Group, and the newly formed Wilson's Plover Working Group. The groups meet regularly to collaborate on conservation issues, improve management practices, and share research results.

The knowledge base and partnership networks are already established in Florida. To effectively implement this plan and achieve plan goals, these partnerships will need substantial additional resources to scale-up management, coordination, and monitoring activities.

1.4.2 Conventions, legal frameworks, and initiatives

The North American Migratory Bird Treaty Act between Canada, Mexico, and the United States is a United States federal law, first enacted in 1916 in order to implement the convention for the protection of migratory birds between the United States and Canada. The statute makes it unlawful to pursue, hunt, take, capture, kill or sell birds listed therein ("migratory birds").

The Important Bird Areas (IBA) program is a site-based conservation initiative developed by Birdlife International and implemented in Florida by Audubon, their U.S. partner. Audubon maintains more than 20 coastal IBAs in Florida that are monitored and protected in coordination with the FWC and other partners.

Florida state law (Chapter 68A-27) provides protections for species state-listed as "Threatened" or "Endangered" in the state. Under state law, no person can take, possess, transport, or sell any organism, nest or egg designated as "Threatened" or "Endangered". Snowy plovers and least terns are protected under this law. American oystercatchers and black skimmers are proposed for listing and likely will receive these protections in 2016. Further authority to protect the wildlife of the state is granted under [Article IV, Section 9 of the Florida Constitution](#), which gives the FWC the constitutional authority to "exercise the regulatory and executive powers of the state with respect to wild animal life and fresh water aquatic life, and shall also exercise regulatory and executive powers of the state with respect to marine life...".

The FWC has established Critical Wildlife Areas (CWAs), several of which include beach-nesting bird habitat. CWAs can be closed to entry during the nesting season or at other critical points in the annual cycle. However, most posted areas for nesting shorebirds and seabirds in Florida are not CWAs so they are posted as "Do Not Enter" areas. These areas are not enforceable as no-trespassing areas, but signs alert the public that entering into such areas could result in "take" or harm of species protected under state rules and the Migratory Bird Treaty Act.

Annual monitoring of beach-nesting bird populations is accomplished through coordinated efforts by FSA partners who collect and input the data into the FSD. FSA staff summarize and report annual results. Data collected during the breeding season includes species distribution, nest locations and outcomes, estimates of breeding abundance, and disturbance and presence of predators. Data collected during the non-breeding season includes locations, species composition, and habitat characteristics of areas used by roosting and foraging birds, disturbance, and presence of predators. Targeted research within limited locations reports

productivity, habitat use and patterns, and survival rates. This annual effort is a significant undertaking and will need to expand substantially to accomplish the monitoring needs outlined in this plan.

2. Conservation Outcomes

2.1 Initiative Goal

The goal of the Florida Beach-nesting Bird Plan is to increase the population level of the five focal beach-nesting bird species by 10% over a ten-year period.

2.2 Species Outcomes

Projected management outcomes for the species included in this plan:

- Reduced disturbance pressure
- Enhanced management of existing habitat
- Increased acreage through habitat creation/improvement
- Reduced predation pressure
- Increased productivity (chicks fledged/pair)
- Increased # of breeding pairs managed and protected
- Increased size of nesting colonies managed and protected for colonial nesting species

2.3 Strategies

Long-term conservation goals and outcomes for species recovery strategies in the Florida Beach-nesting Bird Plan:

Strategy	Long-term Conservation Goals	Outcomes
Reduce Human Disturbance	Improve habitat availability and use at managed sites, resulting in increased fledging success and annual survival.	Increased productivity of focal species to the level that allows for a 10% population increase by 2029 (see Appendix B for productivity goals)

Manage Habitat	Reduce loss and restore wet and dry sand habitats for beach-nesting birds.	<ol style="list-style-type: none"> 1) Manage at least 18,000 acres (see Appendix D) in a manner that provides high-quality breeding and wintering habitat for beach-nesting birds 2) Achieve no net loss of beach-nesting bird habitat from coastal engineering and development projects
Manage Predation	Reduce the proportion of nests and chicks lost to predators	Increased productivity of focal species to the level that allows for a 10% population increase by 2029
Improve Conservation Regulations	Increase the ability of managers to implement effective management actions and minimize incompatible management actions	Improved reproductive success through improved compliance with existing regulations and development of more effective and legally enforceable protections for breeding and wintering habitat and nesting birds
Reduce Knowledge Gaps	Reduce uncertainty surrounding management actions and population parameters	<ol style="list-style-type: none"> 1) Improved understanding of population dynamics 2) Improved management actions informed by monitoring and research

3. Implementation Plan

3.1 Background

This section of the Florida Beach-nesting Bird Plan outlines strategies for addressing the most serious threats affecting focal species and their habitats in Florida. For each strategy, one or more actions are outlined with corresponding SMART (i.e., Specific, Measurable, Attainable, Realistic, and Time-bound) objectives. Together, the implementation of the strategies and actions and completion of the objectives will achieve the goal of increasing focal beach-nesting bird populations in Florida by at least 10% by 2029.

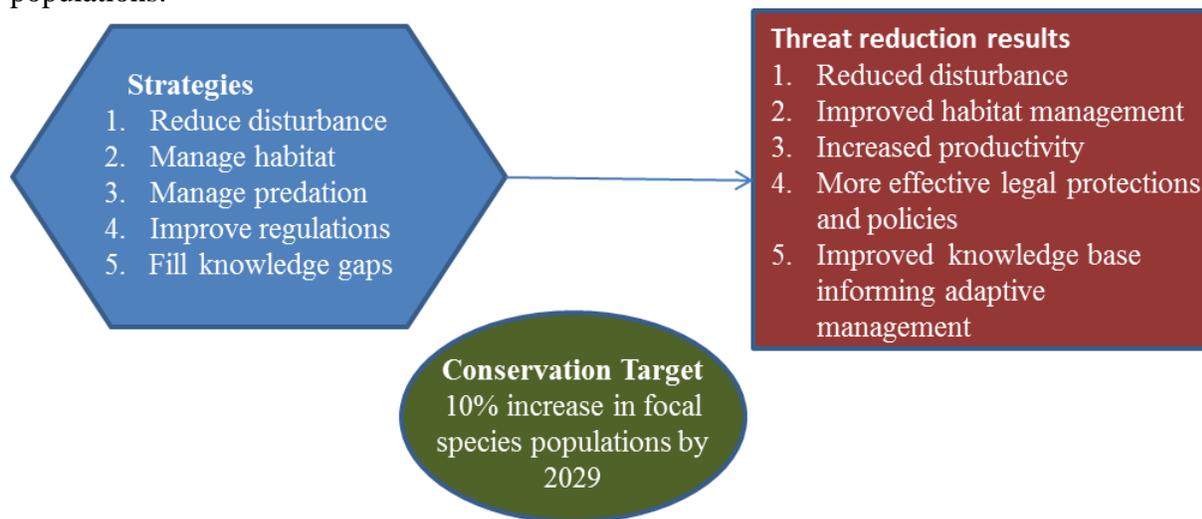
3.2 Foundational Work

The actions presented in the implementation plan are all high-priority, however some actions will need to be addressed earlier in the process. For example, we need reliable estimates of the current population of these species in Florida to measure progress toward the full recovery goals - an overall 10% increase in populations of focal species. Therefore, a key priority during the first three years of this plan (2017-2019) will be to implement surveys to estimate the statewide populations for each of the focal species. For maximum effectiveness, BMPs should be completed and implemented during the early stages of this plan as well as capacity building and database development and improvement.

Foundational actions (identified throughout the implementation plan in red) are important to complete early in this plan, however they should not take the place of ongoing and expanded management work that is consistent with the goals of this plan. Implementing the foundational work concurrently with annual beach-nesting bird management will require substantially increased resources and capacity, but will be critical to the long-term success of this plan.

3.3 Strategies for Implementation

Strategies for implementation are outlined in the “[Conservation Outcomes](#)” section. The implementation of these strategies will lead to a 10% increase in focal beach-nesting bird species populations.



3.3.1 Reduce Human Disturbance

The goal of this strategy is to reduce human disturbance events by 90% on all actively managed sites. Disturbance is a serious threat during both the breeding and non-breeding seasons. In conjunction with other threat reduction activities, disturbance reduction will result in increased site use and improved fledging success and annual survival, which will contribute to the overall goal of a 10% increase in focal beach-nesting bird populations by 2029.

Action 1 (Foundational): Assemble and distribute BMPs – Florida is fortunate to have a diversity of existing BMPs related to posting, beach driving and other habitat management needs. Compile existing BMPs and develop new guidelines as needed for controlling human disturbances following recommendations from the best available science as needed.

Objective: By 2019, develop, publish, and distribute BMPs for managing human disturbance for focal beach-nesting bird species.

Action 2: Expand and coordinate management at a network of sites to reduce disturbance - Use diverse conservation tools (e.g., acquisition, easements, CWA designation, long-term agreements, etc.) to increase the number of priority beach-nesting bird sites that are protected and managed appropriately to reduce human disturbance threats to beach-nesting birds. Ensure that sites protected by local, state, federal, or NGO conservation organizations are managed to reduce human disturbance following BMPs. Encourage and facilitate management at unmanaged breeding sites and other important habitat.

Objective 1: Increase productivity of focal species to contribute to a 10% population increase in 10 years (see species-specific productivity targets in [Appendix B](#)).

Objective 2: Increase annual survival of adult, subadult, and juvenile birds to contribute to a 10% population increase in 10 years.

Action 3 (Foundational): Expand and continue bird stewardship programs – Florida currently has a strong bird stewardship program led by Audubon Florida staff and other partners. This program is focused on protecting beach-nesting birds from human disturbance and other threats at key sites. Bird stewards are properly trained to assist professional staff in a broad range of activities that include reducing human disturbances, increasing public awareness of threats to coastal birds through education and outreach programs, and maintaining consistent oversight of protected areas to discourage disturbance to beach-nesting birds.

Objective: By 2018, Florida’s bird steward program will be expanded by 30%, including appropriate coordination and support.

3.3.2 Manage Habitat

Managing, restoring, and creating new beach-nesting bird habitat are important elements of this plan. A concerted effort is needed to identify remaining sites for beach-nesting birds, and to ensure that these habitats are protected and properly managed. Endorsement of these sites (e.g. national wildlife refuges, Western Hemisphere Shorebird Reserve Network (WHSRN) sites, or Ramsar sites, etc.) as valuable to wildlife as habitat and to local economies through the creation of related jobs and tourism can ensure that they are not lost to development. BMPs for sustaining beach-nesting bird populations should be implemented on sites that have been or are being developed, by encouraging partnerships between developers and local governments,

communities, land trusts and other NGOs, using incentives such as promotion of ecotourism opportunities, provision of technical assistance and habitat grants.

While further loss of some coastal habitat to development is inevitable, a goal of this strategy is to achieve no net habitat loss due to incompatible engineering practices. To do this, projects will be designed to: 1) develop BMPs for coastal engineering and inlet projects; 2) work with government bodies to establish regulatory and policy changes conducive to beach-nesting bird habitat protection; and 3) pursue opportunities to restore and reestablish high quality, intertidal (wet sand) beach-nesting bird habitats, and supratidal (dry sand) habitat previously lost to incompatible engineering practices at coastal sites in Florida.

Action 4: Improve the management of habitat at existing nesting and non-breeding sites –This action aims to improve capacity to manage and enhance habitats that can support beach-nesting birds, provide scientific and economic justification for why a site should be protected, and work with local governments and communities to garner or strengthen protection and implement BMPs. This will result in (a) improved management at existing sites and (b) enhanced habitat through management and restoration. Sites will be assessed and nominated for recognition based on global/regional significance (e.g., WHSRN sites, IBAs, Ramsar sites, etc.). Habitat management should focus on high-quality foraging and roosting areas, historic nesting areas, beach areas backed by ephemeral pools, gravel rooftops, and areas with limited human disturbance and low predator populations. Carefully-evaluated restoration measures may enhance breeding sites that experience high rates of habitat loss due to overwash or erosion. We do note that overwash, which is a naturally occurring process, does improve habitat for foraging and nesting use but improvement of elevated flats near overwash may improve nesting success.

Habitat should be restored in areas where focal species are unable to nest due to limited expanses of open, sandy beach. Reversing succession through vegetation management is an option that can be explored in areas where conditions could otherwise support successful breeding. During development of site-specific management plans, vegetation management may be considered among the tools available to maintain or create sandy beach areas for nesting. However, management should be conducted in a manner that emulates natural coastal dynamics, minimizes impact to coastal features, and carefully considers the needs of all coastal wildlife. Non-native vegetation should be removed from coastal areas once documented. Plantings to stabilize dunes should be minimized following storms or planted with a minimal amount of heterogenous native coastal vegetation.

Rooftops currently used for nesting by focal species should be maintained and enhanced to continue to provide nesting habitat. Replenishing gravel, adding shade structures, and erecting fencing are all tools that can enhance the value of a rooftop nesting site. Although gravel rooftops can last as long as 25 years (DeVries and Forsys 2004), many gravel rooftops in Florida are currently in poor condition (Alex Kropp, FWC, personal communication). Rooftops should be selected strategically for restoration, with

preference given to areas where coastal engineering and development has limited or eliminated suitable habitat on beaches.

Objective: Maintain, create, or manage at least 18,000 acres of beach-nesting bird habitat in a manner that provides high-quality breeding and wintering habitat for shorebirds and seabirds by 2029, with climate change contingencies.

Action 5 (*Foundational*): Support the continuation and development of FSA partnerships for improved conservation and monitoring of beach-nesting birds - Shorebird and seabird conservation cannot be effectively accomplished by any single agency or organization. The FSA informs most of the partnering organizations, agencies, and individuals who conduct beach-nesting bird monitoring, posting, bird stewarding, education, and research in Florida. It is important to provide continuing education and outreach to partners who monitor, survey, and protect beach-nesting birds. Therefore, continued support of the FSA and its staff is critical to long-term, efficient monitoring and conservation of focal species.

Objective: The FSA will remain effective through 2029 and will be the primary body informing partners that implement the elements of this plan. Success will be evaluated by: a) the active involvement of FSA partners in implementing the plan and; b) the long-term maintenance and use of the FSD.

Action 6: Develop outreach campaigns to build a constituency supporting conservation of beach-nesting bird habitats - To reverse the present trends, it is essential that local communities and decision makers have an understanding of the many functions of coastal ecosystems. Education and social marketing campaigns targeting specific stakeholders around important sites will be designed to raise awareness about ecosystem services provided by coastal ecosystems and will underscore the link between ecosystem resilience and thriving local economies (Costanza et al. 1997, UNEP 2006, Raffaele and Wiley 2014). The effectiveness of such campaigns for bringing about positive changes in attitudes and behaviors is well known (e.g., Butler 1995, Dettmann and Pease 1999, Sorenson et al. 2004, Chawla and Cushing 2007).

Objective: By 2029, develop and implement targeted community engagement initiatives for five priority beach-nesting bird sites in Florida. Success will be evaluated using a number of metrics including: a) the number of individuals demonstrating a minimum level of behavior change; b) the number of local businesses developing ‘beach-nesting bird friendly’ policies, c) the number of private landowners supporting beach-nesting bird stewardship on their lands, d) the number of communities reducing or stopping beach cleaning, and d) the number of rooftop colony nesting sites that request information on or assistance with protection efforts.

Action 7 (*Foundational*): Increase capacity to 1) review and monitor coastal engineering projects to ensure compliance, and 2) work with the U.S. Army Corps of

Engineers (USACE) to develop projects beneficial to focal species and expand implementation of the USACE Migratory Bird Protection Policy.

The USACE is the primary entity conducting coastal engineering projects in Florida. In order to minimize the impact of these projects, it will be crucial to have knowledgeable personnel to review and comment on permit applications, monitor projects to ensure compliance, and evaluate post-construction effects. Staff working with USACE and others would work to find and implement “beneficial use” projects to enhance beach-nesting bird habitat. In addition, staff would work to influence the USACE to expand implementation of USACE’s Migratory Bird Protection Policy.

Objective: Protect and enhance priority coastal habitats for beach-nesting bird species throughout their annual cycles by 1) monitoring coastal engineering permit applications and implementation and ensuring compliance with BMPs, and 2) developing and implementing beneficial use projects that create or enhance habitat.

Action 8: Work with the Florida Department of Environmental Protection (DEP) to: 1) reduce impacts to beach-nesting birds from actions permitted under the Coastal Construction Control Line (CCCL) program, and 2) streamline vegetation management permitting - Nests of beach-nesting birds are protected wherever they occur, and should be considered wherever permitted activities are undertaken. Examples of such activities include those regulated by DEP’s CCCL program (e.g., coastal armoring, post-storm emergency permitting activities, new construction, rebuilding or redevelopment, public infrastructure, beach berm or dune restoration, mechanical beach cleaning, and special events). As direct and indirect impacts to focal species may result from the activities regulated by the CCCL program, CCCL permitting activities should support the goals and objectives of this plan and *A Species Action Plan for Four Imperiled Species of Beach-Nesting Birds* (FWC 2013), and at a minimum should not conflict with conservation efforts. DEP permitting is currently constrained by legislative mandates that prohibit consideration of the benefits or impacts to beach-nesting birds caused by these permitted activities. Changing legislation to require consideration of these resources is critical to implementation of this action.

Objective: 1) Incorporate protections for focal species in all activities permitted by DEP under the CCCL program by 2020, and 2) eliminate permitting barriers to habitat management benefiting beach-nesting birds by 2020.

Action 9: Conservation and restoration of critical habitat, sediment deposition, and inlet function - Arguably, there has been no greater impact to coastal-dependent birds over the last century than the destruction of beach, inlet, and intertidal shoal habitats from coastal engineering projects. At the same time, there is an unprecedented opportunity to work effectively with the agencies responsible for coastal engineering and other organizations to restore some important beach-nesting bird habitats. Navigation channel deepening, river channel straightening, near-shore dredging for beach replenishment, dam building, and causeway or dike construction have all limited or eliminated the flow and

eventual deposition of upland sediments into coastal areas that become critical intertidal and supratidal habitats for beach-nesting birds. Working with coastal geologists and project planners can identify historically engineered coastal areas that no longer serve their original purpose. These restoration projects may come in the form of developing recycling standards of maintenance dredging materials instead of the current standards to remove them from the sand-sharing system, or deconstruction of unwarranted or unused dams, jetties, and dikes. In addition, the creation of new nesting islands from dredge material will serve to offset habitat losses from earlier coastal engineering projects. When properly constructed, such islands can provide high quality nesting habitat (Golder et al. 2008).

Implementing strategic habitat management projects, nourishment projects, spoil island projects, and derelict bridge projects constitutes a set of financial and regulatory challenges. Significant funding, or at least significant influence/partnerships with governmental agencies responsible for dredging activities and the placement of dredged materials will be essential. Maintaining navigable waterways through dredging and beach placement is the primary responsibility of the USACE. DEP permits both dredging activities and beach placement activities under the Joint Coastal Permit (JCP) process. Collaboration between FWC, navigation districts, USACE, Port Authorities, USFWS, DEP, the mining industry, and other entities responsible for management of dredge and temporary mining spoils and shore-stabilization projects will be necessary to identify opportunities to restore and create habitat.

Objective: Maintain, create, and restore natural and manmade nesting, foraging, and roosting sites for beach-nesting birds in Florida to mitigate losses from coastal engineering projects and contribute to the overall goal of 18,000 acres managed.

3.3.3 Improve conservation regulations

Part of a comprehensive strategy to insure the long-term viability of beach-nesting bird populations is to develop new laws and policies and improve implementation of existing regulations. The long-term vision is to ameliorate the adverse effects of incompatible management activities and build consensus for strategies that balance beach-nesting bird conservation needs with objectives of stakeholders engaged in profit-driven natural resource extraction (e.g., fisheries) and the conservation needs of other species. In Florida, incompatible management activities can include beach cleanup activities that impact nesting and migratory birds, and aspects of management of other coastal priority species.

Action 10 (Foundational): *Ensure sites used by beach-nesting birds for nesting, roosting, and foraging sites are fully included in updates of United States Coast Guard (USCG) Area Contingency Plans (ACP) (federal, state, and local).* - The Oil Pollution Act of 1990 required the development of ACPs for all coastal areas of the U.S. through Area Committees, organized by the USCG and composed of regional federal, state, and local stakeholders. The ACP was developed to address removal of oil and hazardous substances from waterways. The ACP geographically defines regional environmental and socio-economic resources that require priority protection. The USCG's ACPs include a

partnership with the FWC to develop an ArcIMS (Internet Map Server) website that contains data used in planning and response activities, including an environmental layer (mangroves, salt marsh, Environmental Sensitivity Index, shoreline, primary wildlife areas, etc.). FWC staff can work with the USCG to ensure that data on high-priority beach-nesting bird areas and breeding status from the FSD are included in the environmental data layer for ACPs. Recommended practices for emergency response and clean-up efforts in areas with beach-nesting birds should be provided to response teams. FWC can facilitate the exchange.

Objective: Develop an ArcIMS website for data exchange and provide recommended practices for clean-up by sites used by beach-nesting birds by 2019.

Action 11: Strengthen legislation and policies regarding incompatible management - Develop policies, laws and regulations addressing mechanical beach cleaning, overuse of natural sites, fisheries management, and aquaculture development to reduce the adverse effects of these activities on beach-nesting bird populations. Products from the AFSI incompatible management assessment and working group and from the outcomes of public/private partnership projects can be used to underpin new policies and regulations.

Objective: Successfully improve or develop and implement at least one new policy or law addressing an incompatible management threat by 2021.

3.3.4 Minimize Predation Impacts

Shorebirds and seabirds are extremely vulnerable to predators. Site-specific strategies for integrated predation management should be implemented where it is determined that predators are among the primary causes of nest failure. In areas with high predation pressures, predation management strategies must be implemented or improved and coordinated with other management efforts to maximize effectiveness and efficiency. Expansion of education and outreach efforts are also needed to garner critical public support that will ensure that management can be successfully carried out without opposition. A successful conservation strategy not only requires resources for supporting predation management efforts at important nesting locations, but reliable techniques for measuring management success. Significant gaps remain in our understanding of how predator interactions can influence beach-nesting bird site selection and success. Some of these questions are addressed in section 3.3.5, Fill Knowledge Gaps.

The long-term conservation goal of this key strategy is to reduce the number of nests, chicks, and adults of all five focal species that are lost annually to predators. In combination with other threat reduction strategies, this will result in a 10% increase in populations of focal beach-nesting bird species by 2029.

Action 12: Implement and coordinate integrated predation management efforts - Implementing effective predation management at priority beach-nesting bird breeding sites requires coordination and “on-the-ground” effort. For example, trash on beaches and

feeding of animals such as raccoons, gulls, and crows may attract these predators and locally increase their populations (Smith and Engeman 2002). Therefore, an integrated predation-control approach should educate beachgoers to avoid feeding wildlife and properly dispose of garbage. This approach will also benefit other species such as marine turtles (*Dermochelys coriacea* and species within Cheloniidae; Pruner et al. 2011). FSA partners will promote and support the implementation of BMPs for predation management and monitoring.

Objective: 2017-2029 - Implement predation management at high-priority sites in Florida where high densities of nesting shorebirds are experiencing low productivity as a result of predation.

Action 13 (Foundational): Develop and promote BMPs for predator monitoring and management - Streamlined guidance can greatly assist managers in making decisions about how, when, and where to initiate predation management efforts, evaluate success and adapt management strategies. Creation of a BMP guidance document will include development of tools to help managers determine when management is necessary, recommendations for assessment, evaluation, and improvement of predation management practices, and “beach-nesting bird-safe” guidelines that discuss potentially conflicting management goals (e.g., peregrine falcon nest platforms and perching structures).

Objective: 1) Evaluate site-specific and overall effects of implementing lethal (e.g., trapping) and non-lethal (e.g., predator exclosures, trash management, etc.) predation management on beach-nesting species and predator populations, and 2) develop, disseminate, and promote a BMP document by 2019 that will facilitate effective and efficient predation management.

Action 14: Outreach campaign for predation management support - Public support is crucial to ensure that predation management can be successfully carried out. To achieve this outcome it is important to build local stakeholder support for actions to reduce the predator load, influence funding streams and guide local policy. Outreach directed toward raising public awareness of the impacts that predators have on coastal wildlife and communicating to local governments and stakeholders that beach-nesting birds can benefit from proper waste management practices should be core activities of outreach efforts. Goals of the strategy include development and implementation of a scoring system to track improvements in waste management practices that reduce resources supporting predator populations.

Objective: Implement outreach efforts in 75% of communities near priority beach-nesting bird breeding sites where predation has been identified as a significant issue. Measures of success will include the percent of a community involved in or supporting conservation efforts and local funding levels for improved waste and predation management.

Action 15: Create a fund for annual predation management costs - Predation control can be cost prohibitive in some cases. Because predation is often the cause of reproductive failure, funding options should be explored to assist landowners or managers with costs associated with integrated predation control. Integrated predation control includes lethal control where appropriate, non-lethal control, outreach and education to modify human behavior, and predator monitoring. This may be best accomplished by coordinating with the sea turtle and beach mice conservation communities and to collectively seek funding for an endowment for long-term funding of predation management costs since integrated predation control will benefit multiple coastal species.

Objective: By 2029, establish a common “stewardship” fund to defray annual costs of predation management actions designed to benefit Florida’s native coastal species into perpetuity.

3.3.5 Reduce Knowledge Gaps

Collecting, compiling and analyzing information on breeding and non-breeding bird vitals (e.g. population size, reproductive success, adult survivorship, etc.) is essential to (a) understand how these species are responding to conservation investments, (b) measure progress against outcomes, and (c) adaptively manage. This plan builds on existing monitoring and assessment programs in Florida, but also includes new surveys to refine baseline population estimates, establish long-term support for data management infrastructure, and calls for new research needed to inform management questions of interest.

Action 16 (Foundational): Establish baseline population estimates for focal beach-nesting bird species – Current population estimates for focal species in Florida need to be updated with increased precision to serve as a baseline for population estimation and trend. Updated survey methodology and updates to the FSD for all five focal species will be an important early step in reaching the objectives of this plan.

Objective: By 2019, obtain baseline population estimates for focal species to inform conservation efforts.

Action 17: Annually identify sites to be prioritized for conservation action – Restoring populations of focal species and managing habitats depend on effectively targeting conservation efforts. The first step toward achieving these objectives is identifying sites around the state that either currently support beach-nesting birds or could, with management, support them. In addition, key threats and data gaps at these sites should be assessed to inform the prioritization process. Because of the dynamic nature of coastal habitat, this process needs to be repeated annually. Data collected and entered into the FSD along with historic records, species experts, and FSA partners including land managers, resource professionals, and members of the conservation community can provide valuable input into this process. If currently-used sites are not sufficient to meet the goals of this plan, additional sites (historical and potential nesting habitat) can be managed in order to attract beach-nesting birds.

Objective: Annually identify the highest priority beach-nesting bird sites in the state and set management priorities to include sufficient habitat to meet the goals of this plan. 2017-2029.

Action 18 (Foundational): Implement standardized long-term monitoring programs for all focal species – Refine and standardize current methods for monitoring beach-nesting birds. The *Breeding Bird Protocol for Florida’s Shorebirds and Seabirds* (FWC 2011) has a great deal of built-in flexibility. However, information on trends in seabird and shorebird nesting effort, nesting success, and productivity are dependent on the ability of trained observers to accurately count nesting birds and young. The sources of potential error in the estimates of population size obtained from surveys include variation in time and space as well as detectability (Steinkamp et al. 2003). Mobile family groups, intra-season movements, and double or triple clutching can also lead to error in counts and productivity estimates for unmarked individuals. Accounting for these sources of error and improving application of the monitoring protocols to reduce error will result in more accurate statewide population estimates. The current protocol will be reviewed by FSA partners and modified as needed to track the key metrics associated with this plan. Breeding season monitoring protocols will be compatible across agencies and consistent with broader Gulf Coast and AFSI monitoring initiatives. Non-breeding shorebird monitoring efforts will be consistent with ISS standard protocols and the Florida winter shorebird surveys.

Objective: The *Breeding Bird Protocol for Florida’s Shorebirds and Seabirds* and associated online data entry application (FSD) will be reviewed annually and updated as needed to effectively measure changes in beach-nesting bird site use, population trend, and documented threats.

Action 19 (Foundational): Maintain and expand the FSD – The FSD is the central data repository for beach-nesting bird data and a resource for researchers and managers. Implementing monitoring actions will necessitate modifications to how the monitoring protocols are implemented, expansion of the FSD to include changes to the online beach-nesting bird data entry application, addition of the web-based access to a non-breeding database, batch uploading options, and FSA expansion to train partners on the standardized protocol and data entry in the FSD. Long-term support for the FSD, including adequate staff to manage the database, FSD data application, maintain the interface and functionality, provide technical support, review the data (quality control), manage and analyze the data, and distribute the results to inform adaptive management, and will be crucial for meeting the monitoring and analysis goals included in this plan.

Objective: 2017-2029 – Maintain an active and up-to-date year-round database that allows FSA partners to meet the metric analysis and reporting criteria in this plan.

Action 20 (Foundational): Assess threats and develop site-specific adaptive management plans for high-priority sites - Site-specific beach-nesting bird management

plans can provide land managers information on how to manage habitat for the maximum benefit of beach-nesting birds. Developed in close coordination with the land managers, these plans will consider the characteristics, challenges, needs, and resources specific to individual sites containing beach-nesting bird habitat (or potential habitat). Site-specific management plans should include a strong education component for those lands with high public use. They may also include plans for reducing predation and disturbance, and enhancing or restoring habitat. Actions such as posting, seasonal restrictions, vegetation management, and predation control measures might be outlined, and maps of habitat and management zones could be provided where helpful. Land managers and partners should review these plans annually, and modify them as necessary to ensure an adaptive approach. A comprehensive technical assistance program designed to assist land managers with the development of site-specific management plans would provide a valuable resource to both public and private land managers.

Objective: By 2020, threat evaluations and site-specific management plans are completed for 75% of the high-priority sites in Florida.

Action 21: Assess impacts of various types of disturbance at different life stages (e.g., breeding, brood-rearing, non-nesting, etc.) for focal species - Many studies have documented the effects of anthropogenic disturbance on shorebird and seabird abundance, behavior, and habitat use patterns (Collazo et al. 1995, Gill et al. 2001, Thomas et al. 2003, Burger et al. 2004, Blumstein et al. 2005, Yasue 2006). Shorebirds are considered highly susceptible to disturbance because they frequently use areas that are subject to high levels of human recreation (Gill et al. 2001). Disturbance by humans can have direct (i.e., take of adults, young, and eggs) or indirect (i.e., causing adults to leave nests or causing foraging or roosting flocks to relocate) impacts. Understanding how disturbance alters distribution and behavior of beach-nesting birds in Florida will lead to informed management decisions. Monitoring species' response to site-specific disturbances such as pets (leashed and unleashed) on beaches, fireworks, and recreation activities will allow managers to prioritize management for each site.

Objective: By 2021, incorporate the results of at least one new study on disturbance into management protocols.

Action 22: Model the impacts of climate change to areas currently supporting beach-nesting birds - The combined effects of a growing coastal human population, beach erosion, and climate change will require more intensive management of coastal systems. Modeling the potential impact of climate change will inform site-specific management plans for maximum benefit to beach-nesting birds.

Objective: By 2020, climate change impact models are completed for key beach-nesting bird sites in Florida.

Action 23: Develop and refine population models for all five focal species – The current population models included in this plan are intended to be a starting point to

provide an initial assessment of population trajectories. As new data become available, these models should be updated and refined to be more accurate and useful in an adaptive management context.

Objective: Develop, update, and refine population models for American oystercatchers, snowy plovers, Wilson's plovers, least terns, and black skimmers.

4. Monitoring & Evaluating Performance

4.1 Background

Monitoring programs provide the greatest support for conservation when they are directly linked to actions and incorporate mechanisms for evaluating success. Efficient and targeted monitoring of conservation actions is crucial to understanding the effects of management.

In this plan we seek to use and improve existing monitoring programs where possible and to develop new programs and methods only when necessary to prioritize action or to determine when actions have been successful. In this way, investment in monitoring can lead to a net gain in efficiency by ensuring that action is directed only where it is needed.

4.2 Monitoring Strategies

Refer to [Appendix B](#) for the objectives and metrics for measuring progress on the Florida beach-nesting bird recovery initiative. The ultimate measure of success of this plan is an increase in the population size for each focal species. However, the same life history characteristics and habitats that leave beach-nesting birds vulnerable to anthropogenic threats also make them difficult to monitor. Population size and trends are known with certainty for only a handful of species (Brown et al. 2001). Recognizing the difficulties and costs associated with monitoring shorebirds and seabirds, we propose monitoring at three distinct levels of resolution, outlined below.

4.2.1 Effectiveness Monitoring

Effectiveness monitoring yields immediate results, and allows managers to adapt quickly in response to unexpected outcomes. For example, decisions can be made quickly on the basis of return on investment. In the short-term, monitoring should demonstrate that conservation action achieved the intended short-term outcome. Metrics of success are directly tied to the action and could include measures such as the number of acres of habitat conserved or the miles of beach restored. The full suite of objectives and associated monitoring will provide guidance about the overall effectiveness of this effort in the short term.

4.2.2 Index Monitoring

Index monitoring provides early indications of response, justifying continued investment in what is working and justifying a shift away from what is not, and has proven to be useful for

understanding direction of change in populations (Bart et al. 2007). The conservation actions suggested in this plan are designed on the basis of our collective understanding of the focal species and ecosystems, and index monitoring allows us to demonstrate that species are responding to our actions as expected. In the medium-term, monitoring should demonstrate that conservation actions yield improvements in parameters expected to be correlated with population status. These indices might include beach-nesting bird abundance and residence time at important sites, or demographic parameters such as adult survival or number of young fledged. These programs should be designed to collect data on population status at different stages of the species' life cycles so that we do not miss an important threat that could be affecting the overall population size. Existing programs can collectively address this need, but will require increased support to make improvements in effectiveness and accuracy.

4.2.3 Population Monitoring

Population monitoring is critical for understanding the size of the current population (e.g. Andres et al. 2012), and even more importantly provides the big picture of our success at restoring populations. Actions occur at a local scale and local success can be monitored effectively through indices. However, combining these indices can be challenging when actions address different life-history stages or affect different fractions of the population. Large-scale population monitoring (Bart et al. 2005) provides the integrated signal that demonstrates the statewide conservation successes sought by this plan. Tracking progress towards this goal requires long-term and large-scale monitoring. The International Piping Plover census and the recent American oystercatcher aerial census are examples of ongoing population size monitoring efforts, and are designed to determine the status of single beach-nesting bird species of particular conservation concern. They are comprehensive survey efforts conducted every five to ten years tracking abundance and distribution across a species range. We will seek to implement repeatable population surveys for all five focal species in this plan.

5. Literature Cited

- Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown, and C.A. Friis. 2012. Population estimates of North American shorebirds. Wader Study Group Bulletin 119: 178–194.
- Akçakaya T., J. L. Atwood, D. Breininger, C. T. Collins, and B. Duncan. 2003. Metapopulation dynamics of the California Least Tern. *Journal of Wildlife Management* 67: 829-842.
- American Oystercatcher Working Group, 2012. American Oystercatcher Best Management Practices. www.Amoywg.org
- Avissar, N., W. Haskell, J. Brush, N. Douglass, A. Kropp, K. Rogers. 2015. Florida Shorebird Database Annual Report – 2014. Florida Fish and Wildlife Conservation Commission. Tallahassee, FL.
- Bart, J., B. Andres, S. Brown, G. Donaldson, B. Harrington, V. Johnston, S. Jones, R.I.G. Morrison, and S.K. Skagen. 2005. The Program for Regional and International Shorebird Monitoring (PRISM). In: Ralph, C.J. and T.D. Rich, (eds.). *Bird conservation implementation and integration in the Americas: Proceedings of the Third International Partners in Flight conference, Volume 2, March 20-24, 2002, Asilomar, California*. Gen. Tech. Rpt. PSW-GTR-191. Albany, CA: U.S. Forest Service, Pacific Southwest Research Station. 893-901.
- Bart, J., S. Brown, B. Harrington, and R. I. G. Morrison. 2007. Survey trends of North American shorebirds: population declines or shifting distributions? *Journal of Avian Biology*, 38(1): 73-82.
- Blumstein, D. T., E. Fernandez Juricic, P. A. Zollner, and A. C. Garity. 2005. Inter-specific variation in avian responses to human disturbance. *Journal of Applied Ecology* 42:943-953.
- Brown, S., C. Hickey, B. Harrington, and R. Gill, eds. 2001. *The U.S. Shorebird Conservation Plan*, second ed. Manomet Center for Conservation Sciences, Manomet, MA.
- Butler, P. J. 1995. Marketing the conservation message: using parrots to promote protection and pride in the Caribbean. S. K. Jacobson, editor. *Conserving Wildlife. International Education and Communication Approaches*. Columbia University Press, New York. 87-102
- Burger, J. 1986. The effect of human activity on shorebirds in two coastal bays in northeastern United States. *Environmental Conservation* 13:123–130.
- Burger, J., C. Jeitner, K. Clark, and L. J. Niles. 2004. The effect of human activities on migrant shorebirds: successful adaptive management. *Environmental Conservation* 31(4):283-288.
- Chawla, L., and D. F. Cushing. 2007. Education for strategic environmental behavior. *Environmental Education Research* 13:437-452.

Collazo, J. A., J. R. Walters, and J. F. Parnell. 1995. Factors affecting reproduction and migration of waterbirds on North Carolina barrier islands. Final Report to the National Park Service, Cape Hatteras and Cape Lookout National Seashores, NC.

Colwell, M. A., Burrell, N. S., Hardy, M. A., Kayano, K., Muir, J. J., Pearson, W. J., Peterson, S. A. and Sesser, K. A. 2010. Arrival times, laying dates and reproductive success of Snowy Plovers in two habitats in coastal northern California. *J. Field Ornithol.* 81:349 – 360.

Conklin, J.R., M.A. Colwell, and N.W. Fox-Fernandez. 2008. High variation in roost use by dunlin wintering in California: Implications for habitat limitation. *Bird Conservation International* 18: 275-291.

Costanza, R.R., R. d'Arge, R. de Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R.V. O'Neill, J. Paruelo, R.G. Raskin, P. Sutton, and M. van der Belt. 1997. The value of the world's ecosystem services and natural capital. *Nature* 387: 253-260.

Dettmann-Easler, D., and J. L. Pease. 1999. Evaluating the effectiveness of residential environmental education programs in fostering positive attitudes toward wildlife. *The Journal of Environmental Education* 31:33-39.

DeVries, E.A., and E.A. Forsys. 2004. Loss of tar and gravel rooftops in Pinellas County, Florida and potential effects on Least Tern populations. *Florida Field Naturalist* 32:1-6.

Florida Fish and Wildlife Conservation Commission [FWC]. 2008. Wildlife 2060: what's at stake for Florida? Florida Fish and Wildlife Conservation Commission Special Report, Tallahassee, FL
http://www.sfrc.ufl.edu/extension/florida_forestry_information/events_calendar/files/assist_vc_wynn_handout.pdf.

Florida Fish and Wildlife Conservation Commission [FWC]. 2013. A Species Action Plan for Four Imperiled Species of Beach-Nesting Birds. Tallahassee.

Florida Fish and Wildlife Conservation Commission [FWC]. 2011. Breeding Bird Protocol for Florida's Shorebirds and Seabirds. Tallahassee.

Gill, J. A., K. Norris, and W. J. Sutherland. 2001. The effects of disturbance on habitat use by black-tailed godwits (*Limosa limosa*). *Journal of Applied Ecology* 38:846-856.

Gochfeld, M. and J. Burger. 1994. Black Skimmer (*Rynchops niger*). *in* The Birds of North America, No. 108 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Golder, W., Allen, D., Cameron, S., & Wilder, T. (2008). Dredged Material as a Tool for Management of Tern and Skimmer Nesting Habitats. DOER Technical Notes Collection (ERDC TN-DOER-E24), Vicksburg, MS: U.S. Army Engineer Research and Development Center.

- Gore, J. A. 1996. Least tern. J. A. Rodgers, J. W. Kale II, and H. T. Smith, editors. Rare and endangered biota of Florida. University Press of Florida, Gainesville, FL. 236-246
- Gore, J. A., J. A. Hovis, G. L. Sprandel, and N. J. Douglass. 2007. Distribution and abundance of breeding seabirds along the coast of Florida, 1998-2000. Final Performance Report. Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Himes, J. G., N. J. Douglass, R. A. Pruner, A. M. Croft, and E. M. Seckinger. 2006. Status and distribution of the snowy plover in Florida. 2006 study final report. Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.
- Hitchcock, C. L., and C. Gratto-Trevor. 1997. Diagnosing a shorebird local population decline with a stage-structured population model. *Ecology* 78: 522-534.
- Koch, S.L., and P.W.C. Paton. 2014. Assessing anthropogenic disturbances to develop buffer zones for shorebirds using a stopover site. *Journal of Wildlife Management* 78:58–67.
- Massey, B. W., D. W. Bradly, and J. L. Atwood. 1992. Demography of a California least tern colony including effects of the 1982-1983 E1 Nino. *Condor* 94: 976-983.
- McGowan, C. P., S. A. Schulte, and T. R. Simons, 2005. Resightings of marked American oystercatchers banded as chicks. *Wilson Bulletin* 117:382–385.
- Murphy, S. P. 2010. Population dynamics of the American oystercatcher (*Haematopus palliatus*) near the northern limit of its range. PhD thesis, The City University of New York, NY.
- National Fish and Wildlife Foundation. 2015. Atlantic Flyway Shorebird Initiative: A Business Plan. http://www.nfwf.org/amoy/Documents/afsi_biz_plan.pdf.
- Niles, L., H. Sitters, A. Dey, and Red Knot Status Assessment Group. 2010. Red Knot.
- NOAA 2013. National Coastal Population Report. <http://stateofthecoast.noaa.gov/features/coastal-population-report.pdf>.
- Nur, N., G. W. Page, and L. E. Stenzel. 2007. Population viability analysis for Pacific coast western snowy plovers. In *Western Snowy Plover (Charadrius alexandrinus nivosus)* Pacific Coast population recovery plan. U.S. Fish and Wildlife Service. 2:D1-D40.
- Placyk, J. S., and B. A. Harrington. 2004. Prey abundance and habitat use by migratory shorebirds at coastal stopover sites in Connecticut. *Journal of Field Ornithology* 75:223-231.
- Pruner, R. A, M. J. Friel, and J. A. Zimmerman. 2011. Interpreting the influence of habitat management actions on shorebird nesting activity at coastal state parks in the Florida Panhandle.

2010-11 study final report. Florida Department of Environmental Protection, Florida Park Service, Panama City, FL.

Pruner et al 2015: Final report - Department of Environmental Protection, Florida Park Service

Raffaele, H.A. and Wiley, J. 2014. Wildlife of the Caribbean. Princeton University Press, NJ.

Rice, T.M. 2012. The status of sandy, oceanfront beach habitat in the coastal migration, and wintering range of the piping plover (*Charadrius melodus*). Appendix 1c in the Draft Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) Coastal Migration and Wintering Range. U.S. Fish and Wildlife Service.

Schlacher, T.A., T. Nielsen, and M.A. Weston. 2013. Human recreation alters behavior profiles of non-breeding birds on open-coast sandy shores. *Estuarine, Coastal, and Shelf Science* 118:31–42.

Schulte, S. A. 2012. Ecology and population dynamics of American Oystercatchers (*Haematopus palliatus*). Ph.D. Dissertation. North Carolina State University, Raleigh, NC.

Schulte, S. A., and T. R. Simons. 2015. Factors affecting the reproductive success of American Oystercatchers (*Haematopus palliatus*) on the Outer Banks of North Carolina. *Marine Ornithology* 43:37–47.

Sherry, T. W. and R. T. Holmes. 1996. Winter habitat quality, population limitation, and conservation of neotropical - nearctic migrant birds. *Ecology* 77:36-48.

Smith, H. T., and R. M. Engeman. 2002. An extraordinary raccoon, *Procyon lotor*, density at an urban park. *The Canadian Field-Naturalist* 116:636-639.

Sorenson, L.G., Bradley, P.E. and Haynes-Sutton, A. 2004. The West Indian whistling-duck and wetlands conservation project: a model for species and wetlands conservation and education. *Journal of Caribbean Ornithology* 17: 72-80.

Steinkamp, M., B. Peterjohn, V. Byrd, H. Carter, and R. Lowe. 2003. Breeding season survey techniques for seabirds and colonial waterbirds throughout North America. Unpublished Final Report. <http://www.waterbirdconservation.org/pubs/PSGManual03.PDF>

Thomas, K., R. G. Kvitek, and C. Bretz. 2003. Effects of human activity on the foraging behavior of sanderlings (*Calidris alba*). *Biological Conservation* 109:67-71.

UNEP. 2006. Marine and Coastal Ecosystems & Human Well-being: A synthesis report based on the findings of the Millenium Ecosystem Assessment. UNEP. 76 pp.

U.S. Fish and Wildlife Service. 1996. Piping Plover (*Charadrius melodus*), Atlantic Coast Population, revised recovery plan. Hadley, MA.

U.S. Fish and Wildlife Service. 2009. Piping Plover (*Charadrius melodus*), 5-year review: summary and evaluation. Hadley, MA.

Winn, B, S. Brown, C. Spiegel, D. Reynolds, S. Johnston 2013. The Atlantic Flyway Shorebird Business Strategy.

http://manometcenter.pairserver.com/sites/default/files/publications_and_tools/AtlanticFlywayShorebirdBusinessStrategy.pdf

Yasue, M. 2006. Environmental factors and spatial scale influence shorebirds' responses to human disturbance. *Biological Conservation* 128:47-54.

Zambrano, R., and T. N. Warraich. 2012. 2010 statewide seabird and shorebird rooftop nesting survey in Florida. Final Report, Florida Fish and Wildlife Conservation Commission, Tallahassee, FL.

6. Appendices

Appendix A: Budget to implement the Florida Beach-nesting Bird plan

1. Manage Human Disturbance	Annual	Years	Total
Develop best practices for disturbance management	75,000	3	225,000
Protect/manage sites (posting, enforcement, etc)	750,000	13	9,750,000
Beach stewardship	700,000	13	9,100,000
			19,075,000
1. Manage Habitat			
Improve and maintain habitat management at existing shorebird sites	400,000	13	5,200,000
Support the continuation and development of FSA partnerships for improved conservation and monitoring of beach-nesting birds	250,000	13	3,250,000
Develop and implement targeted outreach campaigns to build and maintain a constituency that supports conservation of key shorebird habitats	150,000	5	750,000
Increase capacity to monitor implementation of coastal engineering projects and create habitat	125,000	13	1,625,000
Regulatory and policy reform	85,000	5	425,000
Conservation and restoration of critical habitat, sediment deposition and inlet function	800,000	13	10,400,000
			21,650,000
3. Manage Predation			
Develop best practices for predator monitoring & management	175,000	3	525,000
Implement & coordinate predator management efforts	350,000	13	4,550,000
Outreach campaign for predator management support	60,000	13	780,000
			5,855,000
4. Improve conservation regulations			
Ensure beach-nesting bird sites are included in USCG ACP	20,000	5	100,000
	150,000	4	600,000

Strengthen legislation and policies regarding incompatible management

700,000

5. Reduce Knowledge Gaps

Identify and prioritize critical shorebird sites	20,000	13	260,000
Establish baselines of demographic parameters	520,000	5	2,600,000
Evaluate alternative substrate and sites for rooftop-nesting birds.	115,000	3	345,000
Implement standardized annual monitoring of focal species	500,000	8	4,000,000
Develop and adopt site-specific management plans	200,000	6	1,200,000
Expand and maintain the FSD	250,000	13	3,250,000
Research appropriate buffer distances for Beach-nesting birds throughout the year	120,000	2	240,000
Model the impacts of climate change to areas currently supporting IBNBs.	100,000	2	200,000
			12,095,000
TOTAL	4,290,000		59,375,000

Appendix B: Objectives and metrics for measuring progress toward project objectives for Florida’s focal beach-nesting bird species.

Category	Actions	Objectives	2029 target	Metrics
Focal Species		Increase populations of focal species by 10%	10%	% Population increase
		Increase American oystercatcher reproductive success from 0.256 to 0.38-0.45 chicks/pair	0.38-0.45	Chicks fledged/breeding pair
		Increase Snowy plover reproductive success from 0.381 to 1.0 chicks/pair	1.0	Chicks fledged/breeding pair
		Increase Wilson’s plover reproductive success from 0.679 to 0.8-1.16 chicks/pair	0.8-1.16	Chicks fledged/breeding pair
		Increase Least tern reproductive success from 0.21 to 0.75-1.1 chicks/pair	0.75-1.1	Chicks fledged/breeding pair
		Increase Black skimmer reproductive success from 0.46 to 1.0-1.2 chicks/pair	1.0-1.2	Chicks fledged/breeding pair
Disturbance Reduction	Develop BMPs	By 2019, develop, publish, and distribute BMPs for managing human disturbance for breeding, migrating and wintering beach-nesting birds	1 doc (2020)	# of BMP recommendations developed
	Expand and coordinate management at a network of sites to reduce disturbance	Beach-nesting bird sites under management for disturbance increased by 20% by 2029. Disturbance at managed sites reduced by 75%	20% increase in managed sites by 2029. 75% reduction in disturbance	% increase in managed sites. % reduction in disturbance events
	Expand and continue Beach Stewardship Programs	Florida’s beach steward program will be expanded, including	30% increase in program by 2021	% increase in program. # Volunteers and coordinators

		appropriate coordination and support.		
Manage Habitat:	Improve management, enhancement, and restoration, of habitat for beach-nesting birds	1) Managed and protected beach-nesting bird habitat increased.	18000 total acres under improved management or legal protection.	Acres under improved management/protection
	Support the continuation and development of FSA partnerships for improved conservation and monitoring of beach-nesting birds	Between 2017 and 2029, the FSA will remain effective and will be the primary body coordinating and implementing this plan	10% increase in size; improved admin structure	1) The number of FSA partners actively involved in implementing the plan, and; 2) The establishment of a long-term coordination and management structure for the FSA.
	Develop outreach campaigns to build a constituency supporting conservation of beach-nesting bird habitats	Develop and implement targeted community engagement initiatives.	5 sites	1) # of individuals demonstrating a minimum level of behavior change; 2) # of businesses developing 'beach-nesting bird friendly' policies, and 3) # of private landowners requesting information on protecting, restoring, and enhancing their lands for beach-nesting birds.
	Develop BMPs for beach-nesting bird habitat management associated with coastal engineering and inlet projects	Protect and enhance priority coastal habitats for beach-nesting bird species throughout their annual cycles by developing and encouraging the implementation of BMPs	BMPs created - 2019 BMPs fully implemented - 2020	# of management plans incorporating BMPs
	Work with Florida DEP to reduce impacts from permitted actions under the CCCL program and streamline vegetation management permitting	1) Incorporate protections for focal species in all activities permitted by DEP under the CCCL program. 2) Eliminate permitting barriers to habitat management benefiting beach-nesting birds.	1) Fully implemented by 2020 2) Fully implemented by 2020	% permitted activities incorporating beach-nesting bird protection. Permitting barriers eliminated

	Conservation and restoration of critical habitat, sediment deposition, and inlet function	1) Restore the function of coastal processes. 2) Restore and create critical habitat for beach-nesting birds in Florida.	Habitat maintained, created and restored, contributing to the overall management goal of 18,000 acres	# sites with restored natural hydrology. # of created nesting sites. % gain in beach-nesting bird use
Manage Predation	Develop and promote best practices for predator monitoring & management	Develop, disseminate, and promote a BMP document by 2018 that will facilitate effective and efficient predation management	1 doc (2019)	# of BMP recommendations developed
	Implement & coordinate predation management efforts	Implement coordinated predation management at a network of priority breeding sites.	# of sites	# of priority sites with predation management
	Outreach campaign for predation management support	Implement outreach efforts in 75% of communities adjacent to or close by to critical beach-nesting bird breeding sites.	75% of communities near priority sites	# of individuals reached by outreach, training, or technical assistance activities OR # of individuals demonstrating a minimum level of behavior change.
	Threat reduction goal	Reduce human disturbance events by 75% on actively managed sites by 2029	75% reduction in disturbance events	managed sites
Incompatible Management Practices	Ensure beach-nesting bird sites, are included in updates of USCG Area Contingency Plans	Develop an ArcIMS website for data exchange and provide recommended practices for clean-up in bird nesting areas	Website and recommended practices completed by 2019	Website completed. # Plans including beach-nesting bird protection practices
	Strengthen legislation and policies regarding incompatible management	Develop and implement at least one new policy or law addressing an incompatible management threat	Policy/law enacted by 2021	# policies/laws implemented
Reduce Knowledge Gaps	Refine baseline population estimates for focal beach-	By 2019, baseline population estimates for focal species obtained and used to	5 focal species	# of focal species with baseline population estimates

nesting bird species	inform conservation efforts.			
Annually identify sites to be prioritized for conservation action	Annually identify all potential beach-nesting bird habitats in the state and prioritize for management sufficient habitat to meet the goals of this plan. 2017-2029	100%		% sites assessed
Implement standardized long-term monitoring programs for all focal species	By 2018 revisions to the implementation of the Breeding Bird Protocol for Florida's Shorebirds and Seabirds will be established to effectively measure changes in beach-nesting bird site use and population trend.	5 focal species		# of focal species with monitoring protocols revised and implemented
Expand and maintain the FSD	Objective: 2017-2029 – Maintain an active and up-to-date database that allows FSA partners to meet the metric analysis and reporting criteria in this plan.			Database active and up to date
Assess threats and develop site-specific adaptive management plans for important sites	Objective: By 2020, threat evaluations are completed, and conservation actions are prioritized for 75% of the key sites in Florida	75%		% key sites with adaptive management plans
Assess impacts of various types of disturbance at different life stages (e.g., breeding, brood-rearing, non-nesting) for focal species	Objective: By 2020, incorporate the results of at least one new study on beach-nesting disturbance into management protocols.	1 study		# of new studies completed and integrated

Model the impacts of climate change to areas currently supporting beach-nesting birds	By 2029, climate change impact models are completed for key beach-nesting bird sites in Florida	100% of key sites	# Sites with climate change models and associated recommendations
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Develop and refine population models	Refine and update the initial population models included in this plan as newer data become available	5 models updated	# models updated and
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Appendix C: Input parameters for population models used to project population growth and set productivity goals

American oystercatcher

Fecundity: 0.38 – 0.45 chicks fledged/pair (goal)

Juvenile survival: 0.75 (+/- 0.06)

Adult survival: 0.92 (+/- 0.03)

Age of first breeding: 3-5 years

Sources:

McGowan, C. P., S. A. Schulte, and T. R. Simons, 2005. Resightings of marked American oystercatchers banded as chicks. *Wilson Bulletin* 117:382–385.

Murphy, S. P. 2010. Population dynamics of the American oystercatcher (*Haematopus palliatus*) near the northern limit of its range. PhD thesis, The City University of New York, NY.

Schulte, S. A. 2012. Ecology and population dynamics of American Oystercatchers (*Haematopus palliatus*). Ph.D. Dissertation. North Carolina State University, Raleigh, NC.

Schulte, S. A., and T. R. Simons. 2015. Factors affecting the reproductive success of American Oystercatchers (*Haematopus palliatus*) on the Outer Banks of North Carolina. *Marine Ornithology* 43:37–47.

Snowy Plover

Fecundity: 1.05 chicks fledged/pair (goal)

Juvenile survival: 0.50 (+/- 0.08)

Adult survival: 0.76 (+/- 0.05)

Age of first breeding: 1 year

Sources:

Nur, N., G. W. Page, and L. E. Stenzel. 2007. Population viability analysis for Pacific coast Western Snowy Plovers. In *Western Snowy Plover (Charadrius alexandrinus nivosus) Pacific Coast population recovery plan*. U. S. Fish and Wildlife Service. Vol. 2. Pp. D1-D40.

Wilson's Plover

Fecundity: 0.8 – 1.16 chicks fledged/pair (goal)

Juvenile survival: 0.54 (+/- 0.08)

Adult survival: 0.77 (+/- 0.05)

Age of first breeding: 1 year

Sources

Pruner et al 2015: Final report - Department of Environmental Protection, Florida Park Service

Least Tern

Fecundity: 0.75 – 1.1 chicks fledged/pair (goal)

Juvenile survival: 0.50 (+/- 0.06)

Adult survival: 0.88 (+/- 0.07)

Age of first breeding 2-4 years

Sources

Massey, B. W., D. W. Bradly, and J. L. Atwood. 1992. Demography of a California Least Tern colony including effects of the 1982-1983 E1 Nino. *Condor* 94: 976-983.

Akçakaya T., J. L. Atwood, D. Breininger, C. T. Collins, and B. Duncan. 2003. Metapopulation dynamics of the California Least Tern. *Journal of Wildlife Management* 67: 829-842.

Black Skimmer

Fecundity: 1.0 – 1.2 chicks fledged/pair (goal)

Juvenile survival: 0.5 (+/- 0.08)

Adult survival: 0.84 (+/- 0.1)

Age of first breeding: 2-4 years

Source:

Gochfeld, M. and J. Burger. 1994. Black Skimmer (*Rynchops niger*). in *The Birds of North America*, No. 108 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Note: No estimates found on black skimmer survival. Current values are placeholders based on similar species and will need to be updated when data become available.

Appendix D. Process used to estimate total potential acreage under management in Florida for beach-nesting birds:

1. Using only land-based FSD routes, randomly select 10% to sample. Use at least SIX routes within each of the FWC Regions: NW, SW, S, SE, NE.
2. Pick a point along route that is representative of shoreline width along that route; measure (using GIS) width of available beach habitat (from visible water line to the vegetation).
3. Average all width measurements within each Region to come up with a regional shoreline width. Remove all overlapping routes, multiply the length of the Region's routes (ft.) with the regional shoreline width (ft.); convert values into acres.
4. Add all Region acres together.